29th Indian Engineering Congress

December 18 - 21, 2014

Hyderabad

TECHNICAL VOLUME

सत्यमेव जयते

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Hosted by

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PBEL CITY
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29th Indian Engineering Congress

December 18 -21, 2014, Hyderabad

THEME

TECHNOLOGICAL INNOVATIONS AND ECONOMIC GROWTH - INDIA'S EMERGING ROLE

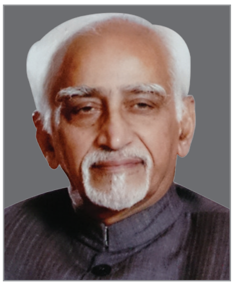
"TECHNICAL VOLUME"

Organised by

The Institution of Engineers (India)

Hosted by

Andhra Pradesh State Centre



M. Hamid Ansari
VICE PRESIDENT OF INDIA

JOINT SECRETARY &
OFFICER ON SPECIAL DUTY
TO THE VICE-PRESIDENT OF INDIA
TEL.:23016422/23016344 FAX:23012645

Date: September 10, 2014

MESSAGE

Hon'ble Vice President of India is happy to Know that the Institution of Engineers (India), is organizing the 29th Indian Engineering Congress on the theme 'Technological Innovations and Economic Growth – India's Emerging Role' in the month of December 2014 at Hyderabad.

The Vice President of India extends his greetings and good wishes to the organizers and the participants and wishes the event all success.

(Nagesh Singh)

Rosaiah
GOVERNOR OF TAMIL NADU

GOVERNOR'S SECRETARIAT
RAJ BHAVAN
CHENNAI-600 022
Phone: (044)22351700
Fax: (044)22350570
E-mail: govsec@tn.nic.in

Date: November 06, 2014

MESSAGE

His Excellency Dr.K.Rosaiah, Governor of Tamil Nadu is pleased to learn that The Institution of Engineers (India) is organizing 29th Indian Engineering Congress on "Technological Innovations and Economic Growth – India's Emerging Role" from 19 to 21 December 2014 at Chennai and is bringing out a Souvenir in commemoration.

His Excellency the Governor of Tamil Nadu conveys his warm felicitations to Dr.U.Chandrasekhar, Secretary & Director General, Office Bearers and Members of The Institution of Engineers (India) and to all the participating delegates and wishes the 29th Indian Engineering Congress all Success.

(Secretary to Governor)

Prof.Kaptan Singh Solanki
GOVERNOR OF HARYANA

HARYANA
RAJ BHAVAN
CHANDIGARH - 160019

Date: November 05, 2014

MESSAGE

It is a matter of immense pleasure to note that The Institute of Engineers (India) is holding he 29th Indian Engineering Congress on the theme "Technological Innovations and Economic Growth India's Emerging Role" on 19-21 December 2014 at Chennai. It is equally gratifying that a souvenir is also being brought out to mark the occasion.

The development of the country is on the fast track and it is much ahead of even developed nations. In this dynamic environment , the Indian Engineers are playing an important role. Modern Technology is the key driver for this accelerated economic growth. However,it needs continuous research and interaction of experience among technocrats. Such congress is the best platform for interaction.

I am confident that 29th Indian Engineering Congress will deliberate upon some of the emerging challenges of the profession and enlighten the technical fraternity about the developments in various fields of Engineering.

I convey my best Wishes for the success of the conference and publication of the souvenir.

(Prof.Kaptan Singh Solanki)

Vajubhai Vala

GOVERNOR OF KARNATAKA

Date: November 06, 2014

MESSAGE

I am happy to learn that the "INSTITUTION OF ENGINEERS (INDIA)" a largest multi-disciplinary professional body of engineers in the whole of Asia, has been representing India in multiple fora, with bilateral agreements with International Engineering Organisations, and is organizing Indian Engineering Congress every year to provide a forum for effective and purposeful interaction and diffusion of knowledge and share experience to infuse thinking. This year, 'ANDHRA PRADESH STATE CENTRE' of the 'Institute' is hosting "29TH INDIAN ENGINEERING CONGRESS" with a Seminar on the theme 'Technological Innovations and Economic Growth – India's Emerging Role' during December 2014 in Hyderabad. An exhibition is also being arranged to show case the products of various industries promoting technological innovations and A Technical Volume containing Visionary Addresses, Invited Talks and Technical Papers by subject experts is also being released for circulation among all the Centers of IE(I) & libraries of various engineering establishments.

I send my felicitations and best wishes to the Organisers, Scientists, Leading Industrialists & Enterpreneurs, Engineer Fraternity, Delegates, Editorial Team and all the Participants on this happy occasion and also for a grand success of the event.

(Vajubhai Vala)

Janaki Ballabh Patnaik
GOVERNOR OF ASSAM

RAJ BHAVAN
GUWAHATI

November 5, 2014

MESSAGE

I am happy to know that The Institution of Engineers(india). Kolkata, West Bengal is organising 29th Indian Engineering Congress on the theme "Technological Innovations and Economic Growth - India's Emerging Role from 19th to 21st December 2014 at Chennai and publishing a souvenir to commemorate the occasion.

I wish the occasion all success.

(Janaki Ballabh Patnaik)
GOVERNOR OF ASSAM

Najeeb Jung
LIEUTENANT GOVERNOR
DELHI

RAJ NIWAS
DELHI - 110054

Date: November 07, 2014

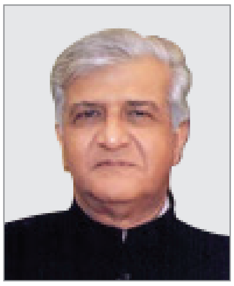
MESSAGE

I am happy to learn that the 'Institution of Engineers' is organizing the 29th Indian Engineering Congress on Technological Innovations and Economic Growth – India's Emerging Role' from 18-21 December 2014 in Hyderabad and a Technical Volume is being brought out on the occasion.

The Congress will no doubt provide an opportunity to the engineering fraternity to discuss and debate about the role of technological innovations in India's growth story .India's growth and development cannot but be inclusive and consequently I would urge the engineering fraternity to deliberate on bringing the benefits of technological innovations to all sections of society. I am sure with devolution Of technology and through concerted efforts India's economy will emerge ever stronger.

I wish the organizers and participants of the 29th Indian Engineering Congress my very best.

(Najeeb Jung)



Dr. K. K. Paul
GOVERNOR OF MEGHALAYA

MEGHALAYA

December 03, 2014

MESSAGE

I am happy to know that the institution of Enginerrs(India) is organizing the 29th Indian Engineering Congress on the theme "Technology Innovations and Economic Growth-India's Emerging Role" from 19th to 21st December,2014 at Chennai and a Sovenir is being brought out to mark the occasion.

The Institution of Engineers(India) plays an important role in promoting innovation and work ethics for our engineers across the country.It is institution of repute and professional integrity.I hope that the delegates and experts who are attending the Congress will have useful deliberations on current engineering and Technology issues and arrive at new strategies for the overall development of the country.

I wish Congress a grand success .

(Dr. K. K. Paul)

K.Chandrashekar Rao
CHIEF MINISTER
TELANGANA

HYDERABAD

October 21, 2014

MESSAGE

I am happy to note that the institute of Engineers (India) is Celebrating 29th Indian Engineering Congress.I am happy to know that a Seminar on the theme as "Technological Innovations and Economic Growth-India's Emerging Role" planned during the celebrations.

It is a platform for the fraternity of engineers within the country and abroad for effective and purposeful interaction and diffusion of knowledge ans share experiences to infuse thinking.

I wish the 29th Indian Engineering Congress all success.

(K.CHANDRASHEKAR RAO)

Dr. Kodela Siva Prasada Rao, M.S.
SPEAKER
ANDHRA PRADESH LEGISLATIVE ASSEMBLY

HYDERABAD

November 18, 2014

MESSAGE

I am happy to know that Andhra Pradesh Centre of Institute of Engineers (India) is hosting the 29th Indian Engineering Congress on the theme "Technological Innovations and Economic Growth - India's Emerging Role".

Innovation and technology transfers are key drivers of economic growth in today's world economy and India has to develop ways and means to translate its immense innovation potential into high value commercial products and services.

I hope the 29th Indian Engineering Congress will bring experience and expertise for accelerating economic growth of the nation.

I convey my greetings and good wishes to the Institution of Engineers (India) in all their endeavors and all the success for organizing Indian Engineering Congress.

(Dr. KODELA SIVAPRASADA RAO)
SPEAKER
ANDHRA PRADESH LEGISLATIVE ASSEMBLY

Jogu Ramanna
MINISTER FOR FORESTS
AND ENVIRONMENT

HYDERABAD

MESSAGE

It is heartening to learn that the Institute of Engineers (India)is conducting 29th Indian Engineering Congress with a seminar on the theme as "Technological Innovations and Economic Growth-India's Emerging Role".

I am confident that the Seminar would crete an atmosphere to impart a distance and diffusion of knowledge and share experience to infuse thinking.

I wish the Seminar a grand success and God-Speed.

(JOGU RAMANNA)

Rajiv Sharma
CHIEF SECRETARY
GOVERNMENT OF TELANGANA

MESSAGE

Engineering and technology have always been key factors in the development of the society for centuries. It is the fruits of all the endeavors of engineering, that we are enjoying today. Only through the innovations in engineering, we could able to improve economy, create innumerable employment opportunities, and to achieve the break even in lives of the poor and downtrodden sections of the society.

The objective of conduct of Indian Engineering Congress for effective and purposeful interaction and diffusion of knowledge and share experience to infuse thinking is indeed quite laudable. The new born Telangana state is in fact eagerly looking forward to utilize all technological innovations in its endeavor to become "Golden Telangana".

It gives me immense pleasure to know about the grand occasion of the 29th Indian Engineering Congress with a seminar on the theme "Technological Innovation and Economic Growth – Indian Engineering Role". It is my sincere hope that this seminar will provide one of the finest opportunities for all engineers, technocrats, academia, scientists, professionals and students etc from all over India to showcase their innovations and to share ideas for further improvisations.

On behalf of the Government of Telangana and on my personal behalf, I extend my best wishes to all the participants and organizers and wish the congress a great success.

(Rajiv Sharma)

Ashok Kumar Basa, FIE
PRESIDENT

KOLKATA

MESSAGE

It gives me immense pleasure to note that our Andhra Pradesh State Centre of The Institution of Engineers (India) is organising the 29th Indian Engineering Congress during 19-21 December 2014 at Hyderabad.

I am confident that the deliberations on the topic "Technological Innovations and Economic Growth – India's Emerging Role" in form of Key Note Addresses, Memorial Lectures and various other technical events would cover all aspects of engineering innovations and economic growth of the country. It is a matter of pride that our Institution has been playing a very pivotal role in dissemination of information on engineering and technology amongst the engineering fraternity through its 95 years of relentless journey and I am confident that Andhra Pradesh State Centre of the Institution will offer a unique platform for the visionaries and doyens in the field of engineering to address various issues on engineering innovations and enlighten various ways of making robust economic growth of the nation.

I am certain that the deliberations at the Congress will have very fruitful outcome and the recommendations so arrived at will benefit the policy makers, implementing agencies and all concerned stake-holders.

I convey my hearty greetings to all and wish the Congress a great success.

(Ashok Kumar Basa)

Dr U Chandrasekhar, FIE

SECRETARY & DIRECTOR GENERAL

KOLKATA

MESSAGE

I am extremely happy that Andhra Pradesh State Centre of The Institution of Engineers (India) is hosting the 29th Indian Engineering Congress during 18-21 December, 2014 at Hyderabad.

The theme "Technological Innovations and Economic Growth – India's Emerging Role" identified by the council of The Institution of Engineers (India) is very apt in the present day scenario and I am sure, with the active participation of eminent engineers, scientists, researchers from the country and abroad, the 29th Indian Engineering Congress will provide a unique platform to the participants to cross-fertilise their views on generating awareness about the responsibility of the engineers in promoting innovations and economic growth of the country. I am sure, the recommendations that will come out of the deliberations, would be learning points to the participants.

I wish the Congress a grand success.

(Dr U Chandrasekhar)

The Institution of Engineers (India)

Andhra Pradesh State Centre

G.Sudhakar
Chairman, Organising Committee
29th Indian Engineering Congress

FOREWORD

"With members drawn from every branch of engineering profession would have unique opportunity of detecting profession early the technical needs of each developing society and advising the Government to consider and where it lies within its power to open the way to whatever the innovation the situations called for", the main objective on which the Institution of Engineers (India) was established in 1920. In order to quench the thirst of knowing 95 years of eventful thrilling past one needs getting into Time Machine to view fascinating and rewarding past. Many a great visionary engineers, relentlessly toiled to put in finest motivation and sustained efforts for the growth of the institution over the decades to accomplish the objective.

It is customary that every Institution / Organization / Society will have to introspect its annual activities and achievements at the end of a year. So is the case with the institution of Engineers (India), the Annual convention used to be held till 1986 and later the event was named as Indian Engineering Congress (IEC) since 1987.

The AP State centre had the privilege of hosting the Indian Engineering Congress twice in the past, and this year also it is bestowed by the President and National Council with the onus of hosting the 29th IEC at Hyderabad. This mega event studded with the novel programmes like Visionary Addresses, Colloquium, Alumni Meet and Woman Engineers' Meet besides the conventional events such as Inaugural Function. Seminar containing technical sessions, Memorial Lecturers, Glimpees of Engineering Personalities etc.

I am deeply beholden to the State Centre Committee and its all members for having extended their individual and collectives co-operation to make this event to happen. I gratefully acknowledge the services rendered by the past and present council Members too for their undaunted support in various facets of the Congress.

I also express my thanks to all those who contributed papers, the abstracts of which are incorporated in the Technical Volume.

(G.Sudhakar)
Chairman, IE(I), APSC

The Institution of Engineers (India)

Andhra Pradesh State Centre

Dr. S. Nagabhushana Rao
Chairman,
Technical Events Committee

PREFACE

The annual event of Indian Engineering Congress organized by the Institution of Engineers (India) is being organized in Hyderabad this year. This is the 29th Congress in the series, commenced from 1986. The A.P. State Centre is bestowed with the honour of hosting this prestigious event, during 18-21 December 2014. A plethora of technical events makes the Congress colourful and a feast to the intellectuals who participate in the event.

Apart from other important events, a technical seminar with a theme of "Technological Innovations and Economic Growth – India's emerging Role" is being conducted in Six Technical sessions wth the sub themes on 1. Infrastructure; 2. Environment and Ecology; 3. Engineering Education, R & D and Skill Development; 4. Technology Management and economic growth; 5. Manufacturing and 6. Poverty alleviation and Health Care.

A number of papers are contributed by many reputed authors for the Technical Seminar. On a peer review, a total of 39 papers are included apart from 10 invited talks. Visionary addresses will be delivered by eminent professionals during the congress. This Technical Volume contains the full text of visionary addresses, abstracts of invited talks and the papers recommended by peer review committee. The Technical Volume will be released during inaugural session. In addition to this, full text of the invited talks and papers will be released in a CD form at the time of the Inaugural function. The congress provides a platform for all engineering professionals to interact on the contemporary subjects of technological importance. The activities will be of grat importance to Engineering professionals, entrepreneurs and environment and development activists. The organizers will see that the activities are organized, in a pleasant and memorable mode. We look forward to meeting all the dignitaries and participants in the technical seminar and the congress.

Dr. S. Nagabhushana Rao
Chairman, Technical Events Committee

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Andhra Pradesh State Centre

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CONTENTS

Initiate Innovative and Incredible India

Er A C Kamaraj[1]

Current Inter Linking of Rivers (some 30 links) studied by the Government with tax payer money for over 30 years is Politically Infeasible. No river basin has surplus all the time.

They will rather dam and use it during lean season, then diverting to another river basin. This is a win-lose situation, hence will lead to discord and skirmishes. Whereas the National Waterways Project of Shri A.C. Kamaraj of Madurai is a win-win solution that all states can agree to. It is a lengthy water bank. Excess flood water in any river is diverted into this storage canal like excess money in a bank. The amount of water diverted from river can be withdrawn by the river during deficit periods. This is a panacea for most of our nation's ills. This waterway will be a greater wonder than the Great Wall of China and forever a tribute to Modi sarkar.

From time immenorial Bharat Rishis have meditated with singular focus with an enquiring and contemplative mind for the purpose and betterment of existence. To them were revealed through inspiration the divine wisdom of the Vedas.

One such Rishi in the modern era was Swami Vivekananda, who meditated and contemplated from the Land's end of India on Bharat's golden past to the present slavish condition to the means to rejuvenate and regain once again the status of Jagad Guru. In this tradition, today a learned soul Prof. Er. A.C. Kamaraj has conceived Ganga Kumari National Waterways Project that will become a model for emulation by the rest of the world. He has for the past 15 years explained his concept and the benefits to engineers and political leaders of all hues.

It is said that a fool digs a well only after he becomes extremely thirsty. No fore thinking.

Those who fail to plan, plan to fail. How true of our present situation in darkness under severe power cut. It is darkest before dawn. Hopefully this project will see the light of dawn soon. Just as Cinema lets the poor vicariously enjoy foreign exquisite locales, let us go on an imaginary journey. Imagine a waterway 120 meters wide, 10 meters deep at a contour elevation of 250 meter above mean sea level. Imagine a 6 lane highway on the embank. It will be impossible to breach by any water surge. Imagine surface to air pinaka missible battery at regular intervals to foil any attack. Imagine inflatable pontoons to seal any breach. Now that safety is assured, let us enjoy the ride.Imagine the waterway as a serpentine dam storing excess flood water in a lengthy reservoir canal with the largest man-made storage capacity in the world. Imagine all rivers having a maximum and minimum height of water flow marked with sensors. Imagine remote operated automatic closing and opening of sluice gates o prevent flow above the maximum river level and

1. Expert Member, ILR, Govt of India.

perennially ensure minimum river flow. Imagine controlling the sluice gates and water flow via satellites.

God in his wisdom stored the life giving water underground in aquifers. Our sages told us stories that even a child can understand of a hen that laid golden egg, one per day for perpetuity. We in our greed kill the hen. Likewise we pump out and deplete the ground water. Let us harvest, store and distribute our white Gold wisely. Imagine with controlled water flow between the minimum and maximum level in the rivers soaking the earth and recharging the underground water table to just 10 meters below ground. Imagine what this would do to the green cover. All tribal's all over the world live in the forest sustained by the forest. They can live and be merry without cell phones, laptops and cars.

We cannot live without vegetation. Imagine a one kilometer width forest along the entire 15000 km length of the waterway. Imagine birds and animals of all kinds living in the forest. Instead of extinction of species, multiplication of life. Catalog and study all kinds of medicinal plants. Imagine theme water parks like Wonder La. Sea World where dolphins and whales put on a display. Ayurvedic health centers. Spiritual Ashrams. Fun resorts. Village cultural tourism. Imagine fisheries and fish factories. Imagine fruit trees, cold storage facilities and food processing factories. Imagine barges with containers transferring the containers on to trains and trucks. Imagine magically swinging railway tracks to allow tall ships. Imagine missile gun boats and troop movement vessels. Imagine standardized 50 Mega Watts hydro electric power plants along the waterway. 1200 such plants providing a total capacity of 60000 MW distributed power. Imagine 7 days 24 hours uninterrupted and non fluctuating non polluting clean power for industry, agriculture, commerce and house. Imagine turbines in the balancing storage canal and solar panels overhead. The canal space becomes an energy farm.

Imagine all involved in the construction of this monument, more grandeur than the Great Wall of China.

Imagine the people not working out of compulsion and competition but out of devotion and co-operation. The path breaking quantum leap of President Kennedy's putting a man on the moon and bringing him safely back to earth produced spin off technological and economical benefits to USA. Likewise this project will invigorate the entrepreneurial and innovative spirit of the youth of the nation bringing prosperity to India. This single project will be a Permanent Poverty Prevention Program in its planning, designing construction, operation and spin off economic activities. Imagine Swami Vivekananda's first priority of poverty eradication for India becoming a reality. Imagine Mahatma Gandhiji village republics with production by the masses becoming a reality. Imagine a farmer dressed in a clean Ramraj dhoti and shirt leaning on his TATA Indigo car in the driveway of his modern house, checking the market price of his produce in his. I-pad while his wife is speaking on her I-phone to her son in Agriculture College. Imagine new well planned futuristic towns with broad roads, battery,operated cars buses, autos. Renewable wind and solar power for all buildings - residential, commercial, offices, schools, shopping centers, hotels, hospitals, health wellness centers etc. No polluting industry or colleges in these towns. The State Capital can be in one such town decongesting Chennai. One new town can be world class Olympic facility for sports persons.

India always valued Abundance and Sharing. Indians have always looked upon an abundance of food as the primary condition of civilization and sharing of food was for us the primary discipline of civilized living. And it is this discipline of civilized living that we call Dharma. Our national culture is intertwined in agriculture.

Bhisma reminds Yudhisthira again and again the duty of the king to ensure that within his domain agriculture is well tended for and that the irrigation of the fields is not left merely upon the mercy of gods, so that there is always an abundance of food and nobody anywhere has to sleep on a hungry stomach. This is also the advice that Sri Rama offers Bharatha when the latter visits him at Citrakuta during the early phase of Sri Rama's long sojourn in the forests.

The second chapter of 10 couplets of Tirukkural deals with Rain. Failure to harness and manage rain water will spell economic and moral destruction of the nation.

The patriotic poet Bharathi, proclaimed in one of his poem a visionary idea, "With surplus water flowing in Bengal, we will grow crops in the middle of the country".

Some race conquered all lands enslaving its people and exploiting the land of its riches. Yesterday it was cotton. Today it is oil. Tomorrow it will be water. Chinese word symbol for water means "Control" USA has set up a military base in Paraguay along Paraguay - Brazil border in the largest Guarani water aquifer in the world. Jenna Bush daughter of former President George Bush, went to Paraguay to buy 100000 acres of land rich in water. Senior George Bush already owns 176000 acres of water land in paraguay. World largest Itapua dam near that area. This region is the Saudi Arabia of water. Bush oil tycoon family moving into water. When they cannot take by convincing, they use political force to dominate water resources like oil. Public municipal water supply is being privatized. Water is made a commodity for sale. Today our oil import bill is over seven lakh crores per year. Wait till you get your water supply bill from the multinational companies. Monsanto's genetically modified seeds to control the food security will be repeated in water. Next can be clean air. Hail to blindly following western capitalism.

Bharat's spirituality is to see the ONE in all its different manifestation. For us Mountains are Gods. Rivers are Goddesses. From the so called progress and advancement that enslave people and exploit the environment to this Ganga Kumari Waterways that will enable the people and enrich the environment.

The project is not just for India. It will be studied and replicated elsewhere in the world with our consultation. Like TCS this will become India's expertise and earnings. This will be a model to heal the planet back to health and enrich mankind both materially and spiritually.

If at all there is any conversion it should be:

1. From Misery to Happiness to Purity
2. From Defilement to Purity

3. From Bondage to Liberation
4. From Ignorance to Enlightenment

In the entire known universe, God has blessed Bharat punniya bhoomi. This land not only produces vegetation, animals and minerals but also in abundance Avatars, Rishis, Mahaans, and Mahatma. Our DNA is that of these noble souls. We are their descendants. With pride know and follow our Dharma.

Swami Vivekananda was a revolutionary in a sanyasin clothes. Netaji Subash Chandra Bose was a sanyasin in a military uniform. Bharat conquered the world only with spirituality.

Let our collective imagination be a prayer of positive thought for the welfare of all through this Ganga Kumari Nation Waterways Project. Bharat Mata needs you. The planet needs you. Selfish Asuras are on a destructive path. Devas unite to save the world and show the constructive path.

Having done our duty let us now take a leisurely cruise in our beautiful waterway. An educational tour to know the people and culture of the land. Sightseeing - Incredible India. Also a holy yatra to pay homage to Bharat Mata, like mother's milk, She has provided us with this life giving holy theerthams. Hoardings of freedom fighters who sacrificed for the nation. Rishis and their sayings, Satsungs in the boat, value education movies. An educational tour should kindle nationalistic pride, and imbibe Bharat's spiritual wisdom. Some of the hoardings:

1. Eight years before Wright brother's aerial show - in India, in the year 1895 at Chowpathy beach in Bombay, an aircraft flew in the skies unto 1500 feet. The inventor of that aircraft was Siva Kumar Bapuji Talap ade.Vasco da Gama came to India on largest ship built in Europe, hugging the coast of Africa. He was afraid to cross the Arabian Sea. Three ships 10 times larger belonging to a Gujarathi trader escorted

2. Vasco da Gama to Goa. The Wall Street journal dated 28.05.2003 had published a news item regarding America's war on Iraq. It says "A ship built based on the technology mentioned in old Indian literature proved extremely successful in the war. It transported more number of tanks than other ships and used to cover 2500 km in 48 hours". Indian ships had greater capacity, speed and twice the life. British government in the year 1814 banned the entry of Indian made ships into European ports. By 1863 Indian ship building artisans were jobless. With the law in force, British queen had eliminated the Indian naval queen.

3. Rocketry was first introduced by Tippu Sultan, and defeated the British forces.

4. India is the only nation to have succeeded in sending a satellite to circle the moon in its very first attempt.

5. India's Mars Mission is the least cost trip to Mars.

6. Nuclear weapons were used in ancient India.

This is not merely a project to benefit a few but a whole new way of thinking - It is God's way of thinking - of ennobling the soul to God consciousness and earth to produce an abundance of healthy life. This is a vision, a movement, a mission, a salvation for the planet. This is a monument, a living monument, a life giving monument, a monument for the life sustaining symbol

referred to as Lord Dhanvantri.
Enru thaniyam indha suthanthira thaagam? - Freedom from thirst, freedom from hunger. Freedom from poverty, freedom from poverty of patriotism, freedom from poverty of sanatan Dharma. Water of this Bharat Waterways is the elixir of life for body, mind and soul!
Sufi Saint Amir Kushiro said India is our beloved Motherland - A Paradise on Earth - Intelligence is the natural gift of its people - There can be no better guide to life - than the Wisdom of India. Muslim poet sang with pride. Sarae jehan ke accha Hindustan Hamara.
Swami Vivekananda said Bharat has to be the Jagad Guru - show the world the way. Wakeup Bharat! Enlighten the World!!

Towards Sat Chit Ananda,
Asokananda.

This article is dedicated to Swami Vivekananda's 150 Jayanthi.

Technology Enhanced Learning-A new Paradigm in Higher Education

R.K. Shevgaonkar[1]

The higher education system is undergoing a transformation worldwide due to emergence of digital technology. Before the digital era, the teaching-learning process practically remained confined to face-to-face teaching in a classroom. However with invent of internet the whole teaching-learning paradigm is undergoing a change. In the pre-internet era (and even in present prevalent system) the main purpose of the classroom teaching was to disseminate information. The whole process was more teaching-centric. The teacher who had knowledge of a particular subject transferred it to the students through written and oral communication. Generally it is believed that the classroom mode of imparting knowledge is the best mode of teaching. Indeed the face-to-face teaching has certain advantages but it has some limitations too. For example a teacher conducts his/her lectures at a pace which is suited for an average level student in a class. Since in a typical class, every student is not at the same intelligence level, a bright student finds the pace too slow, and at the same time a weak student finds the pace too fast. Consequently a large number of students in a class remain unsatisfied. The other limitation of the conventional teaching is non-availability of good, qualified teachers. Teaching is not merely a reproduction of the subject matter in front of the students. A teacher must inspire students and excite their curiosity in the subject. When a subject is taught by a good teacher, not only it becomes enjoyable but the depth of understanding also is enhanced. It is however very difficult to get top rated teachers in every subject and in every college in the country. For a moment even if we assume that we find these teachers, the repetitive teaching of the same subject material may create fatigue in teachers. It is therefore apparent that the conventional paradigm of teaching-learning though very prevalent, is not perfect. There are other issues related to the conventional mode of teaching. For transfer of knowledge a teacher and a student must be present at same location at same time. That is, the knowledge transfer process has to be synchronous in space and time. It may be possible that a teacher and a student may not be at the best of their respective performance at a common location and time. The same thing may happen for an examination, i.e., a student, even if has a good knowledge of a subject, may not perform well in the given examination time slot due to various reasons, like ill health, mental condition etc. Also it is not clear whether a student learned a subject even though the teacher taught it! The examination system also mostly tests how faithfully a student can reproduce the content taught in the class rather than testing knowledge in the subject.

1. Director, IIT Delhi

The conventional way of imparting knowledge therefore needs a fresh look. It is time to ask, whether there is a need to make a radical change in the education system? It is clear that if we have to create a learned society, the education system has to become learning-centric. The teaching-learning process needs to become asynchronous in space and time. A teacher should be able to deliver the subject knowledge at a location and time where and when his/her teaching ability is at the best. Similarly, a student should be able to learn the material when and where he/she is at the best of his/her performance. A student can go through the material at his/her own comfort till he/she learns the material properly. In twentieth century this paradigm of teaching and learning was unthinkable. However, in the twenty first century, with invent of new technology, the new approach seems very much within the reach. In last two decades, with the help of technology, the education system has moved towards asynchronous transfer of knowledge. In early experiments of country-wide classroom through the television channel, a class was expanded beyond the physical boundaries. In these experiments the teaching became asynchronous in space but it was still synchronous in time. A live teaching session could be received by students in every corner of the country but all students had to be sitting in front of their TVs at the same time. With advancement in multimedia and video technology, the teaching-learning process is made asynchronous in time as well. The classroom material can be captured in digital media which can then be accessed by anyone, anywhere at any time.

The digital technology is an extremely powerful technology which is capable of transforming the education system fundamentally. Besides making the teaching-learning process asynchronous, it can facilitate more effective learning even in the conventional class rooms. For example, the digital technology can help in visualizing things which is not possible with a simple blackboard. The digital media can also be used to capture and display real life phenomena to which otherwise students do not have access. Many hazardous and unsafe experiments can be demonstrated with the help of sophisticated modeling and simulations using digital media. A classroom teaching may therefore include blackboards, real life films, dynamic simulations, etc. to create a blended learning environment. Further, with the help of internet, the digital content can be accessed from any part of the world. Digital media can help in delivering content as per individual needs. A well designed web based course can be used for online training of students of varying capabilities. In short, the digital media can enrich the learning experience and can make the knowledge available to one and all irrespective of their geographical location, language or economic status.

The natural question then is, "how the education system will be impacted by the digital revolution?" It is clear that when the information on every subject is available from a variety of sources, the learner has a choice to learn from a source which suits him/her most.

A student therefore need not have to come to a class just for getting information on a subject. The class room teaching has to do more than mere dissemination of subject content. The role of a teacher will have to get re-defined. A teacher's role will have to become that of a mentor or a guide who guides students in accessing right material available in the digital media, and helps them in solving their difficulties. A teacher's focus will have to shift from routine class room lectures to creation of more innovative content. The education system will have to become learning-centric empowering students. The students will then have full flexibility in defining their course content including its source, and duration of the studies. A student will be able to learn a subject from the best expert in that subject and that too with his/her own pace (a dream come true situation). However, such student-centric system will put more responsibility on students. The students will have to be more self motivated.

In higher education therefore we are likely to see more novel concepts like virtual universities, meta-universities, etc. in the next few decades. From Indian perspective, this new paradigm of education is attractive as it is going to take quality education to large masses beyond cities and metros

Developing Technological Universities to "World Class Universities"

Dr. Kuncheria P. Isaac[1]

Introduction

The term "World Class Universities" is widely used mainly to signify the university as "world's best" or highly ranked institution. The world class universities have three major roles (i) Excellence in education of their students, (ii) research and innovation (iii) contributing to the cultural, scientific and civic life of the society. The universities are classified as "world class" or the best by the stake holders based on (i) ranking (ii) outcome of the teaching – learning process reflected by the accreditation status (iii) research and innovations. They are ranked by various agencies and the three rankings universally accepted are (i) Academic Ranking of World Universities (ARWU) commonly known as the Shanghai rankings. (ii) Times Higher Education (THE) and (iii) Quacquarelli – Symonds (Q S). The accreditation is done by various accreditation agencies who are signatories in the Washington Accord and accepted internationally. There are about 700 universities in India, out of which about one hundred are technical universities. This paper discusses the criteria, issues and roadmap for achieving the world class status to our Technical Universities and Institutions.

Characteristics of World Class Universities

Dr. Rajiv V. Dharaskar in his book "113 Difficulties in Developing World Class Universities" has given several characteristics of World class Universities. The characteristics include international reputation in research, presence of international faculty and students, groundbreaking research output recognised by peers and prizes (eg. Nobel prize), large endowment capital and income from public and private, graduates end up in positions of influence and/or power, continually benchmark with top universities and departments worldwide.

The Indian Universities and institutions do not have an international reputation. Moreover the research is absent in most of them which is reflected in the rankings.

Rankings:

The ranking of universities are done by several agencies and the three prominent ones among them are ARWU, THE and QS. The criteria employed by these agencies are as given Table 1, 2 and 3.

1. Vice Chancellor
Kerala Technological University
Trivandrum, Kerala, India

Table 1. Criteria by Academic Ranking of World Universities (ARWU)

Sl No.	Criteria	Indicator	Weight
1	Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
2	Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	20%
3	Highly cited researchers		20%
4	Research Output	Papers published in Nature and Science	20%
5	Papers indexed in Science Citation Index-expanded and Social Science Citation Index		20%
6	Per Capita Performance	Per capita academic performance of an institution	10%
	Total		**100%**

Table 2. Criteria by Times Higher Education (THE)

Sl No.	Criteria	Weightage
1	Teaching – the learning environment	30%
2	Research – volume, income and reputation	30%
3	Citations – research influence	32.5 %
4	Industry income – innovation	2.5 %
5	International mix – staff and students	5 %

Table 3. Criteria by QS WORLD RANKINGS

Sl No.	Criteria	Weightage
1	Academic Reputation (Index)	40%
2	Employer Reputation (Index)	10%
3	Student Faculty Ratio	20%
4	Citation per Faculty	20%
5	International Faculty (Index)	5 %
6	International Students (Index)	5 %

Table 4. Current Global standing of Indian Universities 2014-15

Sl No.	University / Institutes	ARWU	THE	QS
1	Indian Institute of Science	301-400	276-300	
2	Punjab University		276-300	
3	Indian Institute of Technology, Bombay (IITB)		351-400	222
4	Indian Institute of Technology, Roorkee (IITR)		351-400	461-470
5	Indian Institute of Technology, Delhi (IITD)			235
6	Indian Institute of Technology, Kanpur (IITK)			300
7	Indian Institute of Technology, Madras (IITM)			322
8	Indian Institute of Technology, Kharagpur (IITKGP)			324
9	University of Delhi			421-430
10	Indian Institute of Technology, Guwahati (IITG)			551-600
11	University of Mumbai			551-600
12	University of Calcutta			601-650
13	Banaras Hindu University			701+
14	University of Pune			701+

Several agencies have carried out such surveys in India, but this has not been carried out by any accepted agencies. There is a proposal in India to develop a national ranking system for its universities in the light of the observation that none of the Indian institutions are there in first 300. Philip G Altbach in an article opined that the challenge of actually creating rankings that will be based on real and relevant data is immense.

The experience of many other countries is not favourable. A few years ago, the Russians, stung by the poor showing of their universities in international ranking system created an international ranking system of their own. Unsurprisingly, Russian universities did quite well. However, no one, even in Russia, believed the results of this ranking and the project consequently disappeared. The Bertelsmann Foundation in Germany has been working for almost a decade on a non-ranking compilation of German institutions and the same has been widely praised even though it was a time consuming process. Even the influential U.N. News and World Report ranking in the U.S., now in its 30th year, is regularly criticised for methodological and other failings.

Altbach further discussed in the article regarding the problems of non availability of data, measurement of teaching quality, quality research and cautioned Indian administrators before taking up such a task. Internationalisation is one of the key parameters for obtaining a good ranking in the University World Rankings and unfortunately is absent in Indian universities.

There could be several pessimistic views against a ranking exercise in India; it may be prudent to encourage our best institutions to take part in the global rankings and even to initiate a process of ranking our 700 odd universities and 35000 colleges.

Accreditation

In 1996, the ABET (Accreditation Board for Engineering and Technology) Board of Directors adopted the new set of standards, called Engineering Change: A Study of the Criteria 2000 (EC 2000). EC 2000 shifted the basis for accreditation from inputs, such as what is taught, to outputs such as what is learned. The new criteria specify 11 learning outcomes and necessitate the programmes to assess and demonstrate the students' achievement in each of those areas. EC 2000 retains earlier accreditation standards' emphasis on the development of students' mathematical, scientific, and technical knowledge, as well as standards of programme faculty and facilities. It also gives emphasis on developing other professional skills, such as solving unstructured problems, effective communication, and team spirit. In addition, EC 2000 stresses on creating awareness of ethical and contextual considerations in engineering education.

Engineering programmes must demonstrate that their graduates should have:

(a) an ability to apply knowledge of mathematics, science, and engineering to real time problems

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global and social context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Teaching Learning Process

Technical education needs to change significantly in order to prepare our graduates for a world of rapidly accelerating changes. National Academy of Engineering in 2011 identified 14 Grand Engineering Challenges. They are:

- Make solar energy affordable
- Provide energy from fusion
- Manage the nitrogen cycle
- Provide access to clean water
- Restore and improve urban infrastructure
- Advance health informatics
- Engineer better medicines
- Reserve-engineer the brain
- Develop carbon sequestration methods
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools for scientific discovery

These challenges will have to be solved by the engineers and scientists with the active participation of community. While the universities have to continue with the pace of the depth of knowledge and skills by revamping the curriculum, they also have to make use of the Information Communication Technologies (ICT).

It has been reported in a study of the impact of introduction of outcome based learning in engineering curriculum done by ABET (Accreditation Board for Engineering and Technology) reports that there is some significant changes in the teaching methods as can be seen in the table 5.

Table 4. Current Global standing of Indian Universities 2014-15

Parameters	Some to significant Decrease	No change	Some to significant Increase
Computer Simulations	2	31%	67%
Application Exercises	2	33%	65%
Case Studies	2	38%	60%
Open-Ended Problems	4	42%	54%
Design Project	6%	40%	54%
Use of Groups in Class	5%	43%	52%
Lectures	20%	60%	20%
Textbook Problems	22%	61%	17%
	60 40 20 0		0 20 40 60

5-point scale, where 1 = Significant Decrease and 5 = Significant Increase

The study also has reported that there is significant increase in the achievements of the skills those are defined in the outcome based learning curriculum (2004 graduates) compared to the earlier one (1994 graduates). All differences when compared were satisfactorily significant.

Research and Innovation

In the book titled "Creating a Learning Society "by Joseph E. Stiglitz and Bruce C. Greenwald, emphasize the need for creating a learning society for economic development of a country. In developing countries, skills that are of special relevance but particularly scarce, are those associated with entrepreneurship. One of the attributes of entrepreneurship is the ability to learn and adapt. Moreover developing countries have to learn what products they are best capable of producing and are best suited to their conditions.

There are differences between innovation and inventions. The skills and personalities required to invent are markedly different from those required to innovate. Innovation means – 'to bring a new idea to market and market the products'. Innovators like Henry Ford, had to raise capital, organise production processes and to market products. It cannot be ascertained whether the idea is good or not until it is put to test. A major cost of innovation is the cost of finding a good innovator. The greater the number of innovators, the greater are the returns for being an innovator.

Fig. 1 illustrates the relationships between innovators and inventors and also the relationships with bureaucrats.

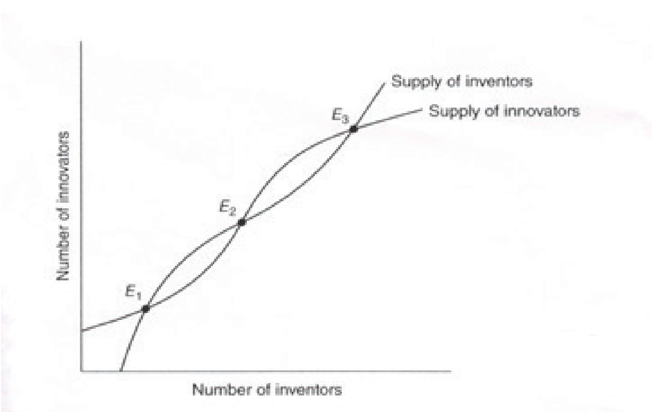

Fig. 1 Multiple equilibria

The number of innovators is an increasing function of the number of inventors, and the number of inventors is an increasing function of the number of innovators. There can be a stable equilibrium at E1 or E3.

World class universities are research intensive and all universities ranked high exhibit these characteristics. Except IITs and some non-universities like Tata Institute of Fundamental Research, AIIMS, no other Indian universities have any real research work carried out in their campuses. May be a few performers are there with a research mind works in few isolated departments of the universities.

To improve research capacity, which is already on an upward trajectory, it is necessary to increase overall research funding for the university system, enable hiring globally, expand doctoral education, and develop strong linkages with industry and government institutions – all within a framework which emphasizes competition and collaboration for excellence. The strategic initiatives include competitive funding, accessibility by both public and private institutions for a variety of research related programs, and global research centres and institutional collaborations. The Inter University Centres established for carrying out research is a right step to promote collaborative research. Evaluating the performance of the research-based Inter University Centres, their numbers and coverage would be enhanced.

Way Forward

(i) All national institutions and the top one hundred institutions should be encouraged to improve the requirements of international ranking agencies and to obtain ranking.

(ii) The All India Council for Technical Education has issued a regulation that accreditation is mandatory for all technical institutions. There are no punitive actions other than withholding grants which is very meagre and hence the real purpose is not served by the regulation. Hence if institutions do not comply with the regulation within a stipulated period they may be forced to close down.

(iii) Policies are to be formulated with adequate financial support to encourage research in all educational institutions, thereby the innovations will happen in India.

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Technical Session I

INFRASTRUCTURE - PRIME MOVER TO ECONOMIC DEVELOPMENT

The Institution of Engineers (India)
Andhra Pradesh State Centre

INVITED TALK

Innovative Approach for the Development of Rural Roads - A Case Study of PMGSY

B.P.Chandrasekhar[1]

ABSTRACT:

Rural connectivity is the key for the development of rural areas. Such connect will provide access to Socio-economic facilities, opening plenty of opportunities through both on-farm and off-farm employment. Rural connectivity is also recognised as a means to poverty alleviation, by bringing people above the poverty line.

Though the development and maintenance of rural roads is a States' subject, Government of India, launched Pradha Mantri Gram Sadak Yojana (PMGSY), as an intervention to develop rural areas through all weather connectivity to eligible habitations. It also provided up-gradation of select existing roads , though it is not centrality to program.

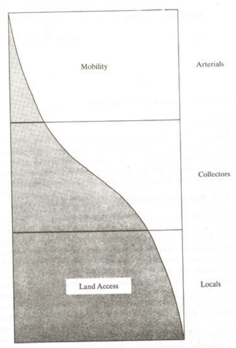
Systematic planning, scientific selection process with due prioritisation, exclusive design manuals and specifications, transparent procurement, uncompromised quality assurance, online management, monitoring and accounts system are the key features in the development of rural roads. Transparency and assured maintenance are the special ity of this program with full citizen interface about all aspects of the program.

In order to consolidate Rural Road Network, PMGSY II is taken up recently, with special focus on sustainable maintenance, Road Safety Audit and use of Innovative technologies

Classifications of Highways in India

Primary Roads
Expressways
National Highways (NH)
Secondary Roads
State Highways (SH)
Major District Roads (MDR)
Tertiary Roads
Other District Roads (ODR) Rural Roads
Village Roads (VR)

Functionalities of the Highway



Relationship of functionally classified highways to mobility and land access.

Rationale for Rural Connectivity Programmes

Investments in rural infrastructure are more effective than safety nets which reduce the vigour of rural poverty but may not remove it Rural infrastructure programmes have a lasting impact on rural development, creating both on-farm and off-farm employment.

Properly supplemented by policies enabling the rural poor to take advantage of new opportunities, investments in creation of rural infrastructure help in poverty alleviation..

1. Technical Advisor, Andhra Pradesh State Rural Roads Development Agency

Hence the Prime Minister's Rural Roads Programme - PMGSY.

Rural Connectivity Prime Minister Gram Sadak Yojana (PMGSY)

Provision of all-weather road connectivity to all the habitations with population of 500 or more

For Hill States, Tribal , Desert Areas and identified IAP districts, minimum population limit is 250 persons

Up gradation of existing Through Routes and MRLs

100% financing by Central Govt.

Maintenance by states

Dedicated implementing machinery at state and district level

Strong quality assurance mechanism

Online monitoring, management and accounting system (OMMAS)

Increased access to market, health and education Investment of One Million Rupees enables 165 poor people to move above poverty line.

Transforming Rural Lives

Source : IFPRI, Research Report 110, 1999

Funding

Budgetary Support from Government of India.

Fuel Cess .

Internal Borrowings.

Externally Aided Projects

Asian Development Bank

World Bank

Quality – The Basic Management Policy

Based on careful analysis of experience gathered in implementation of Rural Roads programmes in the past, programme management systems in PMGSY have been developed.

Management strategy, aimed at embedding quality awareness in all processes of implementation ,has been put in place.

Implementation process beginning from planning and up to maintenance management has been developed.

Special Features of PMGSY

Full farm to market connectivity

Full funding of construction cost by the Central Govt.

Maintenance funding by State Govt.

Implementation responsibility with the States.

National Rural Roads Development Agency (NRRDA) for Technical and Operational management support.

Dedicated implementing apparatus at State & district level.

Ensuring Quality Standards in construction

Five year defect liability

Key Terminology

Habitation

Connectivity

Cluster

DRRP

Core Network

Through Routes

Link Roads

Major Rural Links(MRL)

CNCPL

CUPL

Up-gradation

All Weather Road

Management Strategy

Management strategy aimed at embedding quality awareness in all processes of implementation put in place for PMGSY.

Appropriate Institutional Architecture

Systematic Network Planning

Structured Project Preparation and Selection Process

Setting Standards and Specifications

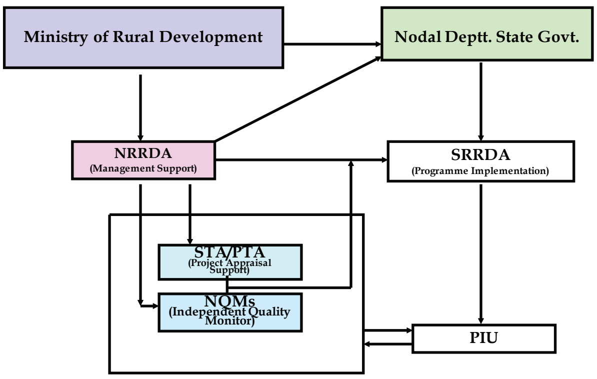
Standardization of Bidding Process

Rigorous Quality Monitoring

Need Based Training, R & D

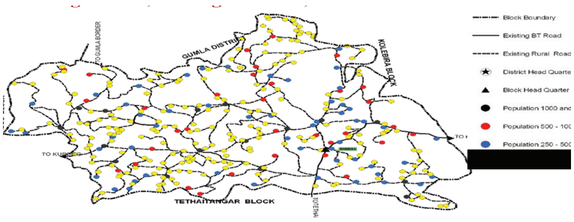
Web based Monitoring Mechanism.

Institutional Architecture



NRRDA: National Rural roads Development Agency,
SRRDA: State Rural Road Development Agency,

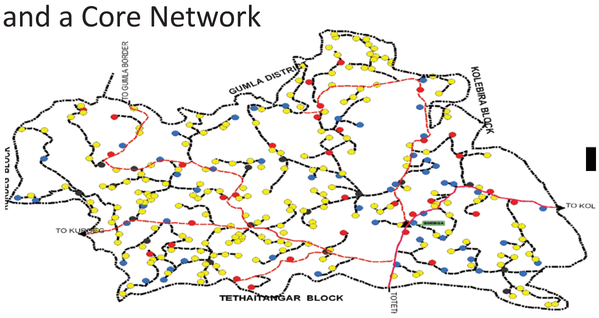
Systematic Network Planning



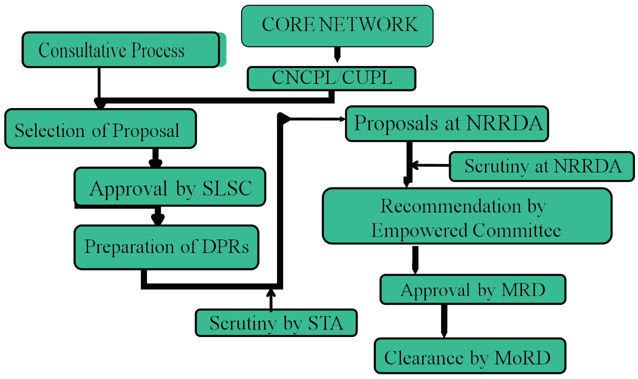
A District Rural Road Plan (DRRP) for every Block and District of India.

Systematic Network Planning

and a Core Network



Selection of Project Proposals and Clearance



Design and Estimates based on detailed field surveys and soil tests and independent scrutiny by the State Technical Agencies (IITs/ NITs etc).

Setting Technical Standards & Specifications for Rural Roads

Standard setting with the help of IRC:

- Rural Roads Manual prepared in 2002.
- Standard Data Book and Specifications for
- Rural Roads published in 2004.
- Operational Manual in 2005.
- Design of flexible and rigid pavements for low volume roads.
- Gravel Road Manual.
- Standards for Steel Bridges.
- Quality Assurance Handbooks.

Standard & Transparent Procurement

Transparent bidding through Standard Bidding Document developed for PMGSY.

E-Procurement of works already institutionalized

Quick Impact Assessment of E-Procurement has shown better participation of contractors leading to competitive prices –Savings.

A Symbol of Quality & Sustainability

Quality Assurance

A three tier quality management mechanism institutionalized under PMGSY.

First tier- Quality control at Programme Implementation Unit (PIU) level. Objective - process control through mandatory tests on material and workmanship at the field laboratory.

Second tier- Regular and structured independent quality monitoring at State level.

Third tier- Independent National Quality Monitors deployed for inspection at random. Objective-guidance and monitoring of quality by a senior independent professional.

For better results and sustainable quality, quality mechanism is continuously reviewed and refined.

Online Monitoring System

A Web-based online monitoring system.

Embedded Decision support systems.

Data Base in Citizen's domain

Transparency & Community Participation

Citizen Information Board in local language showing Quantity of material in each layer.

Provision for periodic joint inspection of field level officers and public representatives.

What Next !!!

PMGSY II

OBJECTIVE OF PMGSY II

Consolidation of Existing Rural Roads Network

Up-gradation of Select Through Routes providing access to Growth poles and Rural Hubs and other places of interest.

This is expected to serve rural population by providing access to Socio-economic facilities like Health, Education, Marketing, Places of tourist interest.

How it difers from PMGSY I

While PMGSY-I is 100% centrally funded, PMGSY II is on cost sharing basis between Centre and States/Uts.

Targets for up-gradation for each State /UT will be only 25% of the centrally funded target of PMGSY I

While in PMGSY-I the programme duration is around 6 Years (1 Year construction and 5 year post construction maintenance), for PMGSY II, it would be 12 years (6+1+5)

Special Focus

Road Safety features, including Road Safety Audit.

Compulsory use of proven/Innovative Technology for at least 15% of length of roads sanctioned

Zonal Maintenance Strategy for renewal and further 5 year maintenance

Innovative Technologies Propogated

- Use of Natural Geo-textiles like Jute and Coir
- Use of synthetic Geo-textiles.
- Soil Stabilizers like:
  - RBI 81
  - Terrazyme
  - Nano Technology-Zydex
- Cold Mix Technology

Increased Market Access for Farmers

Improved Transport Services

Improved Access to Schools

Creating Livelihoods

Roads Built in Forest Areas

INFRASTRUCTURE FOR DEVELOPMENT

C L N Sastry[1]

Abstract:

Infrastructure basically means the installations that form the basis for any operation or system. It is an important yardstick for judging the development of a country or region and is indeed a pre-requisite for development. Infrastructure can broadly take the forms like Hard and Soft Infrastructure, Critical Infrastructure, Urban Infrastructure, Green Infrastructure. The Hard Infrastructure consists of items relating to Transport, Energy, Water Management, Communications, Solid Waste Management, Earth Monitoring and Measurement Networks, while Soft Infrastructure consists of items pertaining to Governance; Economy; Society; Culture, Sports and Recreation. World Development Report 1994 of World Bank examined the link between Infrastructure and Development and explored ways in which developing countries could improve both the provision and quality of infrastructure services. Faster, Sustainable and more inclusive growth are the aspects that characterize the approach to the 12th Five Year Plan of India with a projected investment of around Rs. 65 lakh crores over the duration 2012-17.

KEY WORDS: Development, Infrastructure, Hard and Soft Infrastructure, Critical Infrastructure, Green Infrastructure.

1. DEVELOPMENT connotes Expansion, Progress, Improvement and Growth.

Development is a process of making changes to achieve economic, social or other benefits, particularly the reduction of poverty.

The process involves working cooperatively and respectfully with people and institutions, by focusing on meeting the priority needs identified and on activities that contribute to reduced poverty and/or increased self-reliance.

INFRASTRUCTURE literally means basic facilities, services and equipment needed for a country or organization to function properly. It refers to the basic physical and organizational structures needed for the operation of a society or enterprise , or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide a framework supporting an entire structure of development. It is an important yardstick for judging the development of a country or a region and it is a pre-requisite to Development.

Infrastructure typically refers to the technical structures that support a society, such as roads, bridges, water supply, sewers, electrical grids, telecommunications, irrigation works etc. It consists of the physical components of interrelated systems providing goods and services essential to enable, sustain, or enhance societal living conditions.

1. Former Engineer-in-Chief, Commissioner for Projects Formulation
& Ex-Officio Secretary –I&CAD Dept., Govt. of Andhra Pradesh
Former Adviser, WRD, EM & CTE Divisions, ESCI

Historically, the word infrastructure has been used in English since 1927, originally meaning "the installations that form the basis for any operation or system".

The word was imported from French where it means sub-grade, the native material underneath a constructed pavement or railway. The word is a combination of the Latin pre-fix infra, meaning below a structure.

2. HARD AND SOFT INFRASTRUCTURE

2.1 Hard infrastructure refers to the large physical networks necessary for the functioning of a modern industrial nation, whereas soft infrastructure refers to all the institutions required to maintain the economic, health, and cultural and social standards of a country, such as the financial system, the education system, the health care system, the government system and law enforcement, as well as emergency services.

The following list of hard infrastructure is limited to capital assets serving the function of conveyance of people, fluids, energy or information, which take the form of a network or a critical node used by vehicles, are used for the transmission of electromagnetic waves.

Infrastructure systems include both the fixed assets and the control systems, software required to operate, manage and monitor the systems, as well as any accessory buildings, plants, or vehicles which are an essential part of the system. They also include fleets of vehicles operating according to schedules, such as public transport buses and garbage collection trucks as well as basic energy or communication facilities which are not usually part of a physical network, such as oil refineries, radio and television broadcasting facilities.

2.1.1 Transport infrastructure

➢Road and Highway Networks, including cross drainage and cross masonry works such as bridges, tunnels, culverts, retaining walls, signage and markings, electrical systems (street lighting and traffic lights), edge treatments (curbs, side-walks, landscaping), and specialized facilities such as road maintenance depots and rest areas.

➢Mass Transit Systems, such as commuter rail systems, subways, tramways, trolleys, city bicycle sharing system, city car sharing system and bus transportation.

➢Railways, including structures, terminal facilities (railway stations, rail yards), level crossings, signaling and telecommunication system.

➢Canals and Navigable waterways, requiring continuous maintenance (dredging etc.)

➢Seaports and Lighthouses

➢Airports, including air navigational systems

➢Bicycle Paths and Pedestrian Walkways, including pedestrian bridges, under-passages and other specialized structures for cyclists and pedestrians.

➢Ferries

2.1.2 Energy Infrastructure

➢Electrical power network, including generation plants, electrical grid, substations and local distribution.

➢Natural gas pipelines, Storage and Distribution terminals (may include gas wells as well as the fleets of ships and trucks transporting liquefied gas).

➢Petroleum pipelines, including associated storage and distribution terminals (may include the oil wells, refineries as well as the fleets of tanker ships and trucks).

➢Specialized coal handling facilities for washing, storing and transporting coal (may include coal mines).

➢Steam or Hot water production and Distribution networks for district heating systems.

➢Electric vehicle networks for charging electric vehicles

However, coal mines, oil wells and natural gas wells may be classified as part of the mining and industrial sector of economy, not necessarily part of infrastructure.

2.1.3 Water Management Infrastructure

➢Drinking water supply, including the system of pipes, storage reservoirs, pumps, valves, filtration and treatment equipment and meters, including buildings and structures to house the equipment, used for the collection, treatment, and distribution of drinking water

➢Sewage collection, and disposal of waste water

➢Drainage systems (storm sewers, ditches, etc.)

➢Major irrigation systems (reservoirs, irrigation canals)

➢Major flood control systems (dikes, levees, major pumping stations and floodgates)

➢Large-scale snow removal, including fleets of salt spreaders, snow plows, snow blowers, dedicated dump trucks, sidewalk plows, the dispatching and routing systems for these fleets, as well as fixed assets such as snow dumps, snow chutes, snow melters.

➢Coastal management, including structures such as seawall, breakwaters, groynes, floodgates, as well as the use of soft engineering techniques such as beach nourishment, sand dune stabilization and the protection of mangrove forests and coastal wetlands.

2.1.4 Communications infrastructure

➢Postal service, including sorting facilities

➢Telephone networks (land lines) including telephone exchange systems

➢Mobile phone networks

➢Television and radio transmission stations, including the regulations and standards governing broadcasting

➢Cable television physical networks including receiving stations and cable distribution networks

➢The Internet, including the internet backbone, core routers and server farms, local internet service providers as well as the protocols and other basic software required for the system to function (does not include specific websites, although may include some widely used web-based services, such as social network services and web search engines)

➢Communications satellites

➢Undersea cables

➢Major private, government or dedicated telecommunications networks, such as those used for internal communication and monitoring by major infrastructure companies, by governments, by the military or by emergency services, as well as national research and education networks

➢Pneumatic tube mail distribution networks

2.1.5 Solid waste management

➢Municipal garbage and recyclables collection

➢Solid waste landfills

➢Solid waste incinerators and plasma gasification facilities

➢Materials recovery facilities

➢Hazardous waste disposal facilities

2.1.6 Earth monitoring and measurement networks

➢Meteorological monitoring networks

- ➢Tidal monitoring networks
- ➢Stream Gauge or fluviometric monitoring networks
- ➢Seismometer networks
- ➢Earth observation satellites
- ➢Geodetic benchmarks
- ➢Global Positioning System
- ➢Spatial Data Infrastructure

2.2 TYPES OF SOFT INFRASTRUCTURE

Soft infrastructure includes both physical assets such as highly specialized buildings and equipment, as well as non-physical assets such as the body of rules and regulations governing the various systems, the financing of these systems, as well as the systems and organizations by which highly skilled and specialized professionals are trained, advance in their careers by acquiring experience, and are disciplined if required by professional associations (professional training, accreditation and discipline).

Unlike hard infrastructure, the essence of soft infrastructure is the delivery of specialized services to people. Unlike much of the service sector of the economy, the delivery of those services depend on highly developed systems and large specialised facilities, fleets of specialised vehicles or institutions that share many of the characteristics of hard infrastructure.

2.2.1 Governance infrastructure

- ➢The system of government and law enforcement, including the political, legislative, law enforcement, justice and penal systems, as well as specialized facilities (government offices, courthouses, prisons, etc.), and specialized systems for collecting, storing and disseminating data, laws and regulation.
- ➢Emergency services, such as police, fire protection, and ambulances, including specialized vehicles, buildings, communications and dispatching systems.
- ➢Military infrastructure, including military bases, arms depots, training facilities, command centers, communication facilities, major weapons systems, fortifications, specialised arms manufacturing, strategic reserves.

2.2.2 Economic infrastructure

- ➢The financial system, including the banking system, financial institutions, the payment system, exchanges, the money supply, financial regulations, as well as accounting standards and regulations.
- ➢Major business logistics facilities and systems, including warehouses as well as warehousing and shipping management systems.
- ➢Manufacturing infrastructure, including industrial parks and special economic zones, mines and processing plants for basic materials used as inputs in industry, specialized energy, transportation and water infrastructure used by industry, plus the public safety, zoning and environmental laws and regulations that govern and limit industrial activity, and standards organizations.
- ➢Agricultural, forestry and fisheries infrastructure, including specialized food and livestock transportation and storage facilities, major feedlots, agricultural price support systems (including agricultural insurance), agricultural health standards, food inspection, experimental farms and agricultural research centers and schools, the system of licensing and quota management, enforcement

systems against poaching, forest wardens, and fire fighting.

2.2.3 Social infrastructure

➢The health care system, including hospitals, the financing of health care, including health insurance, the systems for regulation and testing of medications and medical procedures, the system for training, inspection and professional discipline of doctors and other medical professionals, public health monitoring and regulations, as well as coordination of measures taken during public health emergencies such as epidemics.

➢The educational and research system, including elementary and secondary schools, universities, specialised colleges, research institutions, the systems for financing and accrediting educational institutions.

➢Social welfare systems, including both government support and private charity for the poor, for people in distress or victims of abuse.

2.2.4 Cultural, sports and recreational infrastructure

➢Sports and recreational infrastructure, such as parks, sports facilities, the system of sports leagues and associations.

➢Cultural infrastructure, such as concert halls, museums, libraries, theatres, studios (film studios and recording studios), and specialized training facilities.

➢Business travel and tourism infrastructure, including both man-made and natural attractions, convention centers, hotels, restaurants, amusement parks, and other services that cater mainly to tourists and business travelers, as well as the systems for informing and attracting tourists, and travel insurance.

3. CRITICAL INFRASTRUCTURE

The term critical infrastructure has been widely adopted to distinguish those infrastructure elements that, if significantly damaged or destroyed, would cause serious disruption of the dependent system or organization. Storm, flood, or earthquake damage leading to loss of certain transportation routes in a city, for example bridges crossing a river, could make it impossible for people to evacuate, and for emergency services to operate; these routes would be deemed critical infrastructure. Similarly, an on-line booking system might be critical infrastructure for an airline.

4. URBAN INFRASTRUCTURE

Urban or municipal infrastructure refers to hard infrastructure systems generally owned and operated by municipalities, such as streets, water distribution, and sewers. It may also include some of the facilities associated with soft infrastructure, such as parks, public pools and libraries.

5. GREEN INFRASTRUCTURE

Green infrastructure is a concept that highlights the importance of the natural environment in decisions about land use planning. In particular, there is an emphasis on the life support functions provided by a network of natural ecosystems, with an emphasis on interconnectivity to support long-term sustainability. Examples include clean water and healthy soils, as well as the more anthropocentric functions such as recreation and providing shade and shelter in and around towns and cities. The concept can be extended to apply to the management of storm water runoff at the local level through the use

Iof natural systems, or engineered systems that mimic natural systems, to treat polluted runoff.

6. INFRASTRUCTURE ASSET MANAGEMENT

Infrastructure Asset Management (IAM) is the integrated, multidisciplinary set of strategies in sustaining public infrastructure assets such as water treatment facilities, sewer lines, roads, utility grids, bridges, and railways.

Generally, the process focuses on the later stages of a facility's life cycle specifically maintenance, rehabilitation, and replacement. Asset management specifically uses software tools to organize and implement these strategies with the fundamental goal to preserve and extend the service life of long-term infrastructure assets which are vital underlying components in maintaining the quality of life in society and efficiency in the economy.

The US based Institute of Infrastructure Asset Management (IIAM) approach to Infrastructure Asset Management is based upon the definition of a Standard of Service (SoS) that describes how an asset will perform in objective and measurable terms. The SoS includes the definition of a "minimum condition grade", which is established by considering the consequences of a failure of the infrastructure asset.

The 2009 Report Card produced by the American Society of Civil Engineers gave America's infrastructure a grade of D.

INFRASTRUCTURE IN THE DEVELOPING WORLD

According to the researchers at the Overseas Development Institute of UK, the lack of infrastructure in many developing countries represents one of the most significant limitations to economic growth and achievement of the Millennium Development Goals. Infrastructure investments and maintenance can be very expensive, especially in such areas as land-locked, rural and sparsely populated countries in Africa. It has been argued that infrastructure investments contributed to more than half of Africa's improved growth performance between 1990 and 2005, and increased investment is necessary to maintain growth and tackle poverty. The returns on investment in infrastructure are very significant, with on average 30-40% return for telecommunications (ICT) investment, over 40% for electricity generation, and 80% for roads.

8. REGIONAL DIFFERENCES

The demand for infrastructure, both by consumers and companies, is much higher than the amount invested. There are severe constraints on supply side of the provision of the infrastructure in Asia. The infrastructure financing gap between what is invested in Asia-Pacific (around US$ 48 billion) and what is needed (US$ 228 billion) is around US$ 180 billion every year. In Latin America, 3% of GDP (around US$ 71 billion) would need to be invested in infrastructure in order to satisfy demand; yet in 2005, for example only around 2% was invested, leaving a financing gap of approximately US$ 24 billion.

In Africa, in order to reach the 7% annual growth calculated to be required to reach MDGs by 2015, it would require infrastructure investments of about 15% of GDP, or around US$ 93 billion a year. In fragile States, over 37% of GDP required.

9. SOURCES OF FUNDING

Currently, the source of financing varies significantly among sectors. Some sectors are dominated by government pending, others by Overseas Development Aid (ODA) and yet others by private investors.

In sub-Saharan Africa, Government spends around US$ 9.4 billion out of a total of the US$ 24 billion.

In irrigation, governments represent almost all spending. In transport and energy, a majority of investment is government spending. In Information and Communication Technologies (ICT) and water supply and sanitation, the private sector represents the majority of capital expenditure. Overall, between them, aid, the private sector and non-OECD financiers exceed government's spending. The private sector spending alone equals state capital expenditure, though the majority is focused on ICT infrastructure investments.

10. INFRASTRUCTURE FOR DEVELOPMENT

World Development Report 1994 of the World Bank examined the link between infrastructure and development and explored ways in which developing countries could improve both the provision and the quality of infrastructure services. It further reported that, "in recent decades, developing countries have made substantial investments in infrastructure, achieving dramatic gains for households and producers by expanding their access to services such as safe water, sanitation, electric power, telecommunications, and transport. Even more infrastructure investment and expansion are needed in order to extend the reach of services - especially to people living in rural areas and to the poor. But as this report shows, the quantity of investment cannot be the exclusive focus of policy. Improving the quality of infrastructure service also is vital.

Both quantity and quality improvements are essential to modernize and diversify production, help countries compete internationally, and accommodate rapid urbanization. The report identifies the basic cause of poor past performance as inadequate institutional incentives for improving the provision of infrastructure. To promote more efficient and responsive service delivery, incentives need to be changed through commercial management, competition, and user involvement. Several trends are helping to improve the performance of infrastructure. First, innovation in technology and in the regulatory management of markets makes more diversity possible in the supply of services. Second, an evaluation of the role of government is leading to a shift from direct government provision of services to increasing private sector provision and recent experience in many countries with public-private partnerships is highlighting new ways to increase efficiency and expand services. Third, increased concern about social and environmental sustainability has heightened public interest in infrastructure design and performance".

11. INFRASTRUCTURE IN INDIAN ECONOMIC PLANNING SYSTEM

Infrastructure is the corner stone of development of any country.According to the 12th Five Year Plan, India requires an investment in infrastructure sector of around Rs.65 lakh crores over the duration 2012-2017.

A significant boost is required to the infrastructure sector in the country to help India achieve its target for the 12th Five Year Plan.

12. AN APPROACH TO THE 12TH FIVE YEAR PLAN (Planning Commission, October 2011)

The Indian economy on the eve of the Twelfth Plan was characterised by strong macro fundamentals and good performance over the Eleventh Plan period, though clouded by some slowdown in growth in the current year with continuing concern about inflation and a sudden increase in uncertainty about the global economy. The objective of the Eleventh Plan was faster and inclusive growth and the initiatives taken in the Eleventh Plan period have resulted in substantial progress towards both objectives.

Inadequate infrastructure was recognised in the Eleventh Plan as a major constraint on rapid growth. The Plan had, therefore, emphasized the need for massive expansion in investment in infrastructure based on a combination of public and private investment, the latter through various forms of public-private partnerships. Substantial progress has been made in this respect. The total investment in infrastructure which includes roads, railways, ports, airports, electricity, telecommunications, oil gas pipelines and irrigation is estimated to have increased from 5.7 per cent of GDP in the base year of the Eleventh Plan to around 8.0 per cent in the last year of the Plan. The pace of investment has been particularly buoyant in some sectors, notably telecommunications, oil and gas pipelines, while falling short of targets in electricity, railways, roads and ports. Efforts to attract private investment into infrastructure through the PPP route have met with considerable success, not only at the level of the Central Government, but also at the level of the individual States. A large number of PPP projects have taken off and many of them are currently operational in both the Centre and the States.The Twelfth Plan must continue the thrust on accelerating the pace of investment in infrastructure, as this is critical for sustaining and accelerating growth. Public investment in infrastructure will have to bear a large part of the infrastructure needs in backward and remote areas to improve connectivity and expand the much needed public services. Since resource constraints will continue to limit public investment in infrastructure in other areas, PPP-based development needs to be encouraged wherever feasible. It is necessary to review the factors which may be constraining private investment, and take steps to rectify them. PPP, with appropriate regulation and concern for equity, should also be encouraged in the social sectors, such as health and education. Several State Governments are already taking steps in this direction.

As per the prospects envisaged for the 12th Five Year Plan, economy has gained in strength in many dimensions and is therefore well placed to achieve faster, sustainable and more inclusive growth.

Having achieved 8.2 per cent growth during the Eleventh Plan, it is reasonable to aim at 9.0 per cent growth for the Twelfth Plan.Some difficulties suggest that a 9.0 per cent growth target for the next five years is ambitious.

But it is not impossible, if we have the political will to do what is necessary. Economic reforms over the last twenty years have resulted in the citizens of India having high expectations. The Twelfth Plan has to meet the aspirations of millions of young men and women. This cannot be done by following a business-as-usual approach. All sections of society – government, farmers, businesses, labour and concerned citizens– have to adopt newer, more effective ways of pursuing their activities, so that we can collectively achieve our lofty goals.

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DEVELOPMENTS IN POWER SECTOR- A BOON TO INDIA'S ECONOMIC GROWTH

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ABSTRACT:

Power is a critical element of infrastructure for economic development and for improving the quality of life. In India, where per capita power consumption is very low, the demand for power is always growing up whereas the generation levels are lagging behind. It is in this context that deriving better output from the present installation viz increasing the plant load factor of the existing power plants is one definite solution at sight to bridge the gap between demand and generation. Considering the limited options available to us, there is an urgent need to deploy new technologies to achieve higher efficiency. The aim of this paper is to provide an exhaustive picture of advancement in power generating field and its impact on our economic growth.

1.0 PRESENT POWER SCENARIO

Since independence, India's Generation Capacity has grown from 1712 MW in 1950 to over 250256.95MW as on July 2014. The electricity generation target for the year 2014-15 has been fixed at 1023(Billion Units) BU comprising of 858.603 BU thermal, 124.297 BU hydro, 35.300 nuclear. During 2012-13, energy requirement was 9, 98,114MU and energy availability was 9, 11,209Million units (MU) and 11,209MU with peak demand of 1, 35,453MU. Despite growth in installed capacity & generation, country is still facing the shortages. To achieve healthy economic growth rate, electricity generating capacity needs to be increased.

2.0 MEASURES TO BRIDGE THE GAP

Initiatives are being launched for 50,000MW Hydro Electric Generation &100,000MW Thermal generation. Apart from the above there is a need for improvement in the existing plants output / efficiency through.

1. Remnant Life Assessment (RLA) / Renovation&Modernisation of the old units.
2. New technology (Circulating fluidized bed circulation-CFBC,Super critical boilers, Renewable energy resources)
3. Practicing better Operation & Maintenance practices

3.0 REMNNANT LIFE ASSESSMENT (RLA) & LIFE EXTENSION PROGRAME (LEP)

RLA and LEP for thermal units have assumed great significance in today's context marked by financial crunch, slow pace of implementation of infrastructure projects. At the same time, the safety and reliability of the

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boilers is of utmost concern, and hence the RLA and LEP of boilers have to provide adequate confidence of reliability for the continued functioning of the equipment.

What is RLA?

RLA involves

1. Life Extension studies,
2. Performance evaluation
3. Thermal Design Check
4. Adequacy assessment studies of all equipment and associated systems.

4.0 REMNNANT LIFE ASSESSMENT – A NEW LEASE OF LIFE

Life evaluation is the first step in the decision making process to determine if further life extension is warranted. The Study is designed to:

1. Assess the present condition
2. Identify potential problem areas provide
3. Remaining life estimation

The Study includes basically five steps:

1. Review
2. Inspection
3. Non Destructive / Destructive Examination
4. Engineering
5. Analysis
6. Reporting

Life extension evaluates and recommends changes consistent with current and future operational requirements. The five phases of a typical RLA study is discussed below

4.1 Review Phase

This initial phase is comprehensive in nature and serves to provide current database, which helps determine specific areas to focus during inspection.

• Review of Operating History includes
• Unit's Performance
• Abnormal Events Failures
• Forced Outages
• Unit's Availability
• Original design specification
• Operating and Engineering procedures
• Stress and Performance analysis
• Temperature, pressure and flow rate histograms
• Support loads.
• Review of Boiler operation for assessing
• Abnormal events
• Rapid temperature and pressure excursions

4.2 Inspection Phase

This phase includes:

• Visual examination
• Measurements and photographs, if required
• Structural damage
• Interferences
• Malfunctions
• Misalignment
• Visible corrosion, erosion, pluggage, swelling, sagging, etc.

4.3 Analytical Phase

The aspects studied in this phase include

Wastage Study through:

• Ultrasonic thickness measurement correlated with physical measurement.
• Internal and external deposits

Current condition to estimate remaining service of boiler tubes.

Metallurgical Evaluation by

• Sample replica examination in the lab

4.4 Reporting Phase

The report provides with information on present condition of boiler. The principal goal in the Life Extension process is to defer capital expenditures for new capacity addition.

There are added benefits, which may be realized through implementation of Life Extension Programme

• Reporting of current physical condition of equipment.

• Feasibility, scheduling and cost to extend the Boilers operating life.

• Upgrading/Up-rating can be done

• Improvement in operating efficiency.

• Operational requirements in the extended life period

• Documentation of Units condition for insurance purposes.

The world at large has realized the potential of Remnant Life Assessment and has accepted the methodology in practice. It should be our endeavor to build up a database, carry out confidence building, planned RLA studies and to adopt state-of-the-art techniques, equipment and materials to enhance the safety and reliable operation of the boilers beyond the designated life.

4.5 Why RLA / R&M

• Extremely vital in the context of power development programme for India. With R&M, a new lease of life can be given to the existing plant with life extension of 20-25 years.

• With R&M, improvements can be made in unit output, efficiency, pollution, O&M costs, reliability, and life expectancy.

• To achieve economic, reliable, efficient, safe & environmentally acceptable operation of old power plants for extended periods.

5.0 NEW TECHNOLOGY FOR POWER SECTOR DEVELOPMENT

5.1 Bubbling Fluidized bed combustion technology (BFBC) and Circulating fluidized bed technology (CFBC)

FBC boilers with their in-situ SOx capturing capability makes utilization of these fuels techno economically very attractive while their utilization in Pulverized fuel boilers would require very expensive add-on flue gas conditioning systems.

Bubbling Fluidized Bed Combustion (BFBC) Boilers can effectively utilize a variety of fuels like coal, lignite, opportunity fuels from Iron and Steel Plants, Coal Washeries and petcoke from refineries.

5.1.1 BFBC

Bubbling fluidized bed belongs to a class of gas-solid contact systems, in which air or gas is passed through an inert bed of solid particles, such as sand or crushed refractory, supported on a grid. Fuel is injected into the bed. The gas will initially seek a path of least resistance and pass upward through the bed, leaving it undisturbed. However, when the gas flow is further increased, it starts bubbling through the bed and the particles attain a state of high turbulence. Under these

Conditions, the bed exhibits the properties associated with a fluid and is hence termed as a BUBBLING FLUIDISED BED. The name Bubbling is derived from the fact that a fluidized bed of this kind has rising gas bubbles. The gas escapes through the incipiently fluidized bed (called the emulsion phase), as bubbles. The bubbling action causes intense stirring of the bed particles, which causes good mixing of fuel and air and uniform temperature, thus creating an ideal environment for excellent combustion. If the bed material in the fluidized state is heated to the ignition temperature of the fuel and the fuel is injected continuously into the bed, the fuel will burn rapidly and the bed will attain a uniform temperature due to effective mixing. This, in short, is fluidized bed combustion.

5.1.2 Advantages of BFBC technology

The BFBC technology has many advantages. However, the principal among them include:

BFBC boilers have the ability to effectively burn a wide variety of fuels which include:

• All types of coal

• Lignite, Rice husk, straw; Saw dust, wood chips; Municipal refuse

• Natural gas and oil.

• BFBC boilers do not require oil for start-up or for load support

• Large amount of ignition energy in the bed, the uniform distribution of air, and the thorough mixing of the fuel and air, enables BFBC boilers to achieve high efficiency.

• Thermally homogenous combustion, hence lower potential for local hot or cold spots

• Lower NOx formation.

• By the addition of a small quantity of limestone along with fuels containing moderate to high sulphur, SO2 can be absorbed in-situ in the bed, eliminating expensive down-stream scrubbing equipment.

• The fluidized bed retains a lot of heat when shut, thus enabling easy restart even after a long stoppage.

• BFBC boilers require less maintenance as compared to conventional boilers due to the absence of pulverizes and moving grates in the hot furnace zone.

• As the combustible content of the material in the fluidized bed at any point of time is very small (< 1%), and the combustion is flameless, BFBC boilers do not require expensive burner management systems

5.2 Circulating Fluidized bed technology (CFBC)

The CFBC technology is best suited where stringent gaseous emission (SOx and NOx) standards are to be maintained.SOx emission in CFBC boilers is controlled by in-situ capture of the gas by adding limestone and NOx is controlled by the staged combustion of air.

5.3 Super critical technology

Conventional coal fired power plants in developing countries have efficiency of about 32%. Supercritical (SC) and ultra -supercritical (USC) power plants operate at temperatures and pressures above the critical point. This results in higher efficiencies – above 45%. Hence, there is gain in efficiency by 13 points (when compared to present older power plants efficiency of 32%).Supercritical (SC) and ultra -supercritical (USC) power plants operate at higher temperatures and greater steam pressures than conventional systems. They require less coal per megawatt-hour, leading to lower emissions per megawatt (including carbon dioxide and mercury), and lower fuel costs per megawatt, leading to higher efficiency and lower fuel

Advantages of Super critical technology

➢ Reduced fuel costs due to improved plant efficiency

➢ Significant reduction in CO2 emissions

➢ Excellent availability, comparable with that of an existing sub-critical plant

➢ Much reduced NOx, SOx and particulate emissions

➢ Can be fully integrated with appropriate CO2 capture technology

6.0 BETTER OPERATION&MAINTENACE PRACTICES

In fact, the market is increasingly shaped by deregulation, globalization, privatization, and availability of finance, environmental pressure, changing energy demands, and the drive for economic growth in developing countries. In the present circumstances, when the investment for new installation is highly encouraged, there are parallel attempts for quality operation & maintenance practices. A very well known fact is that if thermal power stations are properly maintained within their operating parameters they give optimum performance comparable to other new plants. The different factors, which has direct and indirect impact on O & M practices are,

1) Operating parameters and associated systems
2) Boiler components and damage mechanism
3) Breakdown tube repair
4) Plant availability

Efficiency of the cycle improves with higher feed water temperature, optimization of final feed water temperature is carried out for a given cycle to achieve optimum heat rate. Turbine and its auxiliary equipments are designed to operate at specific condition of steam at turbine stop valve. Quite often steam parameters are maintained at low pressure and temperature under the assumption that the boiler and turbine will have fewer problems. Unfortunately such mistaken assumptions have adverse effect on the machines causing loss in operating efficiency.

The effect of low steam parameters on turbine heat rate is as follows:

Parameters Deviation	-	Effect on heat rate
Main steam pressure	- 5kg/cm2	0.40%
Main steam temperature	- 10deg.C	0.30%

For best optimization proper automatic temperature control systems with accurate measurements are ensured. Auxiliary power consumption along with heat rate is the two technical parameters frequently used for measurement and comparison of performance and efficiency of generation of thermal power plants.

7.0 PLANT AVAILABILITY

Improvement in existing maintenance systems and practices would go a long way in reducing planned and forced outages and ensuring higher availability. Plant performance and availability are the key drivers for competitive plant operations. Both terms can be efficiently supported by well defined O & M practices which provide reliable information to prevent serious faults, but also for optimized maintenance planning. Vigilant operation and dedicated maintenance are very essential for excellent quality performance of thermal stations.

8.0 ROLE OF NLC IN POWER SECTOR IN INDIA

Neyveli Lignite Corporation (NLC) has in its fold 3 Power Stations of capacity TPS-I 600 MW, TPS-II -1470 MW, TPS-II (Expansion) 500 MW and TPS-I (Expansion)-420MW. With the years of experience in using lignite as the primary fuel, NLC introduced new technology through CFBC Boilers in its 2x250 MW project at Neyveli and 2x125MW project at Rajasthan. Neyveli power is pooled to southern states like Tamilnadu, Kerala, Andrapradesh, Karnataka and Pondicherry.

9.0 PROJECTS UNDERTAKEN BY NLC

- 2X 500MW capacity thermal power plant at Neyveli at estimated cost of Rs. 5000Crores.
- 250MW capacity of Bithnok thermal power project with linked mine of 2.25MTPA in Rajasthan at estimated cost of Rs. 1700Crores.
- Barsingsar extension power project of 250MW capacity using lignite in Rajasthan.
- 1000MW Gujarat power project with linked mine 8.0 MPTA as Mine-Power project in Gujarat state at estimated cost of Rs. 6400Crores.
- 4 X500MW capacity coal based mega therSmal project plant at Orissa estimated cost of Rs. 8000Crores.

- Mine-III 8.0MTPA and thermal power station –III (2X500MW) in Neyveli.

- 4000 MW capacity coal based power project in the State of Uttar Pradesh in 2 stages each having 2000 MW capacity. The estimated cost Rs. 14858.62 Crores.

CONCLUSION

It is a foregone conclusion that Indian power scenario is fast developing. There is a quantum jump in country's capacity addition program in recent years. There have been a number of technological changes taking place in power sector which will definitely boost our country's economy in the years to come.

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EMPIRICAL METHOD TO ASSESS SIGNALIZED URBAN INTERSECTION CAPACITY

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ABSTRACT:

India has heterogeneous traffic conditions. Some codes of India provide a factor for Passenger Car Unit (PCU) for Urban and Rural roads, but do not provide much guidance on PCU factors at intersections. Experience has shown that utilizing the PCU factors of roads does not yield suitable results in assessing intersection capacity. Further, utilization of international codes / factors has also not yielded suitable results in such cases. This paper illustrates empirical methods that were developed to determine Signalized Urban Intersection capacity. Traffic data was collected at a few Signalized Urban Intersections for various modes of traffic, separately for each direction of traffic, and the average back of queue length was also obtained along with the lane configuration. Several trial and error attempts were made to the saturation flow rate, and the intersection back of queue length was validated. This volume of traffic was identified as the intersection capacity.

INTRODUCTION

Intersections are the bottlenecks of roads. Understanding intersections capacity helps in proper planning of roads, and helps improve roads capacity significantly by avoiding / reducing stopped delays. The traffic on Indian roads is heterogeneous. Passenger Car Unit (PCU) is a system in which each type of vehicle is expressed in terms of a Passenger Car, due to which the traffic analysis can be conducted in terms of one vehicle variable only, i.e., Passenger Car, which greatly reduces the complexity. It is therefore vital to establish accurate values of PCU for all vehicles.

The following sentences are an extract from the Indian Roads Congress (IRC), No. 106-1990, “Guidelines for Capacity of Urban Roads in Plain Areas”.

- The PCU of different vehicles categories do not remain constant under all circumstances.
- The PCU are affected due to the physical dimension of the vehicles and their operational speeds.
- In Urban areas, as the speed differential amongst different vehicle classes is generally low, and therefore the physical dimension of the vehicles is an important factor

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◆ Further, the PCU of vehicle type is affected by its proportion in the total traffic

The following table, as per IRC 106-1990, shows the "Recommended PCU Factors for Various Types of Vehicles on Urban Roads".

Vehicle Type	Equivalent PCU factors: Percentage composition of Vehicle type in traffic stream	
	5%	10% and above
Fast Vehicles		
1. Two wheelers Motor Cycle or Scooters etc.	0.5	0.75
2. Passenger Car, Pick-up van	1.0	1.0
3. Auto-rickshaw	1.2	2.0
4. Light Commercial Vehicle	1.4	2.0
5. Truck or Bus	2.2	3.7
6. Agricultural Tractor Trailer	4.0	5.0
Slow Vehicles		
7. Cycle	0.4	0.5
8. Cycle rickshaw	1.5	2.0
9. Tonga (Horse drawn vehicle)	1.5	2.0
10. Hand cart	2.0	3.0

Table 1: Recommended PCU Factors for Various Types of Vehicles on Urban Roads

It should be noted that IRC 106-1990, states that these PCU factors are applicable for mid-block traffic volume only in Urban Roads. A review of the IRC codes identified that PCU factors were not available for intersections. This paper is limited to assessing the signalized urban intersection capacity, through which the PCU factors for vehicle types could be developed.

METHODOLOGY

The following methodology was utilized in developing the Signalized Urban Intersection Capacity:

▪ A few signalized urban intersections were selected, with similar characteristics

▪ Traffic volume data was collected from morning to night for about 14 hours.

▪ The Traffic volume data was obtained for various types of vehicles predominantly utilizing the urban intersections, which can be classified as:

o Scooters / Motor Cycle / 2-Wheelers

o Auto Rickshaw

o Passenger Car / Pickup van

o Light Commercial Vehicle / Mini Bus

o Bus or Truck

▪ The traffic data was obtained for the various movements of the intersection separately, and was obtained in 15-minute intervals

▪ The morning and evening peak hour traffic was identified from this data

▪ The PCU factors from IRC 106-1990 were applied to this data, to obtain the peak hour traffic in PCU equivalent

▪This volume in PCU was utilized in analyzing the intersection capacity.

▪Sidra software was utilized in the intersection analysis

▪ The intersection queue lengths obtained from the site observations was utilized in calibrating the analysis

▪The intersection geometry was maintained, but the saturation flow rate was modified until the queue lengths from the model were proportional to the queue lengths from the site observations

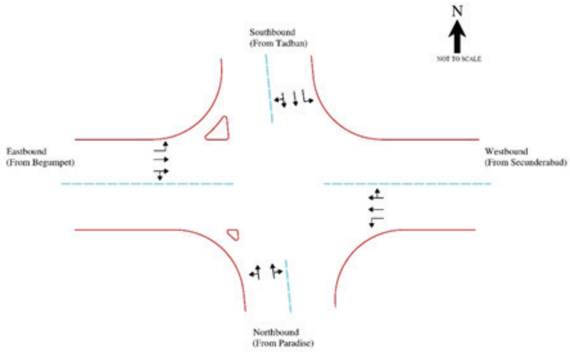
▪ This saturation volume was then divided by the average lane width to develop the signalized urban intersection capacity per meter width of the lane.

For illustrating the analysis, one specific intersection was utilized as shown below. The intersection is located at Secunderabad, at SP Road and MG Road.

INTERSECTION CHARACTERISTICS

Figure 1 shows the intersection layout. It can be observed that the intersection is 4-legged, with the major road running east-west. The intersection has a flyover on top running in the east-west direction. However, the impact of the flyover traffic is absent on the intersection.

Figure 1: Intersection layout



TRAFFIC DATA

As stated above, the traffic data was obtained for the various types of vehicles at the intersection predominantly observed. During the reconnaissance survey, it was observed that the intersection was over-saturated during regular weekdays, with the queues requiring 2 to 3 signal cycles to clear. The evening peak hour was observed to be higher, and therefore this volume was considered in the analysis. Table 2 shows the summary of the peak hour traffic at the intersection for various types of vehicles.

Direction	Movement	Scooters / Motor Cycle	Auto Rickshaw	Passenger Car	Light Cargo Vehicle / Mini Bus	Bus or Trucks	Total Vehicles
Eastbound (from Begumpet)	Left	537	95	613	14	20	**1,279**
	Through	317	104	124	59	200	**804**
	Right	359	93	85	2	7	**546**
	U-Turn	0	7	0	0	0	**7**
Westbound (from Secunderabad)	Left	288	98	97	29	21	**533**
	Through	192	67	89	18	109	**475**
	Right	449	288	361	113	276	**1,487**
	U-Turn	5	1	4	0	0	**10**
Northbound (from Paradise)	Left	259	77	37	12	8	**393**
	Through	1,306	364	607	9	7	**2,293**
	Right	594	121	361	32	19	**1,127**
	U-Turn	5	4	2	1	0	**12**
Southbound (from Tadban)	Left	396	45	139	42	35	**657**
	Through	989	506	386	12	15	**1,908**
	Right	372	127	442	21	11	**973**
	U-Turn	2	9	4	1	0	**16**
Total (Vehicles)		**6,070**	**2,006**	**3,351**	**365**	**728**	**12,520**
Percentage		**48.48%**	**16.02%**	**26.77%**	**2.92%**	**5.81%**	**100.00%**

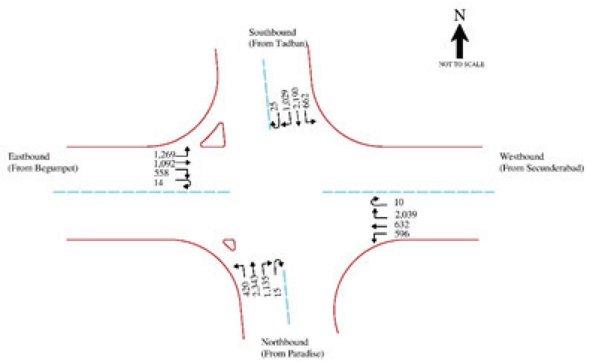
Table 2: Peak Hour Traffic Volume by Various Vehicle Types

It can be observed from the data, that the total vehicles in the peak hour constitute about 12,520 vehicles. Out of these, two-wheelers are a majority, followed by passenger cars and auto rickshaws. The PCU factors according to the proportion of traffic volume from IRC 106-1990 was applied to these volume, and the volume in PCU was developed for various movements as shown in Table 3. Figure 2 shows the peak hour traffic in PCU.

Table 3: Peak Hour Traffic Volume in PCU

Direction	Left	Thru	Right	U-Turn	Total PCU
Eastbound (from Begumpet)	1,269	1,092	558	14	2,934
Westbound (from Secunderabad)	596	632	2,039	10	3,277
Northbound (from Paradise)	420	2,343	1,135	15	3,912
Southbound (From Tadban)	662	2,190	1,029	25	3,905
				Total	14,028

Figure 2: Peak Hour Traffic Volume in PCU



From the field observations, the various lane widths were noted, along with the queue lengths for the different directions. The intersection is signalized, with the signal operating as a 4-phase, with each leg of the intersection being given an exclusive phase. The intersection also did not have separate turn lanes, but this was acceptable due to the signal phasing being given to each leg of the intersection. Further, significant pedestrian activity was observed at the intersection, but the pedestrian movements were unregulated, and the pedestrians were observed to cross the intersection haphazardly, mostly without affecting the green movement of the traffic, and was therefore not considered in the analysis.

INTERSECTION ANALYSIS

The intersection analysis was conducted utilizing Sidra Software. Signalized (or un-signalized) Intersection Design and Research Aid (SIDRA) is an advanced lane-based micro-analytical tool for design and evaluation of individual intersections and networks of intersections including modeling of separate movement class. It provides estimates of capacity, level of service and a wide range of performance measures including delay, queue length and stops for vehicles and pedestrians.

The intersection lane configuration, lengths and widths were input into the software. Also, the field observed signal timing and phasing data was input into the software. The peak hour traffic volume in PCU was input into the software. The field queue lengths were compared to the model queue lengths. To calibrate the model, the saturation flow of the lanes was increased incrementally, until the field queue lengths matched proportionately to the model queue lengths

It was observed that a value of about 6,000 PCU per lane resulted in achieving the desirable results. In comparison to various international and national codes, usually, the lane saturation flow rate at a signalized urban intersection is usually taken as 1,900 cars per lane, which could be adjusted slightly based on field observations. However, the achieved result of 6,000 PCU per lane is more than three times the theoretical values.

Similar values were obtained for all the various lanes groups of the intersection. These values were also found to be similar at other intersections also. Additional field visits were made, and manual traffic volumes were obtained from the onset of green to the onset of yellow. Field observations of the traffic volume also coincided with this model output.

The primary reason attributed for such higher capacity is because of the presence of high two-wheeler population in the traffic volume. The two-wheelers were observed to occupy the entire width of the intersection approach lane, resulting in about 10-15 two-wheelers lined up next to each other. Upon on the onset of green indication, all these two-wheelers would leave followed by another line of such two wheelers. Further, due to lack of lane discipline, in two lane width, more than 3 cars were also observed. These types of driver behavior is unsafe. However, this is the reason for achieving such high saturation flow rates.

Upon dividing these saturation flow rates by the average width of the lane, it was concluded that the capacity of one-meter width of the urban signalized intersection was about 1,750 PCU.

CONCLUSIONS

This paper identifies an empirical method to assess signalized urban intersection capacity. In this process, signalized intersections were identified. Traffic volume data was obtained at the intersection, and the peak hour traffic volume was identified. The Passenger Car Units (PCU) obtained from IRC 106-1990, were applied to this traffic volume to develop the traffic volume for the intersection in PCU. This volume was then input into Sidra software along with various intersection characteristics. The field queue lengths were calibrated to the model queue lengths by modifying the saturation flow rate. A saturation flow rate of about 6,000 PCU per lane was achieved. Upon dividing these saturation flow rates by the average width of the lane, it was concluded that the capacity of one-meter width of the urban signalized intersection was about 1,750 PCU. These high saturation flow rates are attributed to the lack of lane discipline in the traffic volume, and the presence of high two-wheeler volume.

Further research could review the impact of various types of vehicles, and develop the necessary PCU factors for signalized urban intersections.

Global trends in Sustainable Design & Construction of Long Span Bridges

A.Saibaba[1]

ABSTRACT:

With the growing awareness of environmental protection, one of the critical concerns while undertaking major infrastructure projects the world over is sustainability. Sustainability can be defined as the art of designing a project so that resources are available for generations to come, duly considering the environmental, ecological, economic and socio-cultural environments. Hence major bridge projects all over the world are now gearing up to meet the sustainability requirements besides techno-economical issues. Sustainability is the maxim of the 21st century. Business as usual energy and consumer practices are under scrutiny in the wake of depleting natural resources and food shortages! In addition, with global warming becoming a real concern, energy conservation and carbon reduction are major considerations in such projects during not only design and construction phase but also service. Integration of aesthetics poses another dimension to the challenge.

INTRODUCTION:

Sustainability can be epitomized as "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Extrapolating from this basic definition, sustainable bridge can be defined as that one that is conceived, designed, constructed, operated, maintained and finally dismantled in such a fashion that these activities demand as little as possible from the natural, material and energy resources of the surrounding supporting community. So in practice, sustainable bridge design is not about strictly environmental concerns, or only about energy conservation. Instead, it is a more holistic review and evaluation of a bridge project merits and compatibility with the flora and fauna on both micro and macro scale. In order to produce a sustainable bridge project, each of the activities right from planning to completion and operation needs to be considered from sustainability viewpoint.

As depicted in Figure-1 on the side, a sustainable bridge is one that can be constructed and operated without significantly impairing the environmental, social and economical requirements, thereby ensuring adequate resources and a healthy environment for future generations. A major bridge project is no longer seen as a massive cement and steel giant.

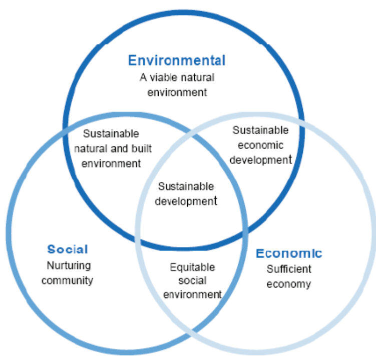


Figure-1 Components of Sustainable design

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It is treated as a living entity brought into life to be synergetic with the environment in which it is constructed. A major bridge with all the effort and investment shall be designed and built to serve satisfactorily during its intended life.

For sustainable bridge design to be successful, there is a need for a paradigm shift away from using economy as the main criterion for bridge design. A greater importance needs to be put on environmental factors, even if addressing these factors may apparently increase the initial cost of the bridge. Sustainable bridges need less energy for operation and maintenance. Hence by evaluating the 'whole-life' costs of the sustainable bridge that includes inspection, maintenance and repairs over the designed life period, it is possible that the sustainable design may have a higher cost upfront but may have considerable cost savings over its life span.

The sustainability of infrastructure is now accepted as a key issue in many parts of the world and it is essential that the construction industry recognizes the important role it has to play and responds positively to the associated challenges. Within our transportation network, crucial for the continued economic growth of our nation, bridges form a critical part. Deficiencies in the durability/strength of bridges which necessitate repairs/replacement can lead to considerable disruption/congestion within the network and have a very negative impact on sustainability.

Sustainable design have a pronounced effect for long span bridges as they demand maximum site preparation, consume maximum material, have larger environmental impact. However, these issues are to be addressed even for medium spans to the extent applicable within the overall framework.

REQUIREMENTS OF SUSTAINABILITY:

Factors that have been identified to have significant contribution towards enhancing sustainability and promoting cost efficiency are listed below:

1.Lower energy input/ Embodied energy
2.Use of sustainable materials- locally available, reusable, recyclable, least waste
3.Simple & Innovative techniques of construction, operation, monitoring, repairs & rehabilitation
4.Increased durability
5.Simplified deconstruction

Based on these founding principles and the rather refined guidelines already available for 'green building' concepts, yardsticks for sustainable bridges can be summarized into three categories:

Embodied energy

It is a measure of the burden placed by construction on our natural resources and can be estimated as the total primary energy that has to be extracted from the earth to per m2 of plan area for bridges. To this, operational energy used during their lifetime has to be added. It is estimated that the embodied energy varies from 16 to 75 GJ per m2 of ridge deck.

Based on study, it is concluded that the short span concrete structural form gives the lowest values while the longer span steel or composite structure the highest. Interestingly, it is seen that a well-engineered longer span bridge using innovative materials and techniques can be almost as environmentally friendly as a shorter span structure where sustainability issues are not considered.

Embodied CO_2

This represents the total carbon dioxide released into atmosphere during resource extraction, manufacturing, transportation, insertion and maintenance of the various bridge components for entire life span. It is estimated that half the CO2 emissions occur during maintenance. CO2 for construction of a bridge is between 1 and 5 tonnes per m2 of deck area. Thus the challenge for bridge designers is to achieve minimum total CO2 emissions over the entire life span.

Total Life Cycle Cost

Whilst the initial 'costs' are useful it is the 'cost'/'energy use' over their full life that is more significant. In this context the importance of maintenance-free bridges like Integral Bridges for medium spans can be best understood. By designing a bridge without movement joints and which is integral from one abutment to the other the maximum resistance to chloride penetration is obtained. As a further step the timely and appropriate application of protective coatings which can be applied whilst it is in service, can delay the need for bridge repair. Thus by using these methods and some of the innovative approaches detailed later in this paper the life of specific types of bridges can be greatly enhanced and the total life cycle 'cost'/'energy use' reduced.

Life Cycle Analysis (LCA)

LCA is a tool used to measure environmental performance of the structure. The concept is to track the production of an item from start to finish, measuring inputs (fuel, electricity etc) and outputs (pollutants, CO2, solid wastes etc) at every step along the way, from the extraction of the raw material to the end of the item's life. In other words, it is a 'cradle-to-grave' analysis that looks at the environmental impacts of raw material extraction, material manufacturing, construction, energy use during life time, and end of life deconstruction. It is a "rational, quantified approach to determine specific environmental impacts", which include both the resources used and the waste products created.

Means of achieving sustainability

Having understood the requirements and yardsticks, the various means of achieving sustainability are grouped into following categories:

Sustainable sites

The requirements of a sustainable site location are -

➢ Provides most acceptable connection to existing developments and has the potential to usher in further development and tourism

➢Provides Value addition to the economic and social life of the connected areas

➢Causes Least disturbance to environment and land use

➢Provide considerable savings in time and fuel consumptions

➢ Having least impact of supports (piers/abutments) on water and aquatic life

➢Employs best practices in sedimentation and erosion control

Taking cue from the above, some of the practices already being followed are:

Preference shall be given to sites that allow supports to be placed on land and not on water. This can be achieved by making use of longer spans, shorter crossing distances and the topography.

Route passing through nature reserves can be avoided, by making an S-shaped bridge as shown in the Figure-2

Figure-2 Sustainable alignment

Similarly, setting the bridge abutment on a slope shall be avoided which will cause slope damage. If possible, bridge can be extended into a tunnel to reduce its impact on the slope as shown in Figure-3

Other alternatives include redevelopment of

Figure-3 Abutment on slope avoided

Brown field sites, avoidance of locations on historic sites etc. If the bridge is to be built on a historic site, improvements shall be made to the facilities and to access to the site.

Bridge Configuration

Bridge configuration refers to the details like- type of bridge, material & type of construction, lane disposition, underway clearances and other salient geometric features. Some of the good practices in the regard are:

➢ Provision for future lanes will avoid need for future heavy rehabilitation or additional bridges.

➢ Use of alternative transportation through High Occupancy Vehicles (HOVs) can be encouraged by providing dedicated travel lanes for exclusive use of HOVs like- Buses & carpools.

➢ Transitways can be provided for future use of public light rail or bus.

➢ Separate lanes can be earmarked for exclusive use of common transportation like bicycles and pedestrians

Based on the above aspects, various alternatives shall be examined- not only for the alignment but also the span configuration, type and overall dimensions.

Environment Impact assessment & Energy Audit

Prior to the commencement of the project, a Preliminary Environmental Impact Assessment study shall be undertaken for the project and approved by the concerned authority. Baseline data shall be established as reference data for "Environmental Monitoring and Auditing (EMA) for various construction activities including dredging and offshore disposal of spoils, piling, construction machineries and equipment during the Construction Phase.

Fast-track construction techniques can be adopted to minimize construction time and thereby overall energy requirements. Development and use of renewable energy technologies on a net zero pollution basis shall be encouraged.

Environmental Audit shall be undertaken by a statutory authority with following objectives:

➢ Checking the implementation of specified environmental mitigation measures

➢ Reviewing environmental monthly report, methodology, sampling and testing procedures as compared to the base line data

➢ Identifying potential environmental issues and recommend appropriate in-time mitigation measures.

Materials and techniques

Material selection is an integral and vital component of the design process for sustainable construction. Choice of bridge material shall be appropriate for the site and the future maintenance and recycling of the structure.

Materials extracted and manufactured within the region can be made full use of, thereby supporting the regional economy and reducing the environmental impacts resulting from transportation over longer distances. Similarly material released from the bridge shall be recyclable or reusable.

Comparisons between steel, concrete and steel composite materials indicate that their embodied energies are similar and that the benefits of an efficient design are more significant than the choice of material.

Concrete

Concrete particularly cement is a major energy sink due to its sheer volume of production and also environmentally unsustainable due to large quantities of CO2 evolution associated with its manufacture. A significant advantage for the use of concrete is that it is the most widely used material, which means that it is often considered a local resource. Reduction in transport cost of concrete will add not only to economy but also to the green points.

Incorporating sustainable principles into the ingredients of concrete further contributes to the cause. Using cement substitutes like fly-ash, GGBFS & other such recycled material, carbon footprint of concrete is further reduced.

Precast concrete

Precast products are considered effective green building products because of their superior performance, minimal environmental impact, quick manufacturing turnaround and reduced life cycle costs. However they can be made even more environmental friendly product if carbon accelerated curing technique is adopted where CO2 is used steam in curing process. This process also makes the product stronger, less porous, and more durable. The production cycle is also significantly shortened when CO2 is used in the curing process instead of steam.

Steel

It is estimated that production and fabrication of one ton of structural steel involves release of one ton of CO2. However considering that it is 95% recyclable, it is a viable option for green construction. Additionally steel offers the flexibility of design and speed of construction.

New materials ideal for sustainability

➢ High Performance Concrete and Ultra High Strength Concrete upto150 MPa– being of very high strength and more durable, drastically reduces the sizes of various bridge components, thereby influencing the overall costs and maintenance efforts

➢ Prefoam concrete – Being lightweight, easier to handle and erect, but not for high stress locations

➢ Carbon sequestered concrete- less carbon footprint as CO2 is effectively recycled for curing of concrete- ideal for major precasting yards

➢ Self Compacting Concrete- environmental friendly as no noisy and heavy vibration mechanisms required, can be easily pumped with near zero slump (Fig.4 below)

➢ Self Curing concrete (with polymer

Fig.4 Self Compacting Concrete

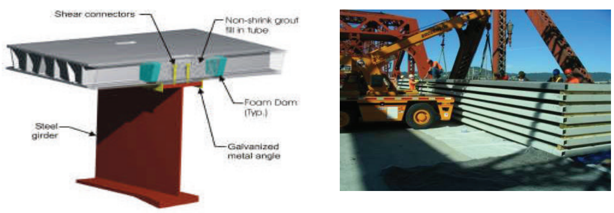
admixture) – ideal for situations where water is a premium.

➢ Cement Replacement with fly ash, silica fumes or GGBFS- All these materials are available in plenty and can be effectively used almost upto 50%. Additional advantage of more durability and chemical resistant

➢ Recycled materials – like sintered reservoir mud to prepare lightweight concrete- encourages use of local materials available in plenty

➢ Fibre Reinforced Polymer (FRP) - FRP composite bridge decks deliver viable solutions to meet critical needs for rehabilitation of existing bridges and construction of new bridges. Fig.5a and 5b depict the section of FRP deck and erection of FRP deck.

Fig 5a and 5b FRP deck



➢ Primary benefits of FRP decks include:

• Durability (highly resistant to corrosion and fatigue)

• Lightweight -80% less compared to concrete decks

• High service life- two to three times

• Rapid Installation – twice as fast
• Lower or competitive life-cycle cost
• High quality manufacturing processes under controlled environments.

➢ Manufactured Sand: This is sand artificially produced from rock, using the technique of vertical shaft impactor, where rock is subjected to impact and cleavage attrition to result in consistently good quality sand having uniform gradation and shape. This type of sand further contributes to sustainability and strength due to reduction in water and cement demand on account of lower levels of silt and clay.

➢ Synthetic lightweight aggregates: Produced by sintering locally available material like reservoir mud and fly ash, the concrete made of lightweight aggregates can have strengths upto 50MPa. Being light weight also is seismically favourable as it attracts less inertial forces during an earthquake.

➢ Concrete with recycled construction wastes: Though not a well-established practice, use of recycled demolition and construction waste for buildings has lot of potential in contributing towards sustainability. Several experimental studies have proved that this type of concrete can be used in bridge projects for ancillary works like paving blocks, drain slabs, retaining walls and pavement sub bases.

Innovations in design and construction technique

Design

The basic principle of sustainable design involves assembling the entire design team at the onset of the project, in order to set the goals of the design not only from a programmatic standpoint, but also from a green and energy consumption standpoint. Every decision taken during the design process is based on promoting energy efficiency, minimal site disturbance, healthier environments and reduction in the use of virgin material. In order to produce a truly sustainable structure, each of the tasks needs to be considered from a sustainability standpoint. Sustainable goals need to be considered and accounted for at every phase of planning, design, construction and maintenance.

Through increased knowledge of materials reflected in design code development, more efficient designs can be developed that make full use of our current understanding of material performance and structural behavior.

Construction techniques

Integral bridge (Fig.7)

Integral Bridges, without movement joints and bearings, are ideal for are ideal for medium spans. As the bridge is integral from one abutment to the other, maximum resistance to chloride penetration is obtained. As a further step the timely and appropriate application of protective coatings, can enhance durability.

Fig.7 Integral bridge

Aluminium alloy bridge decks (Fig.8)

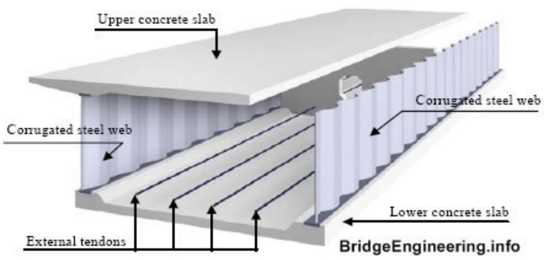
Aluminum has been used in various ways in hundreds of bridge structures around the world, and most remain in service today, including some for more that 50 years.

Aluminum alloy bridges can be used where their light weight, high strength-to-weight ratio, and excellent corrosion resistance satisfy service requirements and justify the additional initial cost. When considered on a life-cycle cost basis, aluminum bridges components have clear superiority.

Corrugated steel-web composite girder bridge (Fig 9a and 9b)

By using corrugated steel plate to replace concrete web, it can reduce 15% self weight.

Fig 9a and 9b Corrugated web



Precast piers (Fig 10a & 10b)

Construction of new bridges in metropolitan areas can cause great public disruption. Completing the constructions in a rapid and clean manner has become a key consideration.

Fig 10a & 10b Precast piers

Recycled plastic kerbs

As name suggests, the prefabricated kerbs are manufactured from recycled plasics. Being light, it is easy to transport, handle and install. Even dismantling and replacing is easy. It has further recycle value at the end of bridge life.

Smart Bridge technology

The innovative combination of reliable existing technologies for heating and cooling of buildings with low maintenance, sustainable and durable bridges are the major components of the SMART BRIDGE TECHNOLOGY. This will lead to complete new Bridge concepts allowing Integral Bridges with unlimited total length. This will cause reduction of temperature expansion in the bridge due to heating/ cooling of superstructure. Use of geothermal energy with e.g. energy piles is made use of. The required operative energy is provided by use of photovoltaic panels.

Bridge Maintenance Management

Performance of a bridge in service depends on probability assessment of failure carried out at the design stage to determine design parameters, workmanship, material deterioration and maintenance requirements. These factors can be evaluated in a reliability management study and there are various methods through which a longer service life can be achieved. Besides, service life of bridges depends much on maintenance strategy and commitment to asset management.

Remote monitoring systems can be installed to reduce frequent physical inspections. Accessibility of various components is vital for their longevity by providing maintenance ladders, exclusive maintenance vehicles etc.

Conclusion

Bridges are vital link in the transportation network crucial for the continued economic growth of our nation. Hence any deficiencies in the durability/strength of bridges necessitating repairs/replacement leads to considerable disruption/congestion in the network and have a very negative impact on sustainability. Experience of countries where sustainable bridges are already being built, shows that the benefits of sustainable construction are immense and far outweigh any negative aspects, considering the overall performance during service life of the bridge. Hence it is high time that we realize that sustainability is an indispensable ingredient in the process of designing major bridge projects in the overall interests of the community, of the nation and of the whole world.

Further study and research is required to consolidate and establish the design concepts, material selection and construction techniques that suit our nation the best. Also the standard metrics to be adopted for assessment of sustainability practices and accord grading shall be devised, similar to the grading concept for 'green buildings'.

With the growing awareness for environmental protection and reduction of GHG, it is incumbent upon us engineers to master the art and technique of delivering bridges that are not just safe and economical but also socially and environmentally acceptable for generations to come!

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TENSIOMETER BASED DRIP IRRIGATION SCHEDULING OF CUCUMBER UNDER POLYHOUSE

Sapna Singh[1] and P. K. Singh[2]

ABSTRACT

The present study was undertaken to investigate the "Tensiometer Based Drip Irrigation Scheduling of Off-season Cucumber in Pantnagar Tarai Condition of Uttarakhand". The objective of the study was to see the response of different irrigation regimes in combination with fertigation levels on the biometric growth and yield of cucumber. The economic feasibility of cucumber production under the polyhouse was also undertaken during the study. During the five month growing period in double span naturally ventilated polyhouse (DS NVPH), the average depth of water applied at the irrigation level I1 (20-30 kPa) was 10.42 litres per plant(lps), I2 (30-50 kPa) was 11.22 litres per plant and at I3 (50-70 kPa) level was 9.24 litres per plant (lps), whereas in conventional practice (control) depth of irrigation was 15.92 mm. Production of the of cucumber at irrigation levels I1, I2, I3 and control were recorded as 8.50 and 11.00 kg/m2; 10.60 and 10.65 kg/m2; 9.08 and 12.04 kg/m2 ; and 6.05 kg/m2 respectively. The average water productivity for cucumber at irrigation levels I1, I2, I3 and control were 22.64 -29.83, 23.39-23.49, 20.58-25.53 and 41.15 litres/kg respectively. Production of cucumber under treatment was economically feasible at selling price higher than Rs.20/kg.

Introduction

The Cucumber is an important crop of India. However, its production is restricted to summer and rainy seasons. To ensure its regular and off season supply, technology for growing of cucumber under protected conditions needs to be standardized. Greenhouses provide protection against biotic and a biotic stresses and ensure high quality produce (Peet and Welles 2005). Low cost naturally ventilated polyhouse offers a great scope for the off season cultivation of cucumber for round the year supply in the mild winter climatic areas of India. To obtain higher and quality cucumber production in polyhouse, proper irrigation and fertilizer management becomes very important. In the greenhouse, crops require frequent irrigation in order to minimize the water stress and obtain maximum production and high quality. Thus, scheduling of irrigation is very critical as excessive irrigation reduces yield, while inadequate irrigation causes water stress and reduces production (Locascio and Smajstrla 1996). Applying water through drip irrigation based on tensiometer inside polyhouse would be a convenient method to schedule irrigation. Good irrigation scheduling means making sure water is available when the crop needs it. One of the benefits of scheduling with tensiometers is the ease of use and the

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immediate results. With tensiometers, users only need to look at the gauge to determine the soil moisture level with no other meters or instruments necessary. The soil water tension or suction is measured in centibars (cbars) or kilopascals (kPa) which is related to the amount of water in the soil available to plants. An effective irrigation management practices alone is not enough for higher production as nutrient management also play important role. Drip irrigation system provides an opportunity for efficient and effective nutrient management through fertigation. In fertigation, about 50 percent saving in fertilizer as compared to traditional method of fertilization is possible (Chopade et al. 1998). The application of recommended dose of P and K to soil at transplanting and N as urea through drip proved better than control in growth and yield of chilli (Deolankar and Firake 1999). Keeping above in view the present study was undertaken to investigate the water requirement, water productivity, and water use efficiency under tensiometer based irrigation scheduling for cucumber crop in naturally ventilated polyhouses and to study the growth and yield response of cucumber crop to drip irrigation and fertigation.

MATERIALS AND METHODS

The study was conducted in a double span naturally ventilated polyhouses (DSNVPH) at the experimental site located premises of the Department of Irrigation and Drainage Engineering, College of Technology, G.B. Pant University of Agriculture and Technology, Pantnagar, located in the Tarai region of Uttarakhand, lies at 29.50N latitude, 79.30E longitudes and at an altitude of 243.83 m above mean sea level. Double span naturally ventilated polyhouse (DS NVPH) having size of 20 m x 10 m with side wall role up curtains on both side walls for the side ventilation and provision of insect proof net also used to protect the plants from insect-pests. UV-stabilized polyethylene diffused sheet of 200 micron (800 gauges) was used as cladding material. It has two span gable roofs and central height is 5 m from ground surface. The top 30 cm of the soil profile is Beni silty clay loam with sand (18%), silt (50%) and clay (32%). The study included three irrigation levels with the help of six tensiometers, installed between two plants on their root zone at the depth of 20 cm. Set points between, (1) I1 = 20-30 kPa, (2) I2 = 30-50 kPa, (3) I3 = 50-70 kPa in both the Polyhouses. Where, minimum tension point indicates end of irrigation and maximum start of irrigation. Purpose is to maintain the irrigation level in a specified tension point in all three irrigation treatments. With these three irrigation levels were combined with two fertigation levels . By the combination of three irrigation levels and two fertigation levels, six main treatments and a controlled treatment were created for analysis in the Polyhouses.

The experiment was laid out in randomized block design with three levels of irrigation viz., I1 = 20-30 kPa, I2 = 30-50 kPa, I3 = 50-70 kPa maintained with the help of tensiometers, installed between two plants on their root zone at the depth of 20 cm and two fertigation levels i.e. F1 = 75 % of recommended doses of fertilizers and F2 = 100 % of recommended doses of fertilizers and a control treatment were evaluated in both the polyhouses. Various biometric growth parameters like plant height, number of branches, average fruit diameter, average fruit length and fruit weight were recorded. The cost benefit (B:C) ratio was calculated assuming the life period of the polyhouse structure as 24 years with 10 percent depreciation cost and rate of interest was taken as 13.5 percent. For evaluation the cost benefit ratio, the yield and selling price of produce was used. The selling price rate was taken from the nearby local market.

RESULTS AND DISCUSSION

Water Requirement and Water Saving

The amount of water applied at three irrigation levels i.e. I1 (20-30 kPa), I2 (30-50 kPa), I3 (50-70 kPa) under drip irrigation and a control plot in cucumber crop under DS NVPH has been plotted in Fig.1 and Table 1.The cumulative amounts of water applied are shown as a function of day of growing season for all four irrigation treatments. The steeper slopes of the curves under control treatment, show time periods of high water demand, similar trend was also obtained under the tensiometer based irrigation treatments during the same period of observation.

Fig. 1 shows that initially up to 15 days after sowing (DAS) the irrigation was kept constant for development of root and establishment of the cucumber plant under all treatments. At this stage each of the three irrigation levels i.e. I1 (20-30 kPa), I2 (30-50 kPa), I3 (50-70 kPa) and C (controlled treatment), cumulative irrigation application was 6.00 litres/plant (lps). These four useful curves were obtained for four different irrigation treatments. Cumulative amount of water applied in controlled treatment was higher as compared to tensiometer based different irrigation levels.

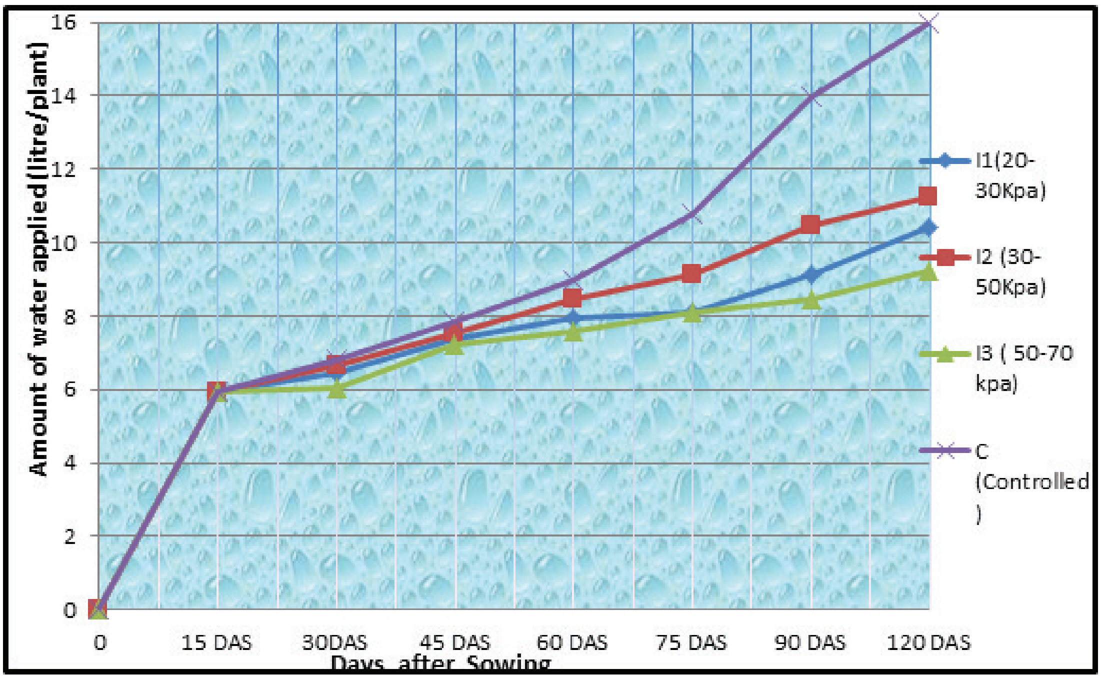

Fig. 1. Cumulative water applied in cucumber during growing season

It is seen from the Table 1, that the total amount of water applied in tensiometer based different irrigation levels I1, I2 and I3 and controlled treatment C was 10.42, 11.22, 9.24 and 15.92 litres per plant, respectively. The data pertaining to the water saving and relative water use due to tensiometer based irrigation scheduling over control are given in Table 4.19. The water saving (%) and relative water use in case of I1, I2 and I3 level of irrigation was determined as 35, 30, and 42 % respectively over control and the relative water use was found to be 0.35, 0.30, and 0.42 in respective irrigation treatments. Water saving due to tensiometer based irrigation scheduling was higher because the water application based on soil moisture tension involves no water loss and chance of over irrigation was minimized. In case of control treatment, since the water application was based on conventional irrigation practices at 25 % soil moisture depletion and there are most chances of over irrigation due to human error on general field observation.

Table 1: Total water applied and corresponding water saving and relative water use as compared to control

Treatments	Water applied (litre/plant)	Water saving, (%) over control	Relative water use
I_1	10.42	34.54	0.35
I_2	11.22	29.53	0.30
I_3	9.24	41.96	0.42
C	15.92	-	-

Fruit Quality Parameters as Affected by Irrigation and Fertigation

Significant response of drip irrigation and fertigation to cucumber fruit growth parameters was observed (Table 2 and Table 3). It was also observed that the average fruit length of cucumber at different treatments was found to be significant. The average length of fruit in treatments T2 was increased maximum by 29.17 % as compared to the control T7. Table 2 also reveals that the average diameter of fruit at the different treatments was found to be significant. The average diameter of fruit was higher by 27.56 % in the treatments T4 and T6 over control T7. The specific gravity of fruits was highest in T5 (6.94%) as compared to control. The average weight of fruit produced was 246.23 gm in tensiometer based irrigation with fertigation treatment (T1 toT6) and in control it was 210.40 gm. Table 3 also shows that the effect of treatments on the average fruit weight was found to be significant. The average weight of fruit was increased maximum in the treatments T2 and T6 by 21.24 % as compared to control T7. The mean yield per plant ranger from 1.67 – 2.40 kg/plant in the tensiometer based irrigation with fertigation treatment(T1 toT6) and in control it was 1.21 kg/plant. Table 3 reveals that the effect of various treatments on the average yield per plant was found to be significant. Table 4 shows that the average yield per square meter from six tensiometer based irrigation with fertigation treatments (T1 toT6) ranged from 8.50 to 12.08 kg/m2 with maximum 12.08 kg/m2 in the treatment T6 i.e. I3F3 while the minimum was 8.50 kg/m2 in the I1F1 (T1)treatment. While in in control i.e. C (T7) the yield was lowest as 6.05 kg/m2 compared to all the treatments under drip irrigation. These findings are in agreement with Madile et al. (2012).

Table 2: Effect of various treatments on cucumber fruit length, diameter and fruit weight

Treatment	Fruit length (cm)	% increase over control	Fruit diameter (cm)	% increase over control	Specific gravity (gm/cm^3)	% increase over control
I_1F_1 (T_1)	18.13	25.03	4.95	20.73	1.010	4.86
I_1F_2 (T_2)	18.73	29.17	5.20	26.83	1.038	7.80
I_2F_1 (T_3)	18.33	26.41	5.10	24.40	1.024	6.30
I_2F_2 (T_4)	18.23	25.72	5.23	27.56	0.939	-2.50
I_3F_1 (T_5)	18.37	26.70	4.90	19.51	1.030	6.94
I_3F_2 (T_6)	18.37	26.70	5.23	27.56	0.980	1.75
C (T_7)	14.50	-	4.10	–	0.9632	-
CD ($P<0.05$)	2.07		0.57		0.16	
SEM ±	0.67		0.18		0.493	
CV	6.58		6.44		2.77	

Table 4: Effect of various treatments on cucumber yield per square meter, water use efficiency and water productivity

Treatment	Fruit weight (gm)	% increase over control	No. of fruits per plant	% increase over control	Yield per plant (kg)	% increase over control
I_1F_1 (T_1)	250.40	19.01	6.69	16.35	1.67	38.01
I_1F_2 (T_2)	255.10	21.24	8.58	32.98	2.20	81.81
I_2F_1 (T_3)	241.20	14.64	8.80	53.04	2.12	75.21
I_2F_2 (T_4)	251.70	19.63	8.47	47.30	2.13	76.03
I_3F_1 (T_5)	240.70	14.40	7.10	23.48	1.95	61.16
I_3F_2 (T_6)	255.10	21.24	9.50	65.21	2.40	98.35
C (T_7)	210.40	–	5.75	-	1.21	-
CD($P<0.05$)	13.23		0.368		0.55	
SEM ±	4.29		1.135		0.179	
CV	3.06		8.15		15.899	

Table 4: Effect of various treatments on cucumber yield per square meter, water use efficiency and water productivity

Treatment	Yield (kg/m^2)	% increase over control	WUE (kg/m^3)	% increase over control	Water productivity (liter/kg)
I_1F_1 (T_1)	8.50	40.50	33.53	37.98	29.83
I_1F_2 (T_2)	11.00	81.81	44.18	81.81	22.64
I_2F_1 (T_3)	10.60	75.20	42.57	75.18	23.49
I_2F_2 (T_4)	10.65	76.03	42.77	76.01	23.39
I_3F_1 (T_5)	9.75	61.16	39.17	61.19	25.53
I_3F_2 (T_6)	12.08	99.66	48.57	99.87	20.58
C (T_7)	6.05	–	24.30	-	41.15
CD ($P<0.05$)	1.03		5.19		4.71
SEM ±	0.33		1.68		1.53
CV	5.91		7.41		9.93

Water Use Efficiency

Significant observations on yield response to water were recorded during the study (Table 4). The water use efficiency was determined as maximum in the treatment I3F2 (T6) by 99.66 % higher as compared to the control C (T7). Table 4 reveals that the effect of the various treatments on water productivity (litres/kg) for cucumber production was significant. The water productivity in treatment I3F2 (T6) was highest among all the treatments under the study. The amount of water required to produce one kg of cucumber was highest for the control treatment (41.15 litres/kg) and lowest (20.58 litres/kg) for the treatment I3F2 (T6). In general water productivity under drip irrigated treatments (T1 to T6) was higher (37.98 to 99.87 %) than surface irrigated (T7) cucumber.

Economic Feasibility of Cucumber Production under Polyhouse

The economic analysis of cucumber production was worked out under tensiometer based drip irrigation scheduling in Polyhouse. During the growing period the market price of cucumber has been varied between Rs.10 to 60 that was used to evaluate the benefit cost (B:C) ratio and net seasonal income (NSI). Fig.2 also revealed that the production of cucumber under tensiometer based drip irrigation with fertigation is economically profitable under naturally ventilated Polyhouse even at Rs. 20/kg. However, the prevailing market price for the cucumber has been generally more than Rs.20/kg.

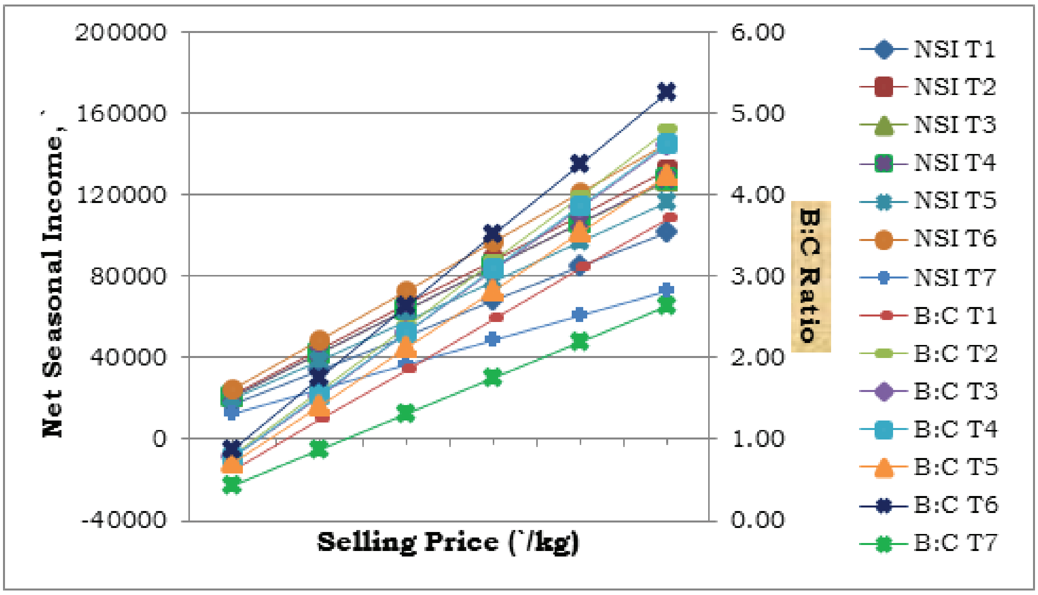

Fig. 2. Effect of market price on B : C ratio and net seasonal income on production of cucumber in Polyhouse

CONCLUSIONS

Thus, the study reveals that tensiometer based drip irrigation and fertigation improved the biometric growth parameters and yield and yield attributes of cucumber was higher at drip irrigation scheduled at 50-70 kPa soil moisture tension in DS NVPH. The water use efficiency and water productivity was also higher drip irrigation scheduled at 50-70 kPa soil moisture tension in DS NVPH. Production of cucumber under tensiometer based different irrigation level and different fertigation level in both polyhouses were economically feasible even at the selling prices from Rs. 20/kg and highly profitable for the grower at the prevailing offseason market price (Rs. 40 to 60/kg).

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EVOLUTIONARY TECHNIQUES FOR TRANSMISSION EXPANSION PLANNING

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Abstract:

Power Infra structure plays a critical role in the economic and social development of a country. Economic growth in India has spurred the need for more power and hence the infrastructure to transport the power. Adequate transmission capacity is very essential in any long-term planning for improving the availability and supply of power. So Transmission Expansion Planning (TEP) is integral to the development of a stable and reliable power infrastructure. Planning for transmission lines in to the future is a very complex task which needs a coordinated and analytical analysis of various scenarios and contingencies. In this work we have implemented a scheme for Transmission Expansion Planning which factors load growth and considers N-1 contingency. The optimization of the expansion plan is done with the help of Backward Search (BS), Forward Search (FS), Hybrid Search (HS) and Genetic Algorithm (GA). The expansion plan is suggested for a 6 Bus-Roy Billinton Test System (RBTS). The plans suggested by different optimization algorithms are compared in terms of number of new lines, length of new lines and the total cost of expansion.

Keywords:Transmission Expansion Planning (TEP), Backward search (BS), Forward Search (FS), Hybrid Search (HS), Genetic Algorithm (GA), N-1 Contingency and Roy Billinton Test system (RBTS).

I. INTRODUCTION

Electric energy is the most popular form of energy because it can be transported easily at high efficiency and reasonable cost. Currently the real-world electric power systems are large-scale and highly complex interconnected transmission systems. Over the past few decades, the amount of electric power energy to be transmitted from generation sites to major load areas has been mounting considerably [1]. Due to increasing costs and the essential need for reliable electric power systems, suitable and optimal design methods for different sections of the power system are required. Transmission systems are a major part of any power system therefore they have to be accurately and efficiently planned [1].The aim of Transmission Expansion Planning (TEP) is to specify addition of transmission lines that give sufficient power and at the same time maintain reliability of transmission system. To meet demand growth, generation addition and increased power flow, Transmission Expansion Planning must identify efficient plan, precise site, capacity, timing and type of novel transmission apparatus [2]. One of the major challenges in power system optimization is that TEP must be cost-effective in spite of the problem being complex, large-scale and nonlinear.

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Planning horizon, instance topology of the base year, candidate circuits, load forecast, generation expansion and investment constraints are to be considered for TEP, increasing the complexity of the problem [2]. Transmission Expansion Planning shall be made based on analysis of AC load flow or DC load flow. Real and Reactive Power flows can be obtained from AC load flow or DC load flow, but DC load flow is preferred due to simple calculations and less time required for simulation [2].

II. PROBLEM DEFINITION

Transmission Expansion Planning is to find out the transmission paths between existing and new buses and their features like voltage level, number of circuits, conductor type, etc,. Transmission Expansion planning should reduce investment cost and operational cost as well as to meet various constraints during normal and contingency conditions i.e. Investment cost involves the cost of adding new transmission elements and the operational cost would be the cost of power losses during the element life [3]. Transmission Expansion Planning must not violate the basic constraint i.e. the limiting transfer capacity of a Transmission line. The contingency is, in fact, an outage taking place on a single element such as a line, a transformer, and / or a generator or some other elements. The N-1 condition is referred to as outage single element, therefore, the Transmission Expansion Planning should be done that system must meet the load and no violation happens [3].

III. PROBLEM FORMULATION

The problem is considered as an optimization problem which involves minimizing objective function by satisfying various constraints.

The objective function comprises the investment cost for novel transmission lines, whereas fulfilling constraints like power flow node balance, power flow limit of transmission lines, power generation limits, bus voltage phase angle limit and right off way [3].

The objective is to minimize the total cost (Ctotal), comprising the investment cost for new transmission lines (Cnew-line), i.e.

$$C_{total} = C_{new-line} \qquad (1)$$

Where

$$C_{new-line} = \sum_{i \in L_c} C_L(x_i) L_i \qquad (2)$$

Where Li is the length of transmission line candidates in Km, Lc is the set of possible candidates, x_i is the type of transmission line candidate i.e. various types such as number of bundles, conductor types and number of circuits and CL(x_i) is the investment cost per km for type x_i [3].

IV. CONSTRAINTS

The TEP problem (1) gives the investment cost of the recently added transmission lines; it has some restrictions to solve it. To find optimal solution of TEP, physical and operational constraints must be included into the mathematical model; the constraints are explained as follows [3]:

A. Power Flow Node Balance

The non linear equality constraint characterizes the conservation of power at each node, i.e.

PGi=PDi+Pi (3)

for i=1, 2 ….NB ,Where PGi, PDi and Pi is real power generation, real load demand and real power injection at bus i, respectively [3].

B. Power Flow Limit on Transmission Lines

The inequality constraint of power flow limit on transmission line for each path is

$$|P_{ij}| \le (n_{ij}^0+n_{ij})\, P_{ij}^{max} \qquad (4)$$

Where Pij, Pijmax, nij and nij0 gives total power flow through transmission line i-j, maximum power flow through transmission line i-j, number of lines added to transmission line i-j and number of transmission lines in original base system, respectively [3].

C. Power Generation Limit

In TEP, power generation limit should be incorporated as one of the constraints. Mathematically, it can be shown as follows:

$$P_{gi}^{min} \le P_{gi} \le P_{gi}^{max} \qquad (5)$$

Where Pgi, Pgimin and Pgimax is real power generation at bus i, the lower and upper real power generation bounds at bus i, respectively [3].

D. Right of Way

The planners should know the exact location and capacity of the newly required transmission lines for accurate TEP. Hence this constraint should be included into the deliberation of planning problem. The new transmission line location and the maximum number of lines that can be installed in a specified location shall be obtained from this constraint; it can be represented mathematically as follows [3]:

$$0 \le n_{ij} \le n_{ij}^{(max)} \qquad (6)$$

Where nij and nijmax is the total number of lines added to the transmission line i-j and the maximum number of added lines in the transmission line i-j, respectively [3].

E. Bus Voltage Phase Angle Limit

The bus voltage phase angle is included as a TEP constraint and the calculated voltage phase angle (θical) must be less than the specified maximum voltage phase angle (θimax), it can be defined mathematically as [3]:

$$|\theta_i^{cal}| \le |\theta_i^{max}|$$

To check the reliability of the transmission system, the TEP problem should not only consider the usual operation but also incorporate contingencies due to changes in the system, e.g., generator outage, line outage, load uncertainties, etc [3].

F. Transmission Line Outage

The main causes of transmission line outages are bad weather (i.e. due to lighting, wind and icing), faulty equipment, foreign intervention, bad environment, and human element, it leads to interruption of power supply, hence this constraint must be included in TEP problem [3].

G. Load Uncertainties

The reasons for uncertainty in load are, that the load is always variable, future load is a random variable, random results may be produced by load forecasting methods, errors in forecasted result and the majority of methods suffer from missing data and input data accuracy [3]. Hence, this constraint should be incorporated in TEP problem.

V. DC LOAD FLOW

Load flow analysis presents steady state information about bus voltages, current injections at all buses, real and reactive power flows through transmission lines for given power system [3]. The representation of DC load flow can be given by the following equations:

$$[P] = [B'][\delta] \qquad for\ PQ\ \&\ PV\ buses \qquad (8)$$

$$[Q] = [B''][V] \qquad for\ PQ\ buses \qquad (9)$$

Where

$$[\delta] = \begin{bmatrix} \delta_1 \\ \vdots \\ \delta_n \end{bmatrix}; \quad [V] = \begin{bmatrix} |V_1| \\ \vdots \\ |V_n| \end{bmatrix}; \quad [P] = \begin{bmatrix} P_2 \\ \vdots \\ P_n \end{bmatrix};$$

$$[Q] = \begin{bmatrix} Q_2 \\ \vdots \\ Q_m \end{bmatrix} \qquad (10)$$

$$[B'] = \begin{Bmatrix} B'_{ii} = \sum_{\substack{j=1 \\ j\neq i}}^{n} B_{ij} \\ B'_{ij} = -B_{ij} \end{Bmatrix} \quad where\ \ B_{ij} = \frac{1}{X_{ij}} \qquad (11)$$

Where[P],[Q],[V],[δ]and [B^'] is vector of real power, reactive power, voltage magnitude, voltage phase angle and susceptance matrix, respectively [3].

VI. OPTIMIZATION TECHNIQUES

The TEP problem can be solved by available optimization techniques like Backward Search (BS) technique, Forward Search (FS) technique, Hybrid Search (HS) technique and Genetic Algorithms (GA). If the system is small, the search space can be completely checked to find the best solution. Different types of topologies may be checked to find out the solutions which are feasible in addition to acceptable normal and N - 1 condition. The candidates are added one-by-one in Forward search technique, but backward search technique works vice versa in such a way that, all candidates are initially added to the network and the candidates are removed one-by-one [3].

HS Technique is Backward–Forward-Decrease Method. The search space is enormous for large scale systems, if backward approach is tried for both normal and contingency conditions. One of the possible methods to overcome the difficulties, initially BS technique is applied for the network for normal conditions (no contingency). The solution speed will be high and acceptable due to no contingency is considered at this stage. Thereafter, the forward approach is employed to find the solution in the presence of all foreseen contingencies (N - 1) and then decrease method is applied to find optimal solution [3].Obviously, for a large scale system, the number of candidates would be high and the solution normally ends up with limited number of choices. Moreover, although the optimality of the solution cannot be guaranteed, the solution speed and accuracy would be quite acceptable.The main idea of GA is to mimic the natural selection and the survival of the fittest [4]. In GA, the solutions are represented as chromosomes. The chromosomes are evaluated for fitness values and they are ranked from best to worst based on fitness value. The process to produce new solutions in GA is mimicking the natural selection of living organisms, and this process is accomplished through repeated applications of three genetic operators: selection, crossover, and mutation. First, the better chromosomes are selected to become parents to produce new offspring (new chromosomes) [4]. To simulate the survivor of the fittest, the chromosomes with better fitness are selected with higher. The selection probabilities are usually defined using the relative ranking of the fitness values. Once the parent chromosomes are selected, the crossover operator combines the chromosomes of the parents to produce new offspring (perturbation of old solutions). Mutation is a mechanism to inject diversity into the population to avoid stagnation. In addition to the population size and the maximum number of iterations, several decisions on parameters must be made for GA. Crossover method and crossover probability are the second set of decisions to be made. Finally, the mutation method and mutation probability must be selected as they may help to maintain the diversity of the population by injecting new elements into the chromosomes. In general, these three sets of decisions are set empirically using pilot runs. The flow chart of the Genetic Algorithm is given below.

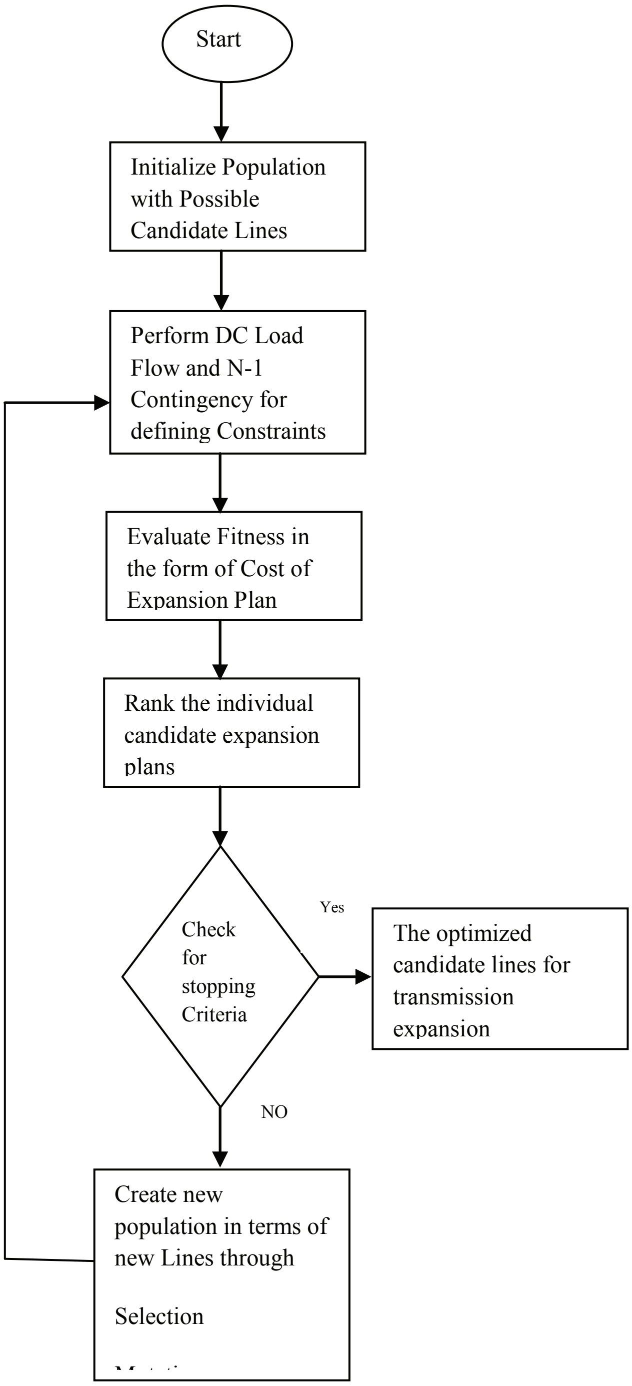

Figure 1: Flow chart for TEP using Genetic Algorithm

VII. RESULTS AND DISCUSSION

The proposed approach is coded using MATLAB Version 7.1 and MatPower version 5 [6] is used to run the optimal power flow solver using Newton-Raphson method. The simulations are carried out in a system having Core 2 Duo processor cloaking at a speed of 2 GHz with a RAM of 2GB.A Roy Billinton Test System (RBTS) is used for the proposed work. The details of the system can be accessed from [5] and the line diagram of the system is given in the figure below

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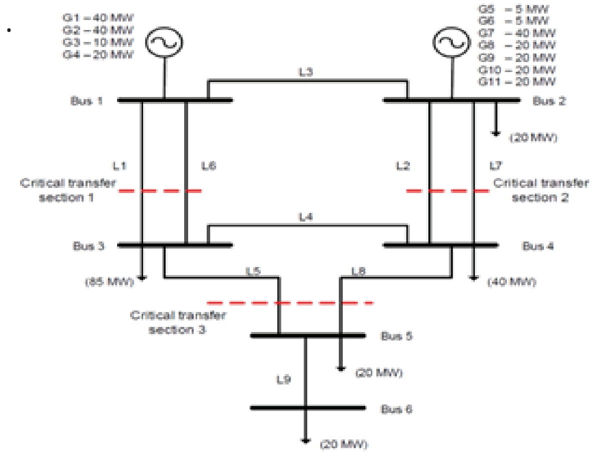

Figure 2: Single Line Diagram of 6-Bus RBTS

The single line diagram of the test system is shown in Figure 2. The system has 2 generator (PV) buses, 4 load (PQ) buses, 9 transmission lines and 11 generating units. The minimum and the maximum ratings of the generating units are 5 MW and 40 MW respectively. The voltage level of the transmission system is 230 kV and the voltage limits for the system buses are assumed to be 1.05 p.u. and 0.97 p.u. The system peak load is 185 MW and the total installed generating capacity is 240 MW. The transmission system contains single lines and double lines on a common right of way and/or on a common tower. The results of the Transmission Expansion Planning as optimized by different methods are given in Table I. In this paper, load growth of 25% was considered for Transmission Expansion Planning.

Table I: TEP using different methods

S.No	Item	BS	FS	HS	GA
1	Number of New Lines Added	7	7	7	7
2	Ckm of Lines Added	950	950	950	600
3	Total Cost of New Lines($)	228000	228000	228000	144000

It can observed that, 7 numbers of new lines are added for through optimization achieved using BS, FS and HS methods to a total length of 950 Ckm and at a cost of 228000$ for the newly added lines. Optimization using Genetic Algorithm resulted in the addition of 7 new lines for a distance of 600CKm at an additional cost of 144000$. Below Table II lists the news lines added through different optimization algorithms.

Table II: New lines added after TEP using different methods

GA	FS	BS	HS
1- 3	1-3	1-3	1-3
3-5	2-4	2-4	2-4
1-3	1-2	1-2	1-2
2-4	3-5	1-3	1-3
4-5	1-3	2-4	2-4
4-5	2-4	4-5	4-5
5-6	5-6	5-6	5-6

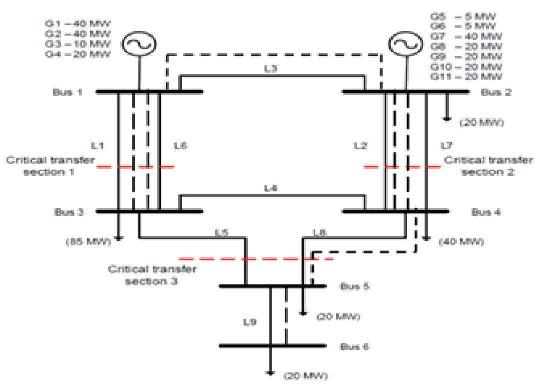

Figure 3: TEP obtained using BS Technique

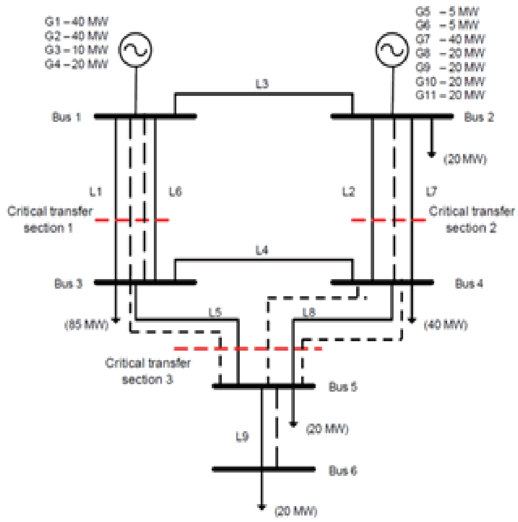

Figure4:TEP obtained using Genetic Algorithm.

The Figure 3 and Figure 4 illustrate the Transmission Expansion Plan as obtained using Backward Search Technique and Genetic Algorithm. The dotted lines indicate new transmission lines added as per the specific optimization algorithm.In this paper, N-1 contingency of single line outage is considered. DC Load Flow was done by removing lines and the total overload is observed. In the expansion suggested by Backward Search, outage of line 1-4 results in maximum overload of 3 lines totaling to 1.403 p.u. The average number of lines that are overloaded because of any given single line outage is 3 for the expansion plan suggested by Backward search. 4 lines are overloaded when there is outage of lines 1-2 and 2-4. Similar results are observed in the case of Hybrid Search also, as both Backward Search and Hybrid Search resulted in same expansion plan.In the network expansion suggested by Forward search outage of line 1-3 results in maximum overload of 3 lines totaling to1.565 p.u.

The average number of lines that are overloaded because of any given single line outage is 2 for the expansion plan suggested by Backward search. 3 lines are overloaded when there is outage of lines 1-3, 3-5 and 4-5. Transmission line expansion as suggested by Genetic Algorithm has provided the best results when compared to other methods used in this paper. The network expansion suggested by Forward search, outage of line 1-3 results in maximum overload of 1 line totaling to 0.709 p.u. Except for line 1-3 other line outages did not produce overload of the system.

The below table details about various factors for different network expansion as suggested by different algorithms .The Table III gives the details related to any single line outage.

Table III: Overload lines due to N-1 Contingency after TEP.

S.No	Item	BS	FS	HS	GA
1	Maximum number of lines overloaded	4	2	4	1
2	Line Outage which causes the Maximum Overload	1-4	1-3	1-4	1-3
3	Maximum over Load (p.u.)	1.403	1.565	1.403	0.709
4	Average total overload for any given line outage (p.u)	0.7812	0.7572	0.7812	0.0484

VIII. CONCLUSIONS

Transmission Expansion Planning (TEP) is made for load growth of 25% hike to normal load using Backward Search (BS), Forward Search (FS), Hybrid Search (HS) and Genetic Algorithm (GA) for 6-bus RBTS. It can be observed that the network expansion as suggested by the Genetic Algorithm optimization performs much better in term of N-1 contingency analysis and also in terms of cost of the expansion. The time taken for optimization for all the four methods is comparable

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DESIGN AND EVALUATION OF M50 GRADE CONCRETE (H.P.C & S.C.C) USING FERRO ALLOY SILICON SLAG AS FINE AGGREGATE

Md Ibrahim Khan[1]

1. ABSTRACT

Natural river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. In such a case non availability of natural fine aggregate and population growth rate in geometric progression has urged the present day engineering society to search an alternative for aggregates to fulfill the basic human need for a shelter. On the other hand Ferro Alloy Silicon Slag, the waste product during the manufacturing process of Ferro-alloys silicon requiring a vast land to be dumped and polluting the environment can be a better substitute for natural fine aggregate i:e natural river sand. Here the objective of the project is the application of slag as a replacement for natural fine aggregate and its effect on mechanical properties of high strength concrete and also self compacting concrete. The paper aims to design concrete with certain target mean strength and to compare the strength of concrete by replacing the natural fine aggregate.

Keywords : High Performance Concrete, Self Compacting Concrete, river sand, ferro alloy silicon slag.

1.1 INTRODUCTION

Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures concrete plays the rightful role and a large quantum of concrete is being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. In the backdrop of such a bleak situation, there is large demand for alternative materials from industrial waste.

This paper presents the feasibility of the usage of Ferro Alloy Silicon slag as a substitute for conventional concretes. Tests were conducted on cubes to study the compressive strength.

1.2 METERIALS AND METHODS

1.2.1 Cement

Ordinary Portland cement (53 grade) with 30% standard consistency confirming to IS : 12269- 1987 was used. The physical properties of cement obtained by testing the samples as per Indian standards are listed in table 1.

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Sl No.	Property	Value
1	Fineness of cement	4.52 %
2	Specific gravity	3.15
3	Normal consistency	28.0 %
4	Setting time i. Initial setting time ii. Final setting time	 145 Mins 265 Mins
5	Compressive strength at i. 3 days ii. 7 days iii. 28 days	32.0 Mpa 39.5 Mpa 59.5 Mpa

1.2.2 Ferro alloy silicon slag

The slag obtained from local resource Shri Hari Ferro Alloys and was crushed at V.K.A stone crusher Hyderabad. The physical properties of Ferro Alloy Silicon Slag as per Indian standards are listed in table 2.

Table 2 - Properties of Ferro Alloy Silicon Slag

Sl No.	Property	Value
1	Specific Gravity	2.77
2	Fineness Modulus	3.77
3	Bulk Density i. Loose ii. Compacted	1475.9 Kg/m^3 1566.6 Kg/m^3
4	Grading	Zone II
5	Water absorption	1.66

1.2.3 Fine aggregate (natural river sand)

Natural river sand properties has been shown in the table 3.

Sl No.	Property	Value
1	Specific Gravity	2.5
2	Fineness Modulus	3.77
3	Bulk Density i. Loose	1361.1 Kg/m^3 1438.8 Kg/m^3
4	Grading	Zone II

1.2.4 Coarse aggregate :

Natural granite aggregate of 12.5mm and 20mm has been used having density of 1521.6 Kg/m^3 and 1581.6 Kg/m respectively. Water Absorption was found to be 0.2% and specific gravity 2.64.

1.2.5 Admixture

Commercially available super-plasticizer has been used to enhance the workability of fresh concrete for selected proportion of ingredients.

2. Mix design for high performance concrete using Ferro Alloy Silicon slag and Natural River Sand separately.

Indian standards has been used for natural river sand as fine aggregate and as there is no standard method of designing concrete mixes incorporating Ferro Alloy Silicon slag and hence the method is proposed by IS.

3. Test specimens and test procedures:

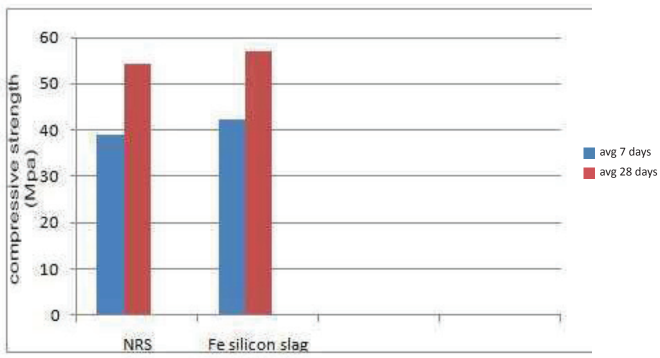
The 150mm size concrete cubes were used as test specimens to determine the compressive strength. The specimens were cast for M50 grade and for coarse aggregates of 12.5mm and 20mm was used.

The workability of fresh concrete was measured in the terms of slump values and equivalent compacting factor super plasticizer (0.7% to 2.4% weight of the cement) were added. The properties of fresh concrete were measured according to IS: 1199-1959. The ingredients of concrete were thoroughly mixed in mixer machine till uniform consistency was achieved. The cubes were compacted on a vibrating table.

Materials used As fine aggregate	Mix proportions C:FA:CA	W/C Ratio	A/C Ratio	Slump (mm)		Compressive strength (Mpa)	
				Initial	After 30 minutes	7 Days	28 Days
Natural river sand	1:1.74:2.5	0.49	6.02	130	90	35	56.2
	1:1.76:2.4	0.33	4.2	140	100	40	54.7
	1:1.75:2.5	0.30	2.87	120	60	42	52.2
Ferro alloy silicon slag	1:1.64:2.5	0.46	3.28	130	90	40.2	58.6
	1:1.7:2.54	0.31	5.04	140	100	45	56.3
	1:1.60:2.52	0.37	6.02	150	80	42	55.7

4. Water absorption :

Six cubes of size 150mm were cast for two different mixes. All specimens were removed 24 hours after casting and subsequently water cured for 28 days. Samples were removed from water and wiped out any traces of water with damp cloth and difference in weight was measured.



To deliver the safe water the distribution pipelines will need to be cleaned off its deposits regularly. This will be mostly a manual work. Can one imagine of the huge potential it will generate for the unemployed unskilled and semi-skilled work force in the organized sector? The encrusted, age-old arteries and machinery will get 'angioplasted' revamped.

The water treatment facilities will become temples of paramount importance. To run the plant efficiently the utilities will require educated technical man power in terms of operators, supervisors, chemists and mechanics. The regulators will then need to design certification courses for various trades. To support the logistics, automation and computerization of water supply control will come in. The strength of modern India, a vast English speaking, computer savvy professionals and students will have a new opportunity at their hand.

The contractors, manufacturers and the suppliers (service sector) of the components who will be a part of the beneficiaries will need to update themselves with appropriate technologies. Sustainability and simplicity will find a new meaning. Manufactures then can base their products on recognized Best Available Technologies (BAT). Funds will flow to the Indian research institutions and universities to do the research work which will be practical and relevant to our unique conditions. Cost benefit life cycle analysis will become practical. Utilities will need to up-grade their facilities. It has inherent meaning of reusing the existing facilities by revamping and retrofitting with appropriate and advanced technologies.

Innovations will be a key to improve the revenue. In the United States some utilities offer the space on roof of elevated tanks and towers to install wireless transmission systems. In India most of our utilities have elevated tanks for distribution systems, placed at a strategic elevation on zonal pattern. It will be a reliable source of revenue for the municipalities. The city of New York has its sewage treatment plant constructed underground (due to lack of space). They have created recreational park above it. Singapore govt. encourages the citizen and tourists to visit their sewage recycle plant and even encourage drinking the water (treated from sewage). The source water lakes have potential to become recreation centers (albeight with stringent hygienic controls). The flattening world will have great many towering ideas. We only need to ensure that these water towers and waters in it are sacrosanct, their safety and sanctity is of paramount public health importance. NGOs can then play a meaningful part by working as watch-dogs of the drinking water quality.

The first opportunity (Is it at our door step?)

And here is a first opportunity to make all concerned of our drinking water responsible. Jawaharlal Nehru Urban Renewal Mission (Ministry of Urban Development) has granted a huge amount (USD 20 billion) of infrastructure development funds to the selected 63 municipal utilities to plan their development up to 2020 (Ref.10). A certain part of the funds needs to be spent on the water supply and sanitation sector.

The capital including interest needs to be paid back to the lenders in a specific time frame. Utility needs to recover the money by levying direct or indirect taxes on the citizens. If looked upon rationally, a great opportunity in history (of water supply) to correct the fundamental deficiency in the system. Can we make these utilities at least to accept voluntary compliance to the drinking quality "recommendations" published by Govt of India? At the least, the water samples will be checked and monitored routinely and we will develop a much needed data base of drinking water quality. The Govt. can even think of giving some incentives to even attend the partial compliance. Immediate aim will be to encourage their autonomy but with a clear cut hint that big brother is watching.

A more permanent and systematic approach will be to approach various state governments and make them aware about the regulations and benefits.

Concept note by Government of Indi on regulations: (Ref. 12)

In India the drinking water supply policies are governed by Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development and Department of drinking water supply and sanitation by Ministry of Rural Development.

It was felt that the issue of drinking water is required to be considered as a separate self contained proposal, considering its desirability, feasibility and all other aspects such as standard setting mechanism, regulation of potable water, phasing of implementation and implications in Center State relations. Since water falls in the entry 17 of the State list in the Seventh Schedule to the constitution, potable water as such is regulated by various local bodies/authorities and the State Governments are responsible for proper implementation of laws made by them. It is felt that the proposals related to potable water should address all relevant aspects with a view to making it a self contained legislative proposal, in consultation with all Ministries/ Departments, as well as the states.

The alternative formulation as such would require making legislative proposals for enacting a central legislation to provide for water and its regulation through the States and its agencies.

A Cautious optimism :

Jamshedpur Utilities and Services Company Limited of Tata Steel (JUSCO), which manages the water supply of Jamshedpur town in Zharkhand, voluntarily observe W.H.O. guidelines through Private Sector Partnership. (Ref. 13).

Rapid mix weir without electrical energy

Clarifier retrofitted by tube settlers

Maharashtra Jeevan Pradhikaran (A statutory body of Govt. of Maharashtra) has standardized "Simplified water treatment plants" (Ref: 14) over last two decades. More than 500 plants stand constructed. These small capacity plants employ minimum mechanical equipment, are cheap to construct and found to be sustainable over a long period of time even in poor operation and maintenance infrastructure

(Pictorial view of small capacity " Simplified " plants

These are the just two examples, there are many more. It is worth recognizing the fact that many developments have taken place in India in drinking water sector too. However they remain piece-meal and isolated efforts. Dissemination of information will be crucial. And for the first time we have even an advantage. In the flattening world, our advances in information technology can actually shrink our real times. Thanks to Thomas Friedman for en-lighting us on our strengths (Ref.15). Can one of modern India's miracle lead to the happening of another? In India we have many individual Banyan trees of knowledge in the water sector. Only they need to come together to set the Juggernaut in motion.

One more hope! Population of 1.25 billion has successfully eradicated polio from India, a no mean achievement

India is in a unique position today to understand that we do need our colas but also appreciate the fact that "aqua pura" remains topmost priority on Indian terra firma.

The transformation in happening or waiting????

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6. American Water Works Association : All the authors of relevant literature published by AWWA

7. Indian Water Works Association: Various quarterly journals of IWWA.

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29th Indian Engineering Congress

Technical Session II

ENVIRONMENT & ECOLOGY FOR SUSTAINABLE DEVELOPMENT

The Institution of Engineers (India)
Andhra Pradesh State Centre

INVITED TALK

Tsunamis and their Impact on Coastal Structures-Need of Tsunami Warning System

Dr. S.R.K.Reddy[1]

Abstract:

Nearly 75% of world population lives on coastal belts and is found to be true in India also. Past history and geological findings show that frequency of occurrence of earthquake induced tsunamis increase in future posing a significant threat to coastal community. Tsunamis are long period sea waves mostly generated by submarine earthquakes when the sea floor abruptly deforms and vertically displaces the over lying water. Tsunamis generated during 2011 Japan, 2004 Indonesia and 1964 Alaskan earthquakes are the most significant events witnessing severe damage to coastal structures and settlements.Even though tsunamis cannot be averted, their after effects could be mitigated with early warning systems. USA and Japan are successful in establishing Pacific Tsunami Warning Centres (PTWC). Apart from having a unified tsunami warning system, it is necessary to train the people to understand the hazard of tsunami and the methods to minimize the disasters.

This paper explains the characteristic features of tsunami, tsunami forces, damage effects, design philosophy and mitigation measures in order to bring awareness among the coastal community and technical experts to minimize the devastating effects.

1.INTRODUCTION

In the next half century the urban population in the world is likely to be doubled and statistics reveal that majority of cities are developed along the coastal belts. Although landslides, volcanoes and asteroid impacts can trigger tsunamis, but the most common cause is due to submarine earthquake. When a powerful earthquake strikes on the bed of the ocean, millions of tons of water may suddenly be moved up generating tsunami waves. M 9.3 Indonesian earthquake of December 26, 2004, that took place at the inter face between Indian plate and Barma micro plate near Northwest coast of Sumatra Islands, caused serious tsunami disasters killing more than 1.5 lakh people. 2011 Japan, 1999 Izmit, 1995 Kobe and 1964 Alaskan are other few examples which triggered tsunamis causing sediment erosions and damage to coastal settlements. Such mega events reminded the coastal community alert on the preparedness against initial ground shaking and subsequent effects followed by tsunamis and hence coastal structures should be designed both against earthquake and tsunami forces. Tsunami resilient analyses are complicated as the motion is transient and time dependent. Though there are no well established design procedures, Coastal Construction Manual (CCM) of Federal Emergency Management Agency (FEMA) 2000 and the draft code of Bureau of Indian Standards(BIS) on "Tsunami Resistant Design of Buildings & Structures – Recommendations" provide some

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guide lines based on the considerations of tsunami forces.

A review by Harry Yeh et al (2005) suggested that tsunami loads exerted on a structure can be evaluated in terms of hydrodynamic, surge and impact forces for a given depth of inundation and the velocity of approaching tsunami. The waves can be sensed by ocean instruments and transmitted via a satellite to the scientists on shore. With a probable technology in place, it is possible, even 15 minutes after occurrence of an undersea earthquake, to determine the path and strength of approaching tsunami waves so that warnings could be sent to vulnerable regions immediately to take evacuation measures. An early warning system with network of sensors is already in operation in pacific ocean and monitoring centers established in Alaska, US, Japan and Hawaii. Cities located in tsunami-prone regions are vulnerable because of concentration of people, buildings, infrastructure and socio-economic activities in the area. Hence, it is important to prepare the region and its community with a disaster mitigation map in order to reduce or minimize potential loss or damage. If the public can be made aware of the risk of a tsunami and trained to know how to act during and after a gigantic tsunami strikes the coast, the casualties and damage to structures could be reduced considerably.

2.TSUNAMI EFFECTS

A tsunami can generate large on-shore currents and move the objects far inland. Tsunami impact forces sometimes can cause collapse of structures. The most interesting tsunami event is that, the ship moved 3 km inland during 1868 Chile tsunami was moved back to the shore during 1877 tsunami. Tsunamis have great erosional ability and they can strip beaches of sand and coastal vegetation. Likewise, tsunamis are capable of inundating the coastal lands. The fast-moving water associated with the inundating tsunami can destroy houses and other coastal structures. A tsunami generated by the Niigatta earthquake 1964 caused damage to port and harbor facilities because of ground failure and liquefaction as a result of ground subsidence. The erosion of soil underneath the foundation during the tsunami caused settlement of many structures during the 1964 Alaska earthquake. Series of tsunamis in Japan in 1986 killed 27000 people. 1992 Nicaraguan earthquake tsunami deposited a vast sediment blanket over many low lands along the affected area. 1998 Papua New Guinea tsunami that killed more than 2100 people, with wave heights up to 12 m, was triggered by a submarine slump. During 2004 Indonesian earthquake, due to subduction of Indian plate underneath the Burma plate, Andaman & Nicobar(A & N) Islands sustained for both uplift and subsidence. The southernmost tip of Great Nicobar Island, which was on elevated ground before earthquake is now under water, indicating a land subsidence of about 3m (Fig.1).On the other hand, the western coast of Middle Andaman Islands showed emergence of new shallow coral beaches suggesting an uplift up to 0.3m and Diglipur harbor at Northern region of Andaman indicated an uplift of 1.2 m (Fig.2). Immediately after the occurrence of 2004 earthquake followed by tsunamis, a group of US geological survey experts, Jain et al. (2005) made aerial and field surveys along east and west coastlines of India and A & N Islands. Some interesting observations on damage both due to earthquake ground shaking and tsunami impact were analyzed. The 11 March 2011 M 9.0 Honshu, Japan earthquake caused tremendous devastation locally. The event caused $200 billion damage and resulted in a nuclear accident with explosions in three reactors at Fukushima nuclear power station. In spite of the well preparedness by the people of Japan, only 15,854 deaths were reported.

Fig. 1 A building in sea water at Port Blair due to subsidence,Fig. 2 Uplift on the western coast of middle Andaman Island

Coastal structures near water were subjected to an active water pressure when the waves arrived and also a suction pressure when waves receded. Due to such reversal action of pressures large number of buildings in A & N Islands were washed away regardless of how they were constructed. Columns have failed mainly due to insufficient lateral reinforcing ties. The seaport control towers at many places collapsed due to both tsunami impacts and ground shaking. A newly constructed 268m long R.C. bridge over Austen Strait suffered with lateral displacement of three middle spans of superstructure. An apartment building in Nicobar Islands on stilt columns, not complying with codal requirements, collapsed. The sea walls constructed along Kerala and Tamilnadu coasts of India helped to reduce the impact of tsunami waves.Experimental studies were conducted to estimate the tsunami force exerted on damaged coastal structures through in situ strength tests. Strong and flexible objects like handrails of balcony or staircase remained slightly deformed or bent even after being hit by gigantic tsunami. Series of in situ strength tests were conducted by Tsutsumi et al. (2000) on similar handrail samples to determine the forces needed to deform them in a same manner as those of handrails bent during the Southwest Hokkaido earthquake tsunami of 1993. Tests were also performed to estimate the advancing direction, true height and flow velocity of the tsunami on land for future assessment of tsunami disasters.

3.CHARACTERISTIC FEATURES OF TSUNAMI

Tsunami events trigger a series of fast moving long waves, initially with low amplitude that radiate outwards in a manner resembling the waves radiating when a stone is dropped in a pond. In general, waves are considered as deep water waves if their wavelength is relatively small compared to the water depth through which they travel.

Most of the wind waves are deep water waves. Shallow Water (SW) waves are those with long wave length relative to depth. The depth and nature of the sea floor strongly influence how SW waves propagate. Because tsunamis have such long wave lengths, even when they travel in deep water, they are considered as SW waves.

Tectonic tsunamis tend to have longer wave lengths, longer periods and a larger source area than those generated by mass movement of the earth. The geometry of earthquake fault constitutes a ternary family featuring three fundamental parameters; strike-slip, thrust and normal fault. Strike-slip is a transform fault, which produces horizontal motion of earth's crust; whereas thrust and normal faults entail vertical motion. Hence, submarine thrust or normal faults produce tsunamis as the sea floor lifts up pushing the water up on one side or drops down pulling it down on the other side and causes triggering wave motion on the ocean surface. Strong earthquakes not only deform larger areas, but they do so by a greater amount of slip, thus producing larger tsunamis than smaller events. Earthquakes deeper than about 30 km, rarely cause sufficient deformation to generate tsunamis. However, truly mega thrust earthquakes, which occur deeper than 30 km, such as 1960 Chile event and 2004 Sumatra earthquake can also occasionally trigger tsunamis.

Tsunamis are characterized with the following parameters:

Wave length (L) –Horizontal distance between crests or peaks.

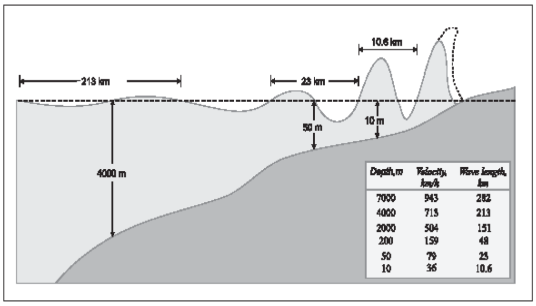
Period (T)– Time it takes successive peaks to pass a fixed point

Depth (d) –Depth of constant depth region below sea water level.

Height (h)– Vertical distance from the wave trough to its crest.

Tsunami speed, v where g – Acceleration due to gravity

The energy imparted to the water during tsunami formation sets the entire water column in motion. Hence, tsunamis not only possess a lot of energy and move at high speeds, but they can also travel greater distances with little energy loss. In typical ocean depth of 4 km, a tsunami travels at a speed of nearly 700 kmph. When tsunamis enter shallow waters, they slow down; at a depth 30 m, SW waves travel at only 60 kmph. Likewise, tsunami transforms as it leaves the deep water of the ocean and travels into shallow water near the coast. The first piece of information required for modeling tsunamis is the size and distribution of seafloor deformation following an earthquake and the amount of energy released. The tsunami speed further diminishes as it travels into the shallower coastal water and its height grows. While tsunami may be imperceptible at sea, the shoaling effect (Fig. 3) near the coast causes the tsunami to grow to be several meters of height (Fig.4). When it finally reaches the coast, the tsunami may develop into a rapidly rising or falling tide, a series of breaking waves.



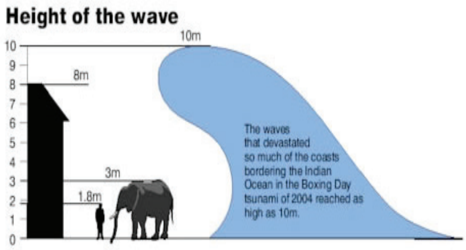


Fig.3 Shoaling effect of Tsunami
Fig.4 Impact of 10m Tsunami approaching the coast

4. TSUNAMI FORCES

Although there is no well established design criterion for tsunami resilient buildings, CCM of FEMA has mentioned the following types of forces when tsunami run-up strikes the buildings.

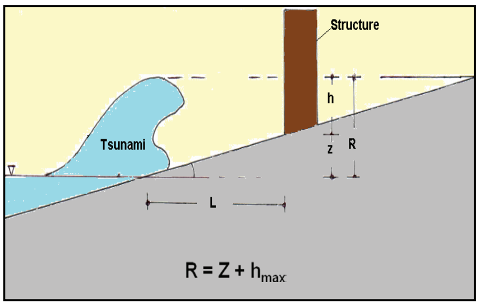
- •Hydrostatic forces
- •Hydrodynamic forces from drag forces in a steady flow
- •Buoyant or vertical hydrostatic forces
- •Impact forces resulting from debris
- •Surge forces from impingement of the leading edge of a surge
- •Breaking wave forces

Hydrodynamic, impact and surge forces are normally more predominant in nature.

4.1 Design Philosophy

Though there are well established procedures for earthquake analyses, till recent years, no significant research has been undertaken on design of structures to resist tsunamis. Bureau of Indian Standard has released the draft code on “Tsunami Resistant Design of Buildings & Structures – Recommendations” and the final code is expected to come into force shortly. The design requirements for seismic response generally depend upon the weight, structural flexibility, ductility and redundancy; while the design parameters for tsunami forces require considerable strength and rigidity particularly at lower levels of the structure. The wave height of tsunami approaching the shore results from the influence of three dimensional bathymetry and coastal topography. Even though good engineering techniques and materials will help a structure to resist tsunami forces and inundation, in case of large tsunami events such as December 26, 2004 tsunami, they will only reduce losses but cannot prevent damage. The best way to minimize the tsunami losses is to construct tsunami shelters for vertical evacuation or locate buildings beyond the reach of tsunami run-up for horizontal evacuation.

4.2 Analysis against Tsunami Forces



In the event of a large tsunami, design codes provide expressions for different forces that may be produced due to tsunami wave impact on coastal structures.When turbulent water flows around the building hydrodynamic loads are exerted on to the structure in the direction of approaching tsunami wave. These loads are caused by the impact of moving mass of the water and friction forces as the water flows around the obstructions. In this paper, the analysis against hydrodynamic forces is presented and the equations suggested by Harry Yeh et al. (2005) are used.

Assuming the beach slope 1 in 50 as in Fig.5, inundation depths are calculated for different run up heights. Inundation depth and flow velocity of a tsunami wave are the important parameters for evaluation of external forces imparted to the structures.

It may be noted that, if a structure is situated at an elevation of 2m above sea level (z), the 3m flow (inundation) depth (h) at the building site would be equal to 5m tsunami (R).

Hydrodynamic (drag) force is expressed as proportional to the product of the square of flow velocity and the projected area of the structure. The drag coefficient value, CD, is taken as 2.0 for rectangular column members and 3.0 for wall members. For a given location, the design value of (hmax u2) is computed from Eq.1 and the corresponding drag force, FD, is obtained from Eq.2 given below.

$$\frac{h_{max}u^2}{gR^2} = 0.125 - 0.235\,\frac{Z}{R} + 0.11\left[\frac{Z}{R}\right]^2 \qquad (1)$$

$$F_D = \frac{1}{2}\,\rho C_D\, b h_{max}\, u^2 \qquad (2)$$

where

L - Distance of location of the structure from shore line

R - Maximum run up height of tsunami above shore line

Z - Height of location point of the structure above shore line

hmax - Maximum Inundation Depth above base of the structure

u - Tsunami wave velocity approaching the structure

ρ - Mass density of sea water

b-Breadth of exposed column / wall member

Using Eq.2, the values of hydrodynamic forces are calculated for different inundation depths.

5.VULNERABILITY ASSESSMENT

Historical and geological evidence suggest that the coastal lands of Pacific Northwest and Northeast of Indian Ocean have experienced numerous earthquake tsunamis in the past and are likely to experience more in future. Ports, harbors and buildings situated at elevations close to sea level and typically built on unconsolidated soils, are vulnerable to tsunami hazards associated with failures like collapse of buildings, liquefaction and tsunami inundation.The goal of vulnerability assessment is to identify the key vulnerability issues at local level, which then serve as a basis for developing appropriate mitigation and preparedness strategies. Because of high uncertainties on the time, place and recurrence intervals of tsunami events, efforts to reduce the vulnerability need balance of anticipation and resiliency. One important approach of incorporating community context into the natural hazard process is to involve stake holders, who are defined as all local individuals, business, builders, governmental and non-governmental organizations with a stake in the outcome of mitigation and preparedness planning efforts. A key concern of vulnerability to earthquake and tsunami hazards was how to maximize productive interaction between stakeholders and technical experts to identify the vulnerability issues that were both technically credible and founded on community values and opinions.

6. MITIGATION MEASURES

In the task of tsunami-disaster mitigation, imparting the state-of-art of the knowledge is the first step to be introduced and more so to translate the knowledge into state-of-art of the practice. The potential for life loss is the major concern reflected by the high interest in raising the community awareness, developing a tele-tsunami warning system, providing evacuation signage and improving evacuation logistics. Some advanced countries like USA and Japan are effectively implementing the tsunami warning systems as mitigation measures and are successful in minimizing the death toll and structure damage during major earthquake and tsunami events.

In recent 2004 Sumatra earthquake and subsequent tsunami, there was a lag of about 150 minutes between the occurrence of earthquake and tsunami reaching the Indian coast. This time lag can be utilized for issuing a warning to the coastal community so that people can be evacuated to safer locations. In 1965, the Intergovernmental Oceanographic Commission (IOC) of UNESCO, established International Tsunami Information Centre in Hawaii. In 1968, the IOC formed an International Coordination Group for Tsunami Warning System in the Pacific with 26 countries in and around the Pacific belt as its members. The system issues tsunami information and warnings to over 100 places scattered across the Pacific. At PTWC Hawaii, the computer systems continually monitor the data from seismic stations and alert people when a significant earthquake has been detected. Consequently National Oceanic and Atmospheric Administration (NOAA) developed the 'Deep Ocean Assessment and Reporting of Tsunamis' (DART) gauge.

6.1 Tsunami Warning System

Warning of an oncoming tsunami is more than a matter of detecting that an earthquake has occurred under or near an ocean. A tsunami cannot be prevented or precisely predicted, but there are some warning signs of an impending tsunami. A tsunami warning system is a system to detect tsunamis and issue warnings to prevent loss of life and property.

A network of sensors to detect tsunamis and the communication infrastructure to issue timely alarms to permit evacuation of coastal areas are the two important components of Tsunami Warning System.

Types of Tsunami Warning Systems (TWS):

1.International: Tsunami warnings for most of the Pacific Ocean are issued by Pacific Tsunami Warning System (PTWS) operated by National Oceaninc and Atmospheric Administration (NOAA).

2.Regional: Regional warning systems use sesmic data about nearby earthquakes to determine if there is a possibility of local threat of a tsunami. Such systems are capable of issuing warnings to the general public in less than 15 minutes.

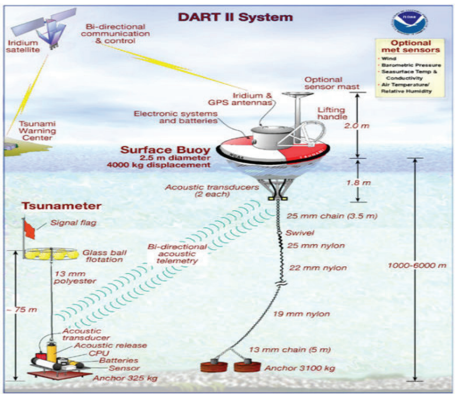


Fig. 6 NOAA's DART Tsunami Warning Buoy System

Each DART gauge has a highly sensitive pressure recorders installed on the ocean floor. From a depth of about 6 km, the recorder is capable of detecting even 1cm increase in height of ocean levels. This data is transmitted acoustically to a surface buoy that then relays it over satellite to the warning centre on the shore. Issuing a reliable warning is just the first step of tsunami warning system as shown in Fig.6. It is then up to the civilian authorities to use the warning for evacuations. TWS is based on the concept that tsunamis travel at much lower velocity (0.2km/sec) as compared to seismic waves (6 to 8 km/sec). Seismic waves travel 30 to 40 times faster than tsunami waves. Hence, warning time of few minutes to few hours is available for tsunamis to reach the coast depending upon the distance of epicenter from the coast. This lag time can be utilized for warning the coastal community on their evacuation procedures.Tsunami protection to some extent can be achieved through the construction of sea walls, beach defenses, shoreline tree plantation and other protection measures. Perhaps the major civil protection measure against a large tsunami is to evacuate the population living close to the coast further inland with high ground. However, Tsunami warning stations are now located at many points in Pacific Ocean and also in Indian Ocean which can detect the sea wave when it is first created. Following the great Indonesian earthquake on December, 26, 2004, India started its own interim Tsunami warning centre in 2007 at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, under the Earth System Sciences Organization (ESSO), Govt. of India.

7. SUMMARY AND CONCLUSIONS

7.1Summary

In-spite of many scientific and technological advancements during last century, the threat of natural disasters, particularly earthquakes and tsunamis, has remained untamed. History and geological evidences show that the rate of occurrence of earthquakes and tsunamis will increase in future. With rapid increase in rate of population and construction activity along coastal towns and cities, the potential for massive destruction increases against earthquakes and tsunamis and hence the risk also increases.

In the event of a major submarine earthquake, not only severe ground shaking but also high tsunami waves are expected posing a significant threat to coastal community and structures.

7.2Conclusions

•Weight of the structure plays vital role under seismic conditions, while the exposed area on seaward side of the structure in run up zone is a major factor to resist tsunami wave pressures.

•Earthquake response depends upon the weight, structural flexibility, ductility and redundancy; whereas tsunami response depends upon strength, rigidity particularly at lower levels, tsunami wave height and bathymetry.

•Soft stories tend to be more vulnerable to earthquakes; while they are considered as effective openings for tsunami flow reducing the impact on the structure.

•Awareness about tsunamis and their impact on coastal structures has to be created not only among the public but also among the officials, scientists and field engineers. Early warning systems are to be installed at various coastal regions

•Protection against tsunamis can be achieved through construction of sea walls, beach defenses, tree plantations and buffer zones like raised land masses and forests.

•Mooring methods should be developed for the fishing boats along the coasts of towns and villages where there is no harbor facility.

•Enforcement of bye-laws and Coastal Regulation Zone (CRZ) norms should be strictly implemented to minimize earthquake and tsunami damage.

•sunamis are secondary effects of earthquakes and hence, a clause on "Secondary effects of Earthquakes" shall be incorporated in relevant seismic codes.

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INVITED TALK

ELECTROMAGNETICS AND ELECTROMAGNETIC POLLUTION

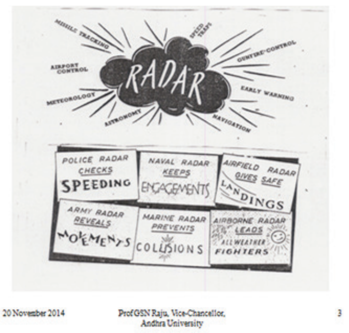
Dr.G.S.N.Raju[1]

Abstract:

The Electromagnetic Applications are mostly in use for RADARS, Communications, and Bio-Medical equipment.EMI is defined as the undesirable signal which causes unsatisfactory operation of a circuit or device. EMC is defined as the ability of electronic and communication equipment to be able to operate satisfactorily in the presence of interference and not be a source of interference to nearby equipment.

Electromagnetic susceptibility (EMS) is the capability of a device to respond to

EMI.



The basic types of EMI are Intra EMI and Inter EMI. Intra-EMI arises when functional characteristics of one module with in an electronic equipment or system are disturbed due to EMI from another module. Whereas Inter-EMI arises if the functional characteristics of one equipment is disturbed due to EMI generated by equipment. The EMI sources are natural and manmade. The natural EMI sources are of two types viz. terrestrial and extra-terrestrial. Terrestrial sources our due to thunder storms, lightening discharges and precipitation static. The sun disturbed, cosmic noise and radio stars arise under Extra-Terrestrial sources. The man made EMI sources arise in Electric power sources and Electronic communication devices.The EMI is coupled by Conduction and Radiation. EMI is considered to be a silent and unknown threat leading to hazardous. In many occasions, intermittent malfunctions or random failures of equipment are experienced by many users due to presence of EMI. The Radiation upto 0-80(R) effects minor changes in blood,80-330 cause vomiting and sickness Beyond this range upto 500 cause vomiting couples with leading symptoms to death due to passage of time in range of one month to six months. No survival when intensity of radiation is 500 and beyond and extremely dangerous.

Effect of Cell Phones: The cell phone is called Electromagnetic weapon and functions due to the electromagnetic waves generated by antenna fixed over cell towers normally erected on house tops, work places, schools and hospitals. The five senses of human beings are not useful to identify the presence of these electromagnetic waves which are harmful to human beings. The wireless network keeps emitting ever-increasing and dangerous levels of microwave radiations. The research and literature evidenced that radiation due to cell towers lead to 80 immune system disorders.

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Micro waves depolarize the body's red blood cells leading to diminished flow of oxygen to brain cells and body's other organs. The Israeli study on effects of cell phones reveal the increased risk of developing tumors.

Conclusion:

It is commonly unnoticed about effect of Electromagnetic pollution and also radiation effect of Cell towers which ultimately reflecting the cell users. The number of Cell users is increasing rampantly in the present generation. Hence awareness on ill effects of Electromagnetic pollution needs to be created among common public to take precautions and prevent health hazards of self and society at large.

Electromagnetic Applications

- All Types of RADARS
- All Types of Communications
- Bio-Medical

MAXWELL'S EQUATIONS FOR TIME-VARYING FIELDS

$$\nabla \times \mathbf{H} = \dot{\mathbf{D}} + \mathbf{J}$$

$$\nabla \times \mathbf{E} = -\dot{\mathbf{B}}$$

$$\nabla \cdot \mathbf{D} = \rho_v$$

$$\nabla \cdot \mathbf{B} = 0$$

MAXWELL'S EQUATIONS FOR TIME-VARYING FIELDS

Integral Form

$$\oint_L \mathbf{H} \cdot d\mathbf{L} = \int_S (\dot{\mathbf{D}} + \mathbf{J}) \cdot d\mathbf{S}$$

$$\oint_L \mathbf{E} \cdot d\mathbf{L} = -\int_S \dot{\mathbf{B}} \cdot d\mathbf{S}$$

$$\oint_S \mathbf{D} \cdot d\mathbf{S} = \int_v \rho_v \, dv$$

$$\oint_S \mathbf{B} \cdot d\mathbf{S} = 0$$

Wave Equation in Free

$$\nabla^2 \mathbf{E} = \mu_o \in_o \ddot{\mathbf{E}}$$

$$\nabla^2 \mathbf{H} = \mu_o \in_o \ddot{\mathbf{H}}$$

Here $\ddot{\mathbf{E}} = \dfrac{\partial^2 \mathbf{E}}{\partial t^2}$

$$\ddot{\mathbf{H}} = \frac{\partial^2 \mathbf{H}}{\partial t^2}$$

Wave Equations in General Medium

$$\nabla^2 \mathbf{E} = \mu \in \ddot{\mathbf{E}} + \mu\sigma \dot{\mathbf{E}}$$

$$\nabla^2 \mathbf{H} = \mu \in \ddot{\mathbf{H}} + \mu\sigma \dot{\mathbf{H}}$$

Boundary Conditions

The tangential component of E is continuous across any boundary i.e.

$E_{tan1} = E_{tan2}$

or

The tangential component of E in medium 1 is the same as that of E in medium 2 at any boundary.

2. The tangential component of magnetic field H is continuous across any boundary except at the surface of a perfect conductor, i.e.

$$\mathbf{H}_{\tan n1} - \mathbf{H}_{\tan n2} = \mathbf{J}_s$$

At non-conducting boundaries, $J_s = 0$

3. The normal component of D is continuous across any boundary except at the surface of the conductor. In general

$$D_{n1} - D_{n2} = \rho_s$$

ρ_s = surface charge density, (C/m2). For other than the conductor boundary,

$$D_{n1} = D_{n2}.$$

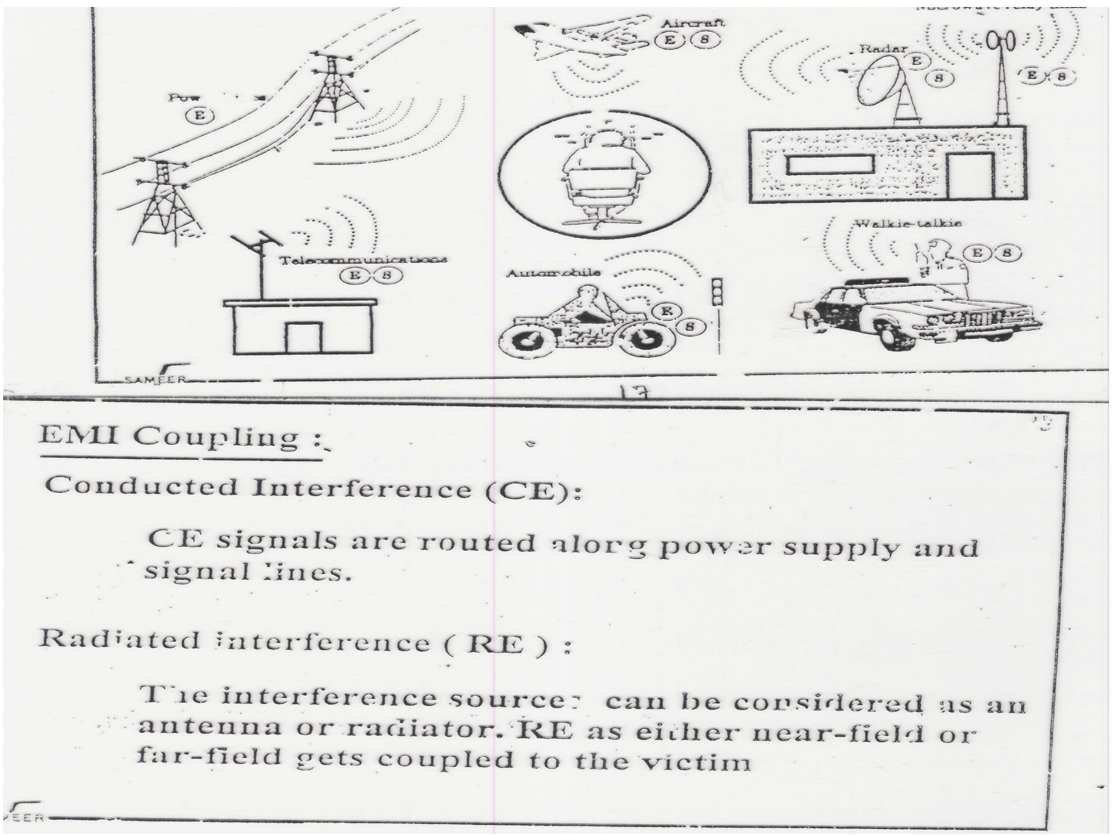
4. The normal component of Magnetic flux density, B is continuous across any discontinuity, i.e.,

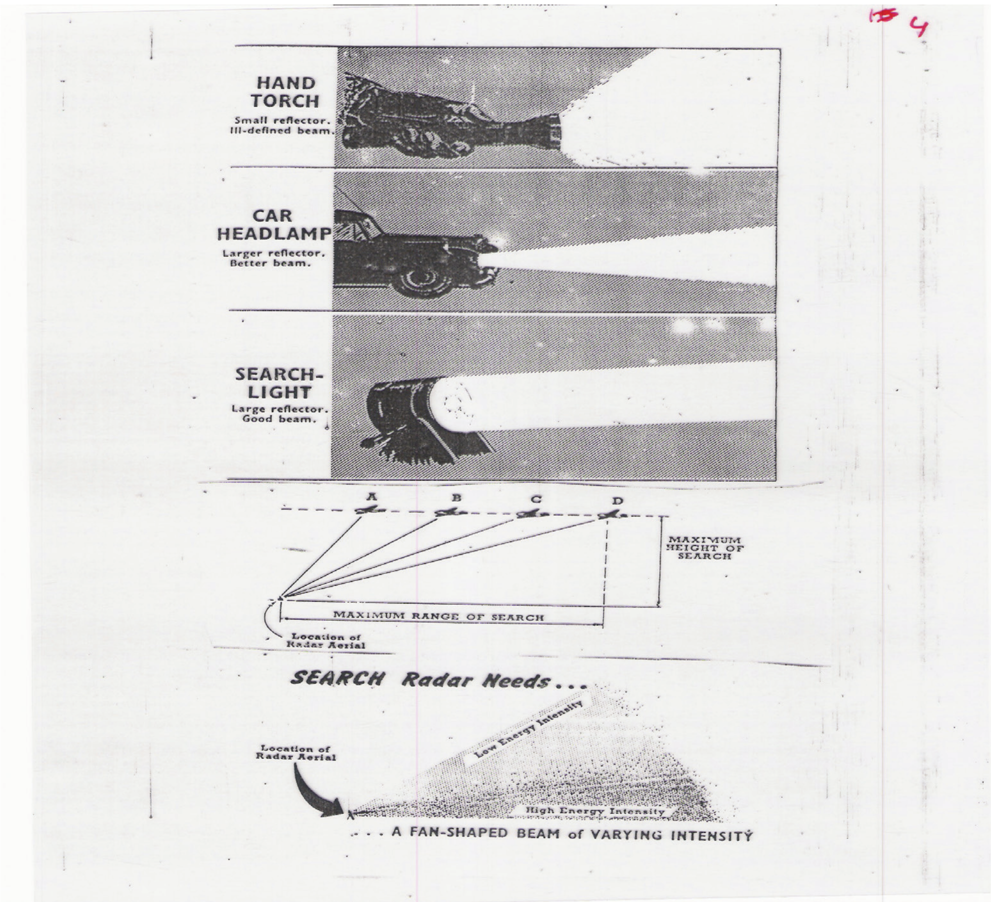
$$\mathbf{B}_{n1} = \mathbf{B}_{n2}$$

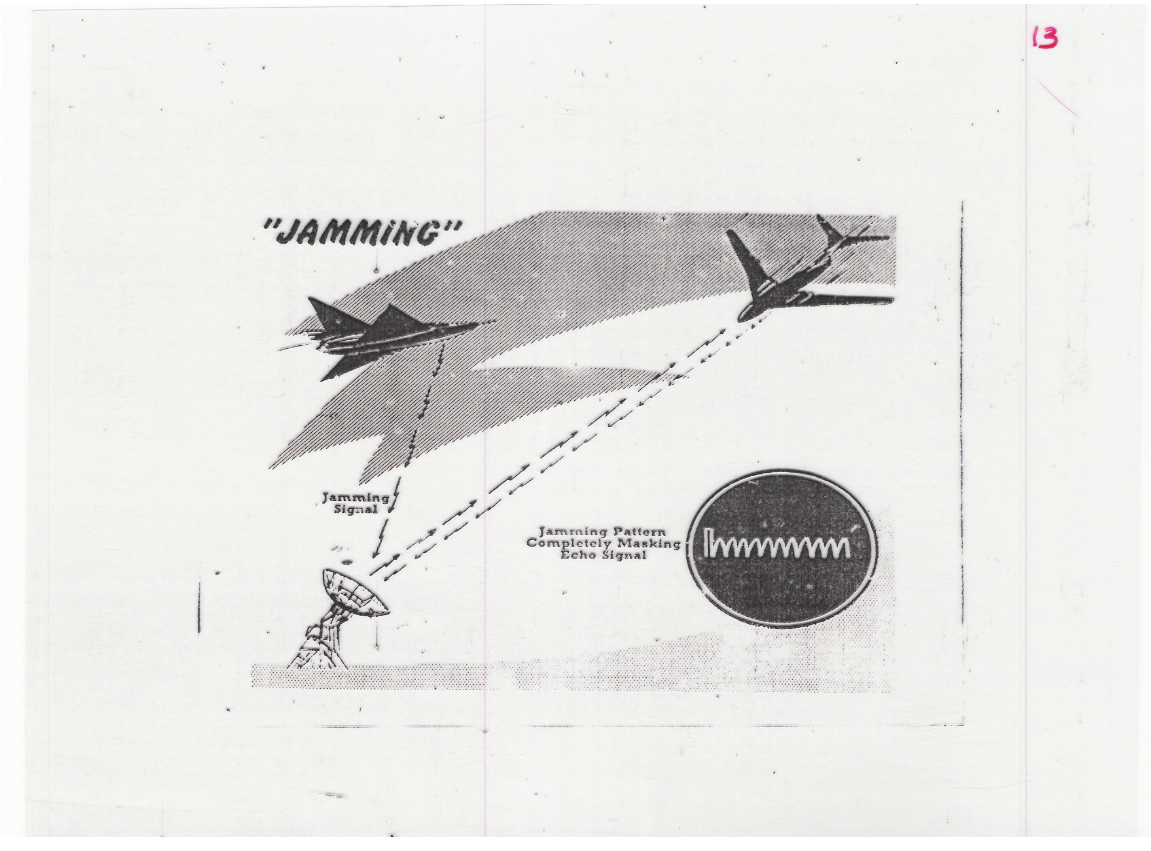
Electromagnetic Pollution

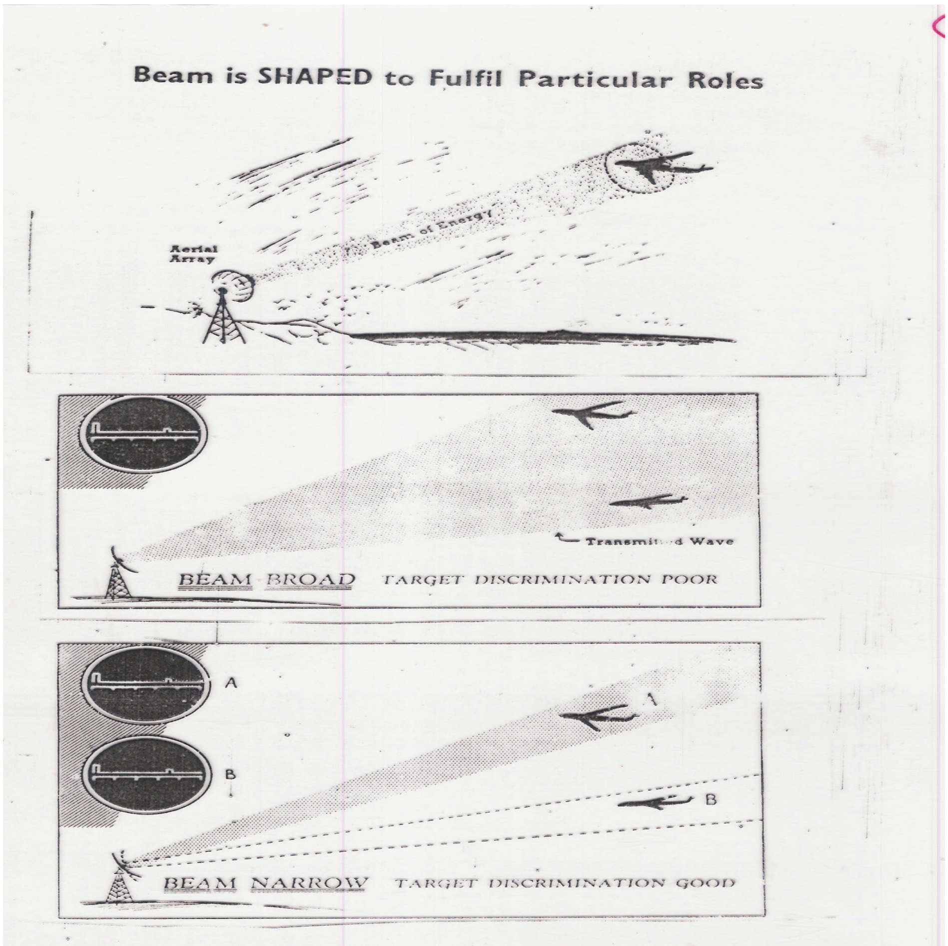
- EMI is defined as the undesirable signal which causes unsatisfactory operation of a circuit or device.
- EMC is defined as the ability of electronic and communication equipment to be able to operate satisfactorily in the presence of interference and not be a source of interference to nearby equipment.
- Electromagnetic susceptibility (EMS) is the capability of a device to respond to EMI.

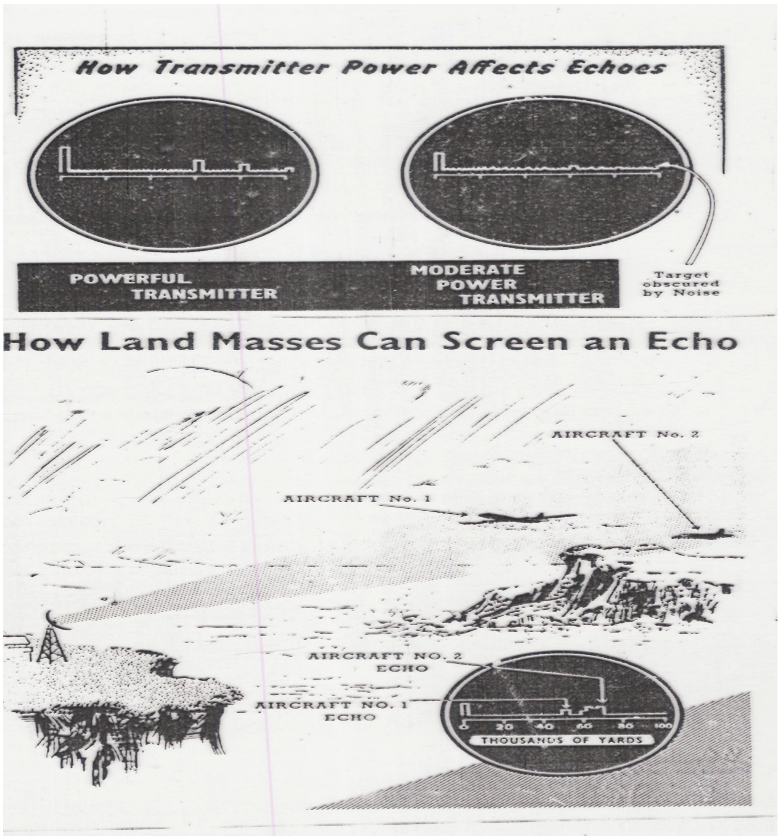
Typical EMI Environment

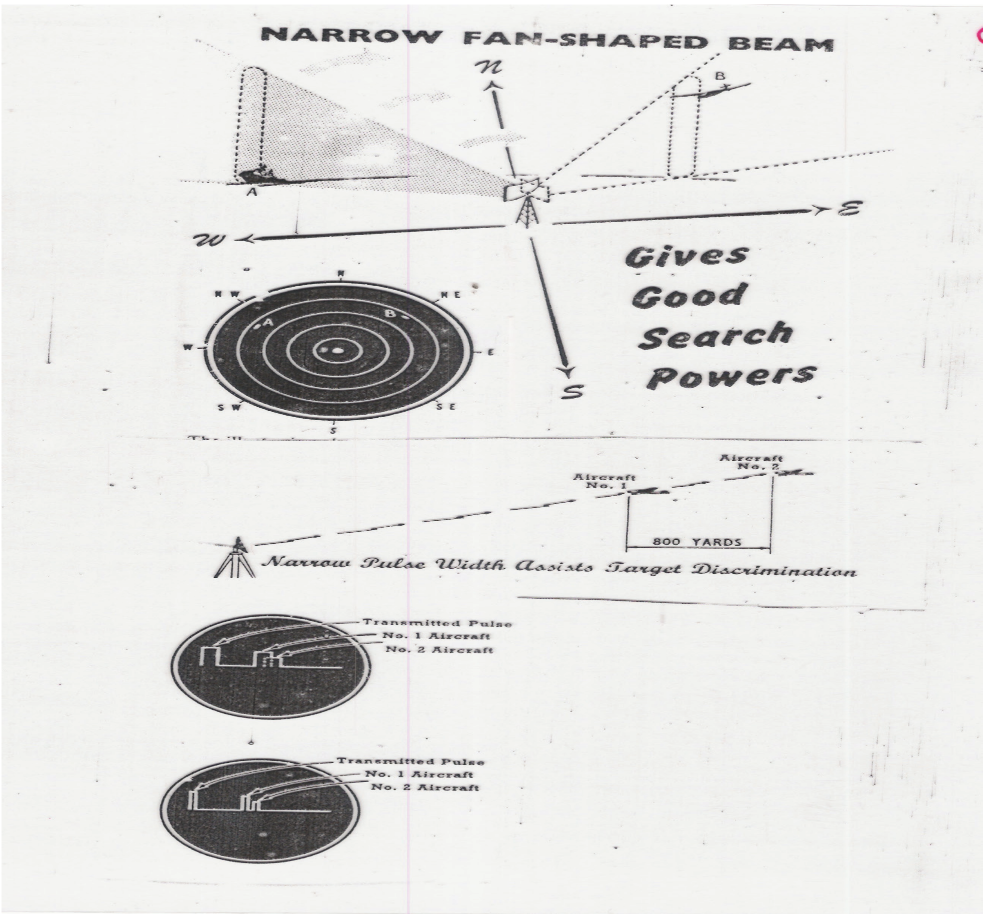


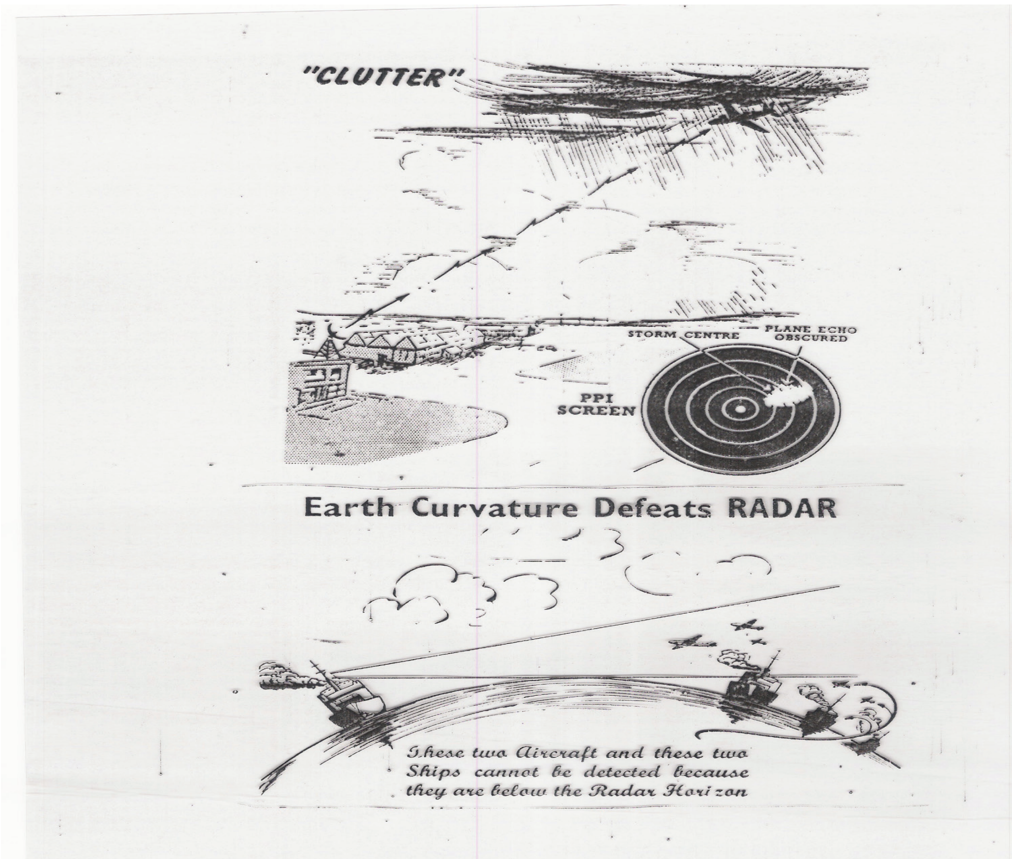

HAND TORCH
Small reflector. Ill-defined beam.
CAR HEADLAMP
Larger reflector. Better beam.
SEARCH-LIGHT
Large reflector. Good beam.
A
B
C
D
MAXIMUM HEIGHT OF SEARCH
MAXIMUM RANGE OF SEARCH
Location of Radar Aerial
SEARCH Radar Needs...
Low Energy Intensity
Location of Radar Aerial
High Energy Intensity
. . . A FAN-SHAPED BEAM of VARYING INTENSITY


"JAMMING"
Jamming Signal
Jamming Pattern Completely Masking Echo Signal


Beam is SHAPED to Fulfil Particular Roles
Aerial Array
Beam of Energy
BEAM BROAD
TARGET DISCRIMINATION POOR
A
B
BEAM NARROW
TARGET DISCRIMINATION GOOD


How Transmitter Power Affects Echoes
POWERFUL TRANSMITTER
MODERATE POWER TRANSMITTER
Target obscured by Noise
How Land Masses Can Screen an Echo
AIRCRAFT No. 2
AIRCRAFT No. 1
AIRCRAFT NO. 2 ECHO
AIRCRAFT NO. 1 ECHO
0
20
40
60
80
100
THOUSANDS OF YARDS


NARROW FAN-SHAPED BEAM
N
B
A
W
E
S
Gives Good Search Powers
N
NW
NE
W
E
SW
SE
S
Aircraft No. 1
Aircraft No. 2
800 YARDS
Narrow Pulse Width Assists Target Discrimination
Transmitted Pulse
No. 1 Aircraft
No. 2 Aircraft
Transmitted Pulse
No. 1 Aircraft
No. 2 Aircraft


"CLUTTER"
STORM CENTRE
PLANE ECHO OBSCURED
PPI SCREEN
Earth Curvature Defeats RADAR
These two Aircraft and these two Ships cannot be detected because they are below the Radar Horizon

Basic Types of EMI: These are of two types. They are

a) Intra-EMI: EMI is said to be intra-EMI if the functional characteristics of one module within an electronic equipment or system is disturbed due to EMI from another module.

b) Inter-EMI: EMI is said to be inter-EMI if the functional characteristics of one equipment is disturbed due to EMI generated by another equipment.

EMI SOURCES

These are divided mainly into two types.

I. Natural and II. Man-made

I.Natural EMI sources are again of the following types:

Terrestrial and Extra-Terrestrial.

Terrestrial Sources

These are atmospheric thunderstorms, lightning discharges and precipitation static.

Extra-Terrestrial Sources

These are sun-disturbed & quiet, cosmic noise and radio stars.

II.Man-made EMI sources: These are many.

1.Electric power sources: These consist of

(a) Generation equipment, conversion (step up/down) equipment like faulty transformers and faulty insulators.

(b) Transmission equipment like pick-up and re-radiation and faulty insulations.

(c) Distribution equipment like, faulty transformers, faulty wiring, faulty insulation, poor grounding, pick-up and re-radiation.

2.Electronic communication devices:

These are

(a) Police radio

(b) All types of Radars

(c) Cellular and Mobile communication

(d) Satellite communication

(e) Point-to-point communication

(f) TV and Radio

(a) Industrial machines

- Electric cranes
- Fork-lift trucks
- Milling machines
- Printing presses
- Punch presses, etc.

(b) Office/Business machines

- Computers
- Cash registers
- Electronic typewriters
- Photo-copiers, etc.

(c) Welders & Heaters

- Arc welders
- RF stabilized welders
- Induction heaters, etc.

(d) Transporters

- Elevators
- Escalators
- Conveyer belts, etc.

(e) Power tools

- Electric drills & Grinders
- Mixers
- Electric hand-saws, etc.

(f) Appliances

- Air-conditioners
- Refrigerators
- Microwave ovens
- Vacuum cleaners
- Electric lawn mowers, etc.

(c) Tools

- Auxiliary generators
- Lawn mowers
- Portable saws etc.

5. Consumer & medical electric systems

(a) Lights

- Fluorescent lamps
- Faulty incandescent
- Neon lights
- RF excited gas displays
- Light dimmers etc.

(b) Entertainment

- Home computers
- Cassette players/recorders
- Television receivers

(c) Appliances

- Electric shavers
- Washing machines
- Grinders/mixers
- Vacuum cleaners

(d) Medical equipments

- X-ray machines
- Defibrillators
- Ultrasonic scanners
- Scanners

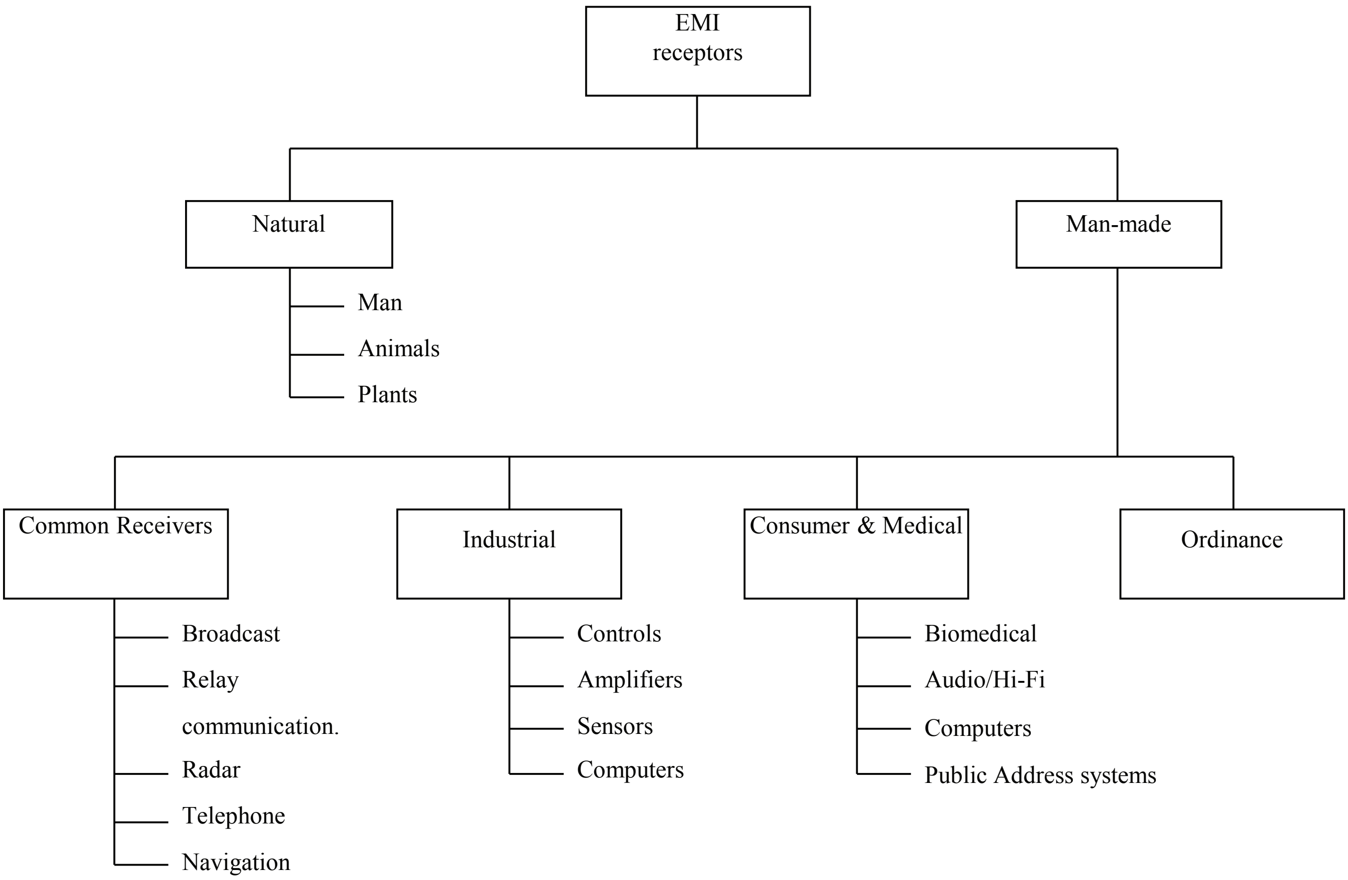
6.Nuclear: These are

(a) Nuclear submarines, ships and nuclear aircrafts

(b) Nuclear detonators

(c) Nuclear power stations.

The devices which are susceptible to EMI are listed below:



EMI is coupled in two ways:

1. By conduction. Here the EMI is routed along power supply and signal lines.

2.By radiation. Here the EMI is coupled through radiation from wires and antennas. This can be either through near-fields or far-fields.

EFFECTS OF EMI

EMI is considered to be a silent and unknown threat. In many occasions, intermittent malfunctions or random failures of equipment are experienced by many users. They are attributed to be due to the presence of EMI. In view of this, the threat due to EMI is silent and proved to be hazardous.

BIOLOGICAL EFFECTS OF EMI / EMR

- ➢ EM waves, light, heat, x-ray and gamma rays are all different forms of electromagnetic radiation.
- ➢ They differ in their wavelength.
- ➢ These radiations have hazardous effects on men and material.
- ➢The effects can be divided into two categories.

BIOLOGICAL EFFECTS OF EMI / EMR

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The effects can be divided into two categories.

Radiation Effects

Radiation Quantity (R)	*Possible Effects*
0 - 80	Minor Changes in Blood
80 - 130	Vomiting for about 24 Hrs. in 5 to 10 % cases. One feel tired.
130 - 170	Vomiting & Nausea for about 24 Hrs. Sickness in 25 % cases.
170 - 230	Vomiting for 24 Hrs. & Sickness in 50 % cases.
230 - 330	Vomiting and Nausea in all , Sickness , 20 % deaths in a month.
330 - 500	Vomiting , Sickness and 50 % deaths in a month. Convalescent for 6 months.
500 - 750	Vomiting in 24 Hrs. , 100 % deaths likely.
750 - 1000	Probably no survivors from radiation sickness.
5000	All will be fatal with in one week.

Radiation Effects On Materials & Components

Component/ Device	Quantity Of Radiation (Rads)	Likely Effects
Resistor	10^2—10^{12}	Changes The Characteristics
	10^{12}—10^{14}	Inoperable
Capacitor	10^3—10^{10}	Changes The Characteristics
	10^{10}—10^{14}	Inoperable
Crystal	10^7—10^{12}	Changes The Characteristics
	10^{12}—10^{14}	Inoperable
Electron Tube	10^2—[illegible]	Changes The Characteristics
	10^{11}—10^{14}	Inoperable
Transducer	10^3—10^{11}	Changes The Characteristics
	10^{11}—10^{14}	Inoperable
Insulators	10^3—10^{13}	Changes The Characteristics
	10^{13}—10^{14}	Inoperable
Circuits & Systems	10^2—10^{13}	Changes The Characteristics Inoperable
Magnetic Materials	10^7—10^{11}	Changes The Characteristics
	10^{11}—10^{14}	Inoperable
Semiconductors	10^2—10^4	Changes The Characteristics
	10^4—10^8	Inoperable

Frequency (GHz)	Effect
0.1	Warming of exposed areas
0.15-1.2	Overheating occurs and hence damage to internal organs
1.0-3.3	Lens of eye and kidneys are susceptible and tissues are heated up.
3.3-10	Noticeable skin heating occurs.
10-100	Skin acts as either reflector or absorber and hence heating takes place.

The damaging levels depend on

- Frequency,
- Ambient temperature
- Body resistance and
- Weight of individual

Exposure over an energy density of **10 mw/cm²** at any frequency is considered to be not safe.

Effects of Cell Phones

The cell phones operate by emitting and receiving electromagnetic waves. Human being can not see, touch, smell, taste or hear the electromagnetic waves.

All the five senses of human beings are not useful to identify the presence of electromagnetic waves.

Such waves have harmful and hazardous effects on humans.

The cell phone is called electromagnetic weapon.

The cell phone effects on humans are

- First ridiculed
- Secondly, they are violently opposed
- Thirdly, they are accepted after they became self evident.

- Most of the people do not know the facts about the dangers of cell phones.
- The wireless network keep emitting an ever-increasing and dangerous levels of microwave radiations.
- The antenna is a source of electromagnetic waves.
- It is erected on cell towers on the house tops in the vicinity of residential areas,
- in the work places,
- schools, and
- most dangerously near the hospitals.

- It is evident from research and literature that there are about 80 immune system disorders.

One must understand and remember that the users of cell phones become sick gradually.

In the early stages of exposure, the following effects are reported.

- ➢Decreased stamina
- ➢Memory problem
- ➢Fatigue
- ➢Sleep disturbances
- ➢Headaches
- ➢Eye sensitivities
- ➢Increased allergies
- ➢Dizziness
- ➢Irritability
- ➢Concentration problems
- ➢Nausea and
- ➢Restlessness etc.

The high exposure levels leads to

- ➢Unexplained anxiety
- ➢Insomnia
- ➢Swollen lymph nodes
- ➢Depression
- ➢Loss of appetite
- ➢Hypoxia (lack of oxygen getting to the tissues)
- ➢Hyper activity
- ➢Dry eyes
- ➢Vision problems
- ➢Weaken immune system

- Frequent urinals
- Night sweats
- Extreme thirst
- Weight gain or weight loss
- Testicular pain etc.

The above problems depend on frequency

- duration
- exposure levels
- Ambient temperature
- Humidity
- Body resistance
- Air circulation

- Microwaves depolarize the body's red blood cells. This leads to diminishing flow of oxygen to brain cells and the body's other organs. This in turn causes nausea, dizziness, inability to concentrate and headaches etc. The microwaves induce protein destruction from the cellular membrane of red blood cells.

Recent Research on Brain and Biological Effects of Cell-Phones

Israeli study

- Regular use of mobile telephones increases the risk of developing tumours.
- It has the risk nearly 50 percent higher for frequent mobile phone users with more than 22 hours a month.
- The risk is still higher if users clamp the phone to the same ear.
- Mobile phones can take as little as ten minutes to trigger changes in the brain associated with cancer.
- Even low levels of radiation from handsets interfere with the way brain cells divide.
- Cell division encourages the growth of tumours.
- Parents should think twice before giving in to a middle-schooler's demands for a cell phone.
- some scientists say, because potential long-term health risks remain unclear.

EMC STANDARDS IN DIFFERENT COUNTRIES

S. No.	Standard Name	Meaning	Country
1.	CISPR (IEC)	Committee International Special Perturbations Radioelectriques – Europe	International committee
2.	FCC	Federal Communications Council	USA
3.	SAE	Society of Automobile Engineers	Trade Association Technical Committee
4.	VG	Military standard	Germany
5.	VDE	Verband Deutscher Electrotecknikev	Germany
6.	ISI	EMI measurements & measuring apparatus	India
7.	DEF STD	59-41 British Mil STD	UK
8.	GAM-EG-13	France Mil. Std.	France
9.	CENELEC	European committee for electro-technical standardization	Europe
10.	EN	European Norms	Europe

EFFECTIVE USE OF WASTE HYDROGEN

V. Vijayakumar[1] & M. Coumarane[2]

ABSTRACT:

In Thermal Power Plant cooling tower water circulating system Chlorine is being used as oxidising biocide to control Algae growth. Since Chlorine gas is hazardous in nature and it is difficult to handle. In thermal power station II expansion / NLC instead of hazardous Chlorine, Sodium Hypochlorite is being used as biocide in cooling tower. Sodium Hypochlorite is liquid in nature and concentration only 7500 Ppm and moreover it is less hazardous as compared to gaseous Chlorine. Sodium Hypochlorite is produced onsite itself by using Sodium Chloride (Brine solution) as raw material. During the electrolytic process of producing Sodium Hypochlorite, Hydrogen gas is produced as a by-product. In thermal power station II expansion / NLC 8.8 Nm3/hr of Hydrogen gas is produced as a by-product and it is vented out in the atmosphere. More effective use of this wasted Hydrogen will add to the overall supply of green source energy and ultimately should help lower the cost of Hydrogen. Hydrogen can be bottled and transported. Use Hydrogen helps mitigate, the intermittency of renewable energy sources by providing opportunities for storage. Hydrogen used in fuel cells to generate electric power on demand (or) to fuel vehicles (or) generator cooling (or) hydrogenation of oil

Keywords: Thermal Power Plant, Cooling tower, Electrolytic process, Waste Hydrogen.

1.0 INTRODUCTION

Hydrogen is the most abundant element in the universe. Nearly nine out of every ten atoms in the universe are hydrogen atoms. Hydrogen is also common on the Earth. It is the third most abundant element after oxygen and silicon. About 15 percent of all the atoms found on earth are hydrogen atoms.

Hydrogen is also the simplest of all elements. Its atoms consist (usually) of one proton and one electron.

Hydrogen was first discovered in 1766 by English chemist and physicist Henry Cavendish (1731-1810). Cavendish was also the first person to prove that water is a compound of hydrogen and oxygen. Some experts believe that hydrogen forms more compounds than any other element. These compounds include water, sucrose (table sugar), alcohols, vinegar (acetic acid), household lye (sodium hydroxide), drugs, fibers, dyes, plastics, and fuels.

2.0 HYDROGEN GLOBAL SCENARIO

In the last decade hydrogen has attracted worldwide interest as an energy carrier. Resulting comprehensive investigation on the technology involved in production, storage

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and applications of hydrogen. The interest in hydrogen as energy of the future is due to it being a clean energy, most abundant element in the universe, the lightest fuel and richest in energy per unit mass. It will provide, cheap Electricity, Cook food, Drive car, Run factories, Jet planes, Hydrogen Village, and for all our domestic energy requirements. In short hydrogen shows the solution and also allows the progressive and non-traumatic transition of today's energy sources, towards feasible and complete sustainable energy chains.

3.0 IMPORTANCE OF HYDROGEN

Even though hydrogen is the most abundant element in the universe in the earth's crust it accounts for less than 1% (by mass). It is the third most abundant element in the human body virtually all of the hydrogen found on earth is in the form of compounds, mainly as water and hydrocarbon compounds.

According to industry estimates up to 15% of the by-product hydrogen produced by chemical plants is vented into the atmosphere or burned. The hydrogen will be used as a low-cost, high-value input to electricity production, rather than being vented into the atmosphere or burned.

4.0 HYDROGEN USAGE

Hydrogen supply mode: Cylinders, Liquefied gas tanks, Pipeline, On-site generator.

• Food and Beverage

H2 gas is used in hydrogenation of amines and fatty acids (food oils)

• Metals Industry

Reductive atmosphere for various process of heat treatment

• Welding Cutting and Coating

Heat treatment of various metals

• Space and Aeronautics

Hydrogen is used in the liquid state as ergols for the propulsion of the cryogenic stages of the Ariane rockets

• Automotive and Transportation

Hydrogen is a carbon-free energy source used in the fuel cells.

5.0 HYDROGEN PRODUCTION

Hydrogen can be produced form a variety of feed stocks. These include fossil resources, such as natural gas and coal, as well as renewable resources such as biomass and water with input from renewable energy sources (e.g. sunlight, wind, wave or hydro-power). A variety of process technologies can be used including chemical, biological, electrolytic, photolytic and thermo-chemical. Each technology is in a different stage of development and each offers unique opportunities, benefits and challenges. Local availability of feedstock, the maturity of the technology, market applications and demand, policy issues, and costs will all influence the choice and timing of the various options for hydrogen production.

5.1 Wasting of Hydrogen Byproduct

Byproduct hydrogen can be particularly valuable since even with clean-up, other processing and delivery costs it may still be less expensive than traditional hydrogen production processes.

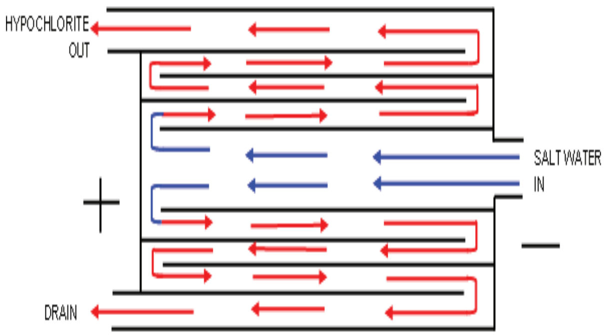
Therefore, byproduct hydrogen can play an important role in early hydrogen energy markets where other bulk hydrogen production is distant. At this time, it is hard to determine exactly how much byproduct hydrogen could be available.

However, a 2008 Energy Information Administration report32 estimated the US byproduct hydrogen production capacity at 10,530,000 kg/day (approximately 77% of which is byproduct capacity from catalytic reforming at oil refineries). A 2007 SRI Consulting report33 lists all US producers with byproduct hydrogen capacity from chlor-alkali or sodium chlorate production via brine electrolysis with a total reported capacity of approximately 1.1 million kg/day.

5.2 Hydrogen as a Byproduct In The Production of Hypochlorite

The control of bio-fouling and sanitizing water systems by chlorination has been proven to be the most effective method for water treatment. Hypochlorination from brine solution provides an effective anti-fouling method of water treatment that is safe for personnel and the environment.

The generation of sodium hypochlorite (bleach) from on-site hypochlorite generators is the safe anti-fouling and marine growth prevention alternative to chlorine gas chlorination systems as the chlorine generated in the generator is locked up as sodium hypochlorite at concentrations below the threshold of hazardous materials (1%) mandated by the EPA.



SODIUM HYPOCHLORITE ELECTROLYTIC CELL

Figure-01

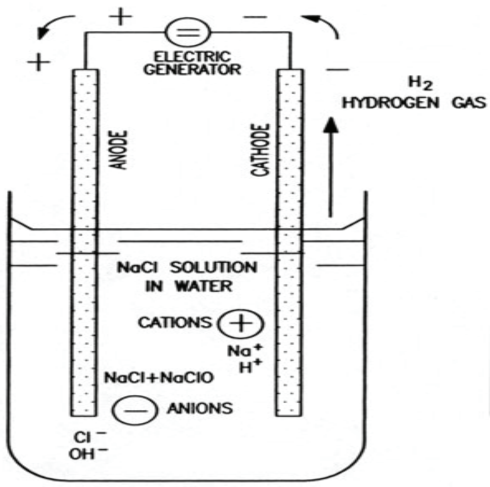


Figure-02

Electrolysis process

Involved electrochemical reactions:

Anode producing free chlorine

2 (Na+ Cl->)   2 Na+ + Cl_2 + 2 e->

Cathode producing Hydrogen:

2 H_2O + 2 e->   2 OH- + H_2

Bulk reaction producing Sodium Hypochlorite iones OH- migrate from cathode and react closed to the anode as:

2 NaOH + Cl_2->   NaClO + NaCl + H_2O

All the above gives the overall reaction in water :

NaCl + H_2O->   NaClO + H_2

6.0 HYDROGEN CO-GENERATION IN NLC:

The Co-Generated Hydrogen is 0.35Nm³ / Kg of chlorine generated.

25 Kg/h generation results in 25 x 0.35 = 8.8Nm³/h

In order to stay in safe limit, this hydrogen is diluted with air such that the concentration in vent is less than 0.8% v/v.

Hydrogen Dilution blowers are accordingly designed and supplied

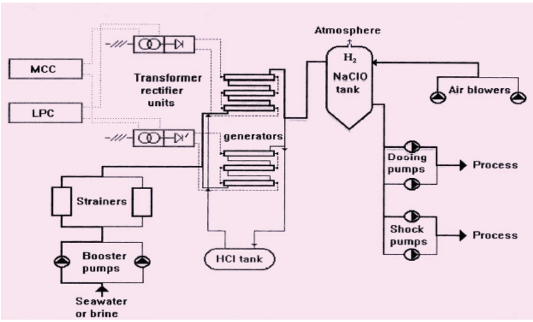


Figure-03 Hydrogen co-generation in a cooling tower chemical plant process of NLC

Figure-04 Electrolyser cell

7.1 Separating Column

The separating column separates gases from sodium hypochlorite.

7.0 HYDROGEN BOTTLING

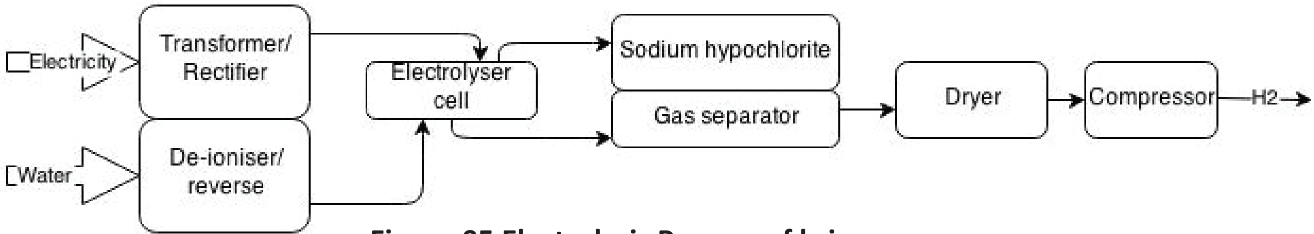


Figure-05 Electrolysis Process of brine

7.2 Gas Washer

The gas washer serves to remove chlorine gas entrained in the gas. This consists of a cylindrical tank into which the condensate is normally admitted from the bottom. Just above the middle of the tank on the periphery and is situated above the normal operating level.

7.3 Cooler

The water cooler is another vertical, cylindrical, dished ended steel tank near the bottom end of the cylindrical surface. The small space below the disc accommodates the bubbler and serves to collect the condensed moisture dropping from the gas. The larger space above the disc is filled with circulation cooling water. The cooling water is admitted at the bottom and taken of the top. The gas entering the cooler is cooled by taking it through a number of coiled tubes immersed in the cooling water and is led to the bottom space, where it is further cooled by expanding through a conical inverted funnel shaped bubbler. The moisture in the gas, which condensesdue to this cooling drip in to the bottom chamber and is drained out. The gas passes out from the bottom chamber through a tube running vertically through the cooling water ad coming out at the top of the tank. From the water coolers, the gas enters the drying system and then to the respective receivers through a non-return valve.

7.4 Drying System:

Drying system for each gas stream consists of an electric heater, two water coolers with a separator and a condensate receiver (Discharge Collector) in between and drying unit. The drying unit consists of two driers/absorbers, which operate alternately for drying and for regeneration.

The drier is vertical cylindrical dished ended steel tank. The dished end at the top is removable having been connected by a flange joint with cylindrical portion.

The vessel is packed with silica gel inside and is surrounded on tis outside by an annual space in which steam or water is circulated. Two tubes for gas inlet and outlet are provided, one at the top and another at the bottom just below the silica gel layer. A connection for draining condensed water is provided at the bottom.

While working as drier, the gas enters form the top passes down through the layer of silica gel, the silica gel absorbs the moisture in the gas and dried gas passes out through the outlet pipe at the bottom. Throughout this drying operation, cooling water is circulated continuously in the outer jacket.

8.0 STORAGE OF HYDROGEN

The most common method to store hydrogen in gaseous form is in steel tanks, although light weight composite tanks designed to endure higher pressures are also becoming more and more common. Cryogens, gaseous hydrogen cooled to near cryogenic temperatures, is another alternative that can be used to increase the volumetric energy density of gaseous hydrogen. A more novel method to store hydrogen gas at high pressures I to use glass microspheres. The next two sections provide further details on two of the most promising methods to store hydrogen gas under high pressure: Composite tanks and glass microspheres.

Hydrogen Differs from Conventional Fuels

Hydrogen is non-toxic. It is also non-poisonous and will cause no ill effect if inhaled with ambient air.

Hydrogen is odorless, colorless, and tasteless. It is thus undetectable by A release of hydrogen is human senses.

Hydrogen is highly combustible. Leaks are easily ignited yet the hydrogen is rapidly into nonflammable concentrations when released to an open environment.

It will not contaminate groundwater. Under normal hydrogen is a gas with a very low solubility in water.

Hydrogen is not a pollutant. Release of hydrogen is not known to contribute to atmospheric or water pollution.

Industry considers these properties when designing structures where hydrogen is used or stored and provides redundant safety systems, including sensors and ventilation.

Critical point

• Critical temperature: -240.01 °C

• Critical pressure: 12.96 bar

• Critical density: 31.263 kg/m3

Triple point

• Triple point temperature: -259.19 °C

• Triple point pressure: 0.077 bar

Gaseous phase

• Gas density (1.013 bar at boiling point): 1.3326 kg/m3

• Gas density (1.013 bar and 15 °C (59 °F)): 0.0852 kg/m3

• Compressibility Factor (Z) (1.013 bar and 15 °C (59 °F)): 1.0006

• Specific gravity : 0.07

• Specific volume (1.013 bar and 25 °C (77 °F)) : 11.983 m3/kg

• Heat capacity at constant pressure (Cp) (1.013 bar and 25 °C (77 °F)) : 0.0288 kJ/(mol.K)

• Heat capacity at constant volume (Cv) (1.013 bar and 25 °C (77 °F)) : 0.0205 kJ/(mol.K)

• Ratio of specific heats (Gamma:Cp/Cv) (1.013 bar and 25 °C (77 °F)) : 1.4054

• Viscosity (1.013 bar and 15 °C (59 °F)) : 8.3969E-05 Poise

• Thermal conductivity (1.013 bar and 0 °C (32 °F)) : 172.58 mW/(m.K)

• Hydrogen is high in energy content as it contains120.7 MJ/kg, which is the highest for any known fuel.

Miscellaneous

• Solubility in water (1.013 bar and 0 °C (32 °F)): 0.0214 vol/vol

• Concentration in air: 0.00005 vol %

• Auto ignition temperature: 560 °C

Major Hazards

• Major hazard: Fire and High Pressure

• Toxicity (Am. Conf. Of Gov. Ind. Hygienists ACGIH 2000 Edition) : Simple Asphyxiant

• Flammability limits in air (STP conditions): 4.0-75 vol%

• Odour: None

9.0 H2 USAGE IN NLC POWER PLANT

Hydrogen is a common coolant used in power station applications. It has a low density and high heat conductivity which are the important properties to increase the efficiency generators. The flammability of Hydrogen is less of a concern here as these systems operate the above the upper flammability limit. In Neyveli have four thermal power plants and in these twenty generators Hydrogen is used as a coolant. Each generator has a capacity volume range 50 to 70 m3. For initial fill up 1400m3 and top up 51100 m3, totally 52500m3 of Hydrogen required per annum for generator coolant.

10.0 CONCLUSION

The hydrogen that is acquired as a byproduct in Thermal Power Station-II Expansion is a rich source of clean energy. If utilized effectively it is more than sufficient to fulfill our requirements for generator coolant in all Thermal Power Plants of NLC. The surplus hydrogen may be bottled and marketed.

ACKNOWLEDGEMENT

The authors thank NLC management for giving permission to publish this paper.

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Study of Heavy Metals in Soil and Selection of Suitable Eco Sustainable Technology for Remediation – A Case study

M.Subha[1]

ABSTRACT:

The contaminated sites are drastically increasing both in terrestrial and aquatic ecosystem due to increase in population, industrialization and urbanization in India .As a result,the strata of ecosystem undergoes a various changes which inturn affect the biotic and abiotic factors. In this present study, area near Amberpet STP is selected and dry soil samples were collected using discrete sampling method near this area and heavy metals are analysed through Inductive Couple Mass Plasma Spectroscopy.(ICPMS).The results have shown that the soil are having various heavy metals(La,Cr,U,Pr,Nd) in slightly higher proportion which may lead to toxicity by leaching due to rainfall and Bioconcentration can takes place at particular point which can affect both water and soil and can cause water & soil pollution. So a Cost effective and Eco Sustainability application like phyotoremediation will help in remediating these higher proportionate elements and also make the environment as “Green Belt Cover”

Keywords:Heavy Metal,Phytoremediation, Eco Sustainable

INTRODUCTION

Burgeoning Population, Rapid Industrialization, Urbanization and Overburdened Municipal infrastructure are ensuring the top cities of India are very productive in one area -Waste Generation in epic proportions. A miserable waste management strategy translates to overflowing land fill sites with more unsorted waste getting added every hour .Currently the total waste generated in India in each category

i)Municipal waste - 68.8 million tonnes per year ii)e-waste -0.8million tonnes per year iii) Hazardous waste - 6.2 million tonnes per year iv)Biomedical Waste -1.05 million tonnes per year v) Plastic waste 5.6 million tonnes per year.Management of waste in an Environmentally Sustainable manner is a challenging task. Any Sustainable approach of waste management i) Municipal waste - 68.8 million tonnes per year

ii)e-waste -0.8million tonnes per year iii) Hazardous waste - 6.2 million tonnes per year iv)Biomedical Waste -1.05 million tonnes per year v) Plastic waste 5.6 million tonnes per year.Management of waste in an Environmentally Sustainable manner is a challenging task. Any Sustainable approach of waste management Sustainability application like phyotoremediation will help in remediating these higher proportionate elements and also make the environment as “Green Belt Cover”.

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MATERIALS & METHODS

Study Area:

Area Near Amberpet Sewage treatment plant(339MLD): It is Asia biggest STP using UASB Technology andtreated effluent is let out to musi river. The latitude and Longitude coordinates are 17.3771° N, 78.4923° E (Fig. 1b). The UASB Sludge is stored in their facility and later it will be sent to Secured landfill.

Methodology:

The Dry sludge sample are taken from two sites according EPA Guidelines of Composite Soil Sampling methodology(SESD Operating Procedure - Soil Sampling, EPA, 2012).The sample is subjected to analysis of Atomic absorption spectrometer(Borges et al., 2003)

Inductive Couple Plasma Mass Spectroscopy(ICPMS) Procedure:

The sample is analysed in ICPMS.A representative 1g Dry weight) sample is heated with repeated additions of nitric acid (HNO3) and hydrogen peroxide (H2O2) Hydrochloric acid (HCl)is added to the digestate. This digestate will be filtered. Then the filter paper and residues are rinsed with reagent water. After all, the digestate is diluted to a final volume of 100 mL

Analysis by ICPMS.

Recorded the absorbance values of the standard solutions, the Soil sample, and the blank for each of the metals. Also recorded the wavelength of the lamp used for each metal. From the absorbance values of the standards, made a calibration curve for each of the metals by plotting absorbance on the vertical axis and concentration on the horizontal axis. Subtracted the absorbance value of the blank from the sample value for each of the metals. Then determined the concentration of each metal in your sample from the corresponding calibration curve. The values is expressed in units of ppm

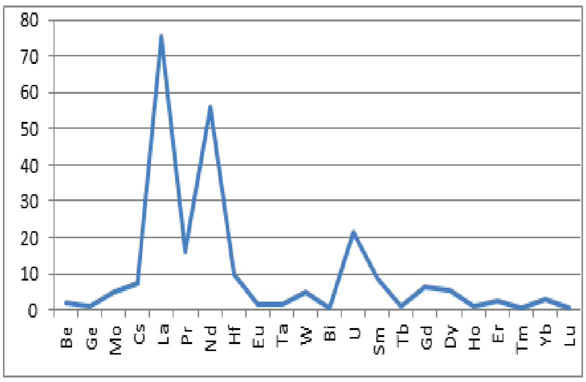
RESULTS AND DISCUSSION

Heavy Metals Concentration (ppm).

Table 1 :

Be	Ge	Mo	Cs	La	Ce	Pr	Nd	Hf	Eu	W	U
2.20	1.23	<5	7.37	75.21	160.02	15.96	56.14	9.60	1.37	<5	21.26
Sm	**Tb**	**Gd**	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Ta**	**Bi**	
8.68	0.99	6.50	5.16	1.03	2.70	0.45	2.87	0.39	1.69	0.33	

Concentration graph



Graph 1. Heavy Metal (Concentration in ppm)

Discussion :

Heavy metal concentration of soil collected near Amberpet is representaed in Table 1. The Concentration graph (Graph 1) Shows the Soil Contains Beryllium(Be) 2.20 ppm, Germanium (Ge) 1.23 ppm, Molybdenum (Mo) <5ppm ,Caesium(Cs) 7.37 ppm, Lanthanum (La) 75.21 ppm, Cerium (Ce) 160.02 ppm, Prasecdymium (Pr) 15.96 ppm, Neodymium (Nd) 56.14 ppm, Hafnium (Hf) 9.60 ppm, Europium (Eu) 1.37 ppm,Tungsten(W) <5 ppm, Uranium (U) 21.26, Samarium (Sm) 8.68 ppm,Terbium (Tb) 0.99 ppm,Gadolium (Gd) 6.50 ppm, Dysprosium (Dy) 5.16 ppm,Holmium (Ho) 1.03 ppm, Erbium (Er) 2.70 ppm,Thulium(Tm) 0.45 ppm, Ytterbium (Yb) 2.87 ppm, Lutetim (Lu) 0.39 ppm,Tantaium (Ta) 1.69 ppm,Bismuth (Bi) 0.33ppm. Among this Concentration of Lanthanum(La),Prasecdymium(Pr),Cerium(Cr) ,Neodymium(Nd),Uranium(U) are slightly higher in proportions than standard limits.(CPCB guidelines 2010).

If these metals in long run due to various reactions,forms complex oxides, hydroxides, chlorides and nitrates etc.., , it will imbibe in to soil and ground water strata towards downward loss(leaching) and cause water and soil pollution in that particular and surrounding area. If this sources (Water & Soil)are utilized by the people which will have a greater health impact issues and also stress to green cover is possible if the concentration exceeds above the limit.

CONCLUSION & FUTURE STUDY FOCUS

The contaminated soil which cause health hazards in long term will be treated with ecofriendly method to arrest leaching in to soil or water body. In future Phytoremediation experiment(Salt DE et al., 1995), will be designed with suitable hyper accumulative plant for absorption of metals for treating the toxicity .The plants identified for experiment are Water hyacinth, Tape Grass etc..

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ENVIRONMENT & ECONOMIC DEVELOPMENT THROUGH GREEN POWER TECHNOLOGY

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ABSTRACT:

Power sector is the most important among various infrastructure sectors in the country. The existence and development of adequate power infrastructure is essential for sustained growth of economy. It is imperative that the growth in Power Sector should be commensurate with GDP growth rate of around 8%.

Today, we stand at the cross roads in choosing between environment and economic development. Developed countries have achieved high level of development and decent standard of living at the cost of environment and depletion of natural resources. Natural Green House effect is enhanced by the increase in green house gases especially carbon di-oxide (CO2) released from burning coal, oil and gas mainly in Thermal Power Plants affecting Carbon Cycle and resulting in Climate Change.

Energy Efficient Renovation & Modernization (EE R&M) technologies is one of the best available solution for quick increase of Power capacity, Reliability & Efficiency of the existing Power Plants which consequently reduces Carbon Foot Print. Adopting Circulating Fluidized Bed Combustion Technology (CFBC) and high energy efficient Super Critical Technology in the upcoming Power Plants will reduce Carbon Foot Print and Emissions (SOx, NOx, SPM).Renewable Energy Sources like solar energy, Wind energy etc., are Green Energy sources for sustainable environment and economic development.

1.0 INDIAN ECONOMY

"India shining" has been the unofficial slogan for India, since the time of the 21st century. India averaged 8% annual GDP growth in last three years. Armed with population strength of more than a billion people, India is the 11th largest economy in the world. Focusing on the economy will yield great results, as India shows great potential for becoming an Industrial Power house. India has the largest population of poverty stricken citizens in the World. The only way to reduce the poverty rate is to focus on developing the country. During the last four decades India's inward looking and Public Sector driven Industrialization strategy led to rates of growth and poverty reduction. The economy has responded well to the reforms, and the government had made it an explicit objective to accelerate the development of human resources. The last five years have shown the rates of growth that India could achieve with market oriented development policies and a better integration with the world economy.

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The Economy of a country can easily be developed without having to deteriorate the environment severely. India can improve its economy without significantly damaging its environment with the emerging new technologies. (Solar, Nuclear, Geothermal, Hydroelectric, Bio energy). As environment friendly products are becoming more and more popular, India could easily develop their economy through these products, thus protecting their environment simultaneously. Social and Economic Development goes hand in hand. With a thriving economy, human rights in India will flourish. Developing the economy of India will require improvements in education, and worker training, in order to improve human capital. With improved education, and worker skill, workers rights will be improved in India, thus improving human rights. Economic development and social development together will allow India to become more progressive, and more democratic.

As on 31.07.2014 India is having the power generating capacity of 2, 50,256.95 MW

✓ Thermal power capacity	1,72,986.09 MW
✓ Hydro power capacity	40,798.76 MW
✓ Nuclear power capacity	4,780 .00 MW
✓ Renewable energy capacity	31,692.11 MW

Targeted capacity addition during the 12th five year plan is 88,537.00 MW

✓ Thermal Power	72,340.00 MW
✓ Hydro Power	10,897.00 MW
✓ Nuclear Power	5,300 MW

Coal is the dominant source of energy for thermal power plant in India. Combustion of hydrocarbon based fuels in thermal power plant generates emissions which could cause impact on environment. The emissions are Suspended Particulate Matter (SPM), Sulphur oxide (SOx), Nitrogen oxide (NOx). Both SOx and NOx emissions have been identified as major pollutant globally as they lead to acid rain which is a trans-boundary environmental issue. Another important emission from fuel combustion is carbon dioxide (CO2), a green house gas. CO2 is considered as a major contributor to global warming and climate change.

Circulating Fluidized Bed Combustion (CFBC) technology boilers in thermal power plant will reduce Carbon Foot Print and emissions (SOx, NOx, and SPM). Sub Critical thermal power plants in developing countries are operating at an efficiency of about 32%. But, Super Critical (SC) and Ultra Super Critical (USC) Thermal Power Plants have efficiency of about 45%.Hence, SC & USC thermal power plants require lesser coal per Megawatt hr, leading to lesser emission (SOx, NOx, CO2) per Megawatt hr.

2.0 GREEN HOUSE EFFECT

The Earth is surrounded by a blanket of gases including Green House Gases. The Green House Gases are those gases in the atmosphere which by absorbing thermal radiation emitted by the earth's surface have a blanketing effect over the surface keeping it warmer that it would otherwise be. This results in build of energy, and the overall warming of the atmosphere. This blanket traps energy in the atmosphere, much the same way as glass traps heat inside a green house. Without naturally occurring green house gases such as water vapour, carbon-di oxide, methane and nitrous oxide, the earth average surface temperature would be a cold -18 °C rather than the tolerable 15°C. This warming of the earth called the Green House Effect is a natural process which made the life on earth possible.

The natural green house effect is enhanced by the increase in green house gases especially CO2 emitted by burning fossil fuels in thermal power plants and by deforestation over the past 200 years and more substantially over the past 50 years. The enhanced green house effect from human activities is changing the global climate. India is facing the challenge of sustaining its rapid economic growth and dealing the global threat of climate change. India needs a national strategy to firstly adapt to climate change and secondly to improve the ecological sustainability of India's development path.

3.**0 ENERGY CONSERVATION ACT-2001**

The Government of India has enacted this act to provide legal framework and institutional arrangements for enhancing energy efficiency. This act led to the creation of Bureau of Energy Efficiency (BEE) as the nodal agency at the centre and State Designated Agencies (SDA) at the state level to implement the provisions of the act.

3.1 Standards and Labeling (S&L)

There is wide variation in energy consumption of similar products by various manufactures. Information on energy consumption is often not easily available.

Energy-Efficient Standards are procedures and regulations prescribing the energy performance of energy consuming products. Energy Efficiency Labels are informative labels affixed to manufactured products to describe the products energy performance. Star rating is a system initiated to determine energy efficiency of an appliance like air conditioner. Depending upon their energy efficiency they are rated on a scale of 1-5 Stars.

3.2 National Action Plan on Climate Change (NAPCC)

National Action Plan on Climate Change (NAPCC) document was released by honorable Prime Minister on June 2008 and it identifies measures to advance India's development without affecting climate change related adaption and mitigation. National mission for enhanced energy efficiency is one of the eight missions under National Action Plan on Climate Change.

3.3 Perform Achieve and Trade (PAT)

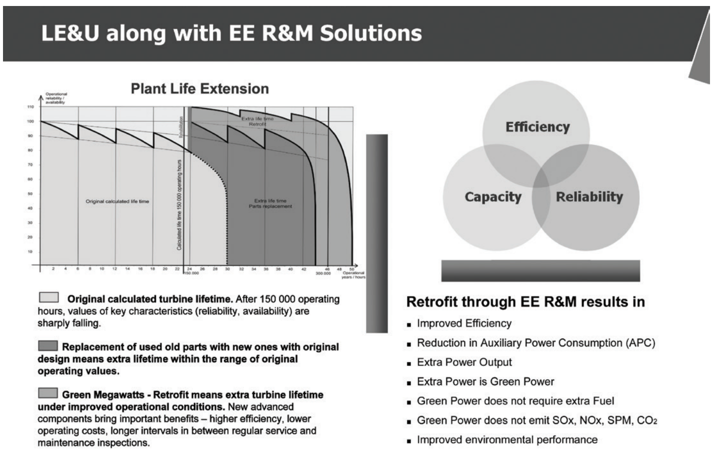
Bureau of Energy Efficiency (BEE) launched Perform Achieve and Trade (PAT) under

under National Mission for Enhanced Energy Efficiency (NMEEE) on 4.7.2012. In its first cycle of three years (2012-13 to 2014-15) the scheme covers eight energy guzzling sectors - thermal power, aluminum, cement, fertilizer, iron and steel, pulp and paper, textiles and chlor - alkali. These sectors account for 40 percent of India's primary energy consumption. The target is to save 6.68 million tons of oil equivalents in these eight sectors by 31st March 2015, the first cycle of the scheme. The target for each plant will vary depending on its size and will be set by BEE. The nation's thermal power plants are the focus of the PAT scheme as 50% saving target (3.21 million tons of oil equivalent) is from thermal power plants against the total target of 6.68 million tons of oil equivalent, which is the target saving of the first PAT cycle.

PAT is a market based mechanism in which industrial sectors are assigned efficiency targets. Industries over active will get incentives in the form of Energy Saving Certificates (ESC). These certificates are tradable and can be bought by other industries which are unable to achieve their target. The price of their certificates will be determined by the market. These certificates shall be tradable at two energy exchanges, Indian energy exchange and Power exchange of India.

3.4 Renovation & Modernization and Life Extension

Coal based power plants are the backbone of Indian power sector. A large number of 200/210 MW thermal units are nearly completion of their operating life being operated at lower energy efficiency and need modernization & life extension. Energy Efficient Renovation & Modernization (EE R&M) along with Life Extension & Up Rating (LE&U) beyond normal design life of the existing power plants in India is an option to address the continuously growing power demand. The approach to EE R&M and LE&U has shifted primarily from 'Generation maximization' to 'Generation optimization' with efficiency improvement. There exists a potential for enhancing their rated capacity by 4-8% and efficiency by 8-10%. Hence it is one of the best available solutions for quick increase of power capacity, reliability & efficiency which consequently reduces carbon font print.



4.0 ELECTRICITY ACT-2003

The government of India has enacted Electricity Act-2003, which seeks to transform and develop the electricity sector. A significant regulatory impact on renewable energy was made by this act, which provides for determination of Renewable Purchase Obligation (RPO) by the State Electricity Regulatory Commissions (SERC). Renewable energy (RE) is the energy obtained from natural sources which are essentially inexhaustible. RE is green, clean and sustainable. RE includes wind power, solar power, geothermal power, tidal power, mini hydro electric power and bio-mass energy. The most important feature of RE is that it can be harvested without the release of green house gas (CO2) and release of environmental pollutant like SOx, NOx and SPM.

4.1 Renewable Purchase Obligation (RPO)

RPO is a policy instrument that a minimum amount of RE is included in the portfolio of resources. The policy obligates each retail sector of electricity to include in its resource portfolio a certain portion of power from RE resources.RPO is being implemented throughout the country to create demand for RE under the electricity policy-2005 and the tariff policy-2006. State Electricity Regulatory Commission (SERC) is obligated to purchase a certain percentage of power from RE resources. Subsequent to the launch of the solar mission under National Action Plan on Climate Change (NAPCC) almost every state announced a solar specific percentage as a part of overall RPO there are currently in the range of 0.25% to 0.5% and expected to go up to 3% by 2022. These are complemented by solar – Specific Renewable Energy Certificate (REC).

There are States (like Rajasthan and Tamil Nadu) where there is very high potential of RE sources. In such States there are avenues for harnessing the RE potential beyond the RPO level fixed by the SERC. However, the high cost of generation from RE sources discourages the local distribution licensees from purchasing RE generation beyond the RPO level mandated by the concerned SERC. RE sources are not evenly spread across different parts of the country. On the one hand there are States (like Delhi) where the potential of RE sources is not that significant. This inhibits SERC in these States from specifying higher RPO. On the other hand there are States (like Rajasthan and Tamil Nadu) where there is very high potential of RE sources.

4.2 Renewable Energy Certificates (REC)

The concept of Renewable Energy Certificates (REC) assumes significance. This concept seeks to address the mismatch between availability of RE sources and the requirement of the obligated entities to meet their RPO. It is also expected to encourage the RE capacity addition in the States where there is potential for RE generation as the REC framework seeks to create a national level market for such generators to recover their cost.

Central Electricity Regulatory Commission (CERC) has notified Regulation on REC in fulfillment of its mandate to promote renewable sources of energy and development of market in electricity. The framework of REC is expected to give push to

RE capacity addition in the country.

The RE generators will have two options - either to sell the renewable energy at preferential tariff fixed by the concerned Electricity Regulatory Commission or to sell the electricity generation and environmental attributes associated with RE generation separately. On choosing the second option, the environmental attributes can be exchanged in the form of REC. The value of REC will be equivalent to 1MW-hr of electricity injected into the grid from renewable energy sources. The distribution companies, Open Access consumer, Captive Power Plants (CPP) will have option of purchasing the REC to meet their RPO.

A proposed target of 29,800 MW comprising of 15,000 MW Wind power, 2,100 MW Mini hydro power, 10,000 MW Solar power and 2,700 MW Bio-mass power has been proposed for capacity addition of grid interactive renewable power during the twelfth five year plan (2012-2017).

Bio-mass is basically organic matter such as wood, straw, crops, algae, animal waste, and biological waste. Bio energy is the derived from bio-mass. Carbon dioxide (CO_2) released during burning of bio mass as fuel is largely balanced by the capture of CO_2 during its growth. Hence it is considered as 'carbon neutral'.

5.0 UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The objective of the convention (UNFCC-1992) in that the concentration of green house gases in the atmosphere should be established at a level which would prevent dangerous anthropogenic interference with the climate system, the stabilization to be achieved within a time-frame sufficient to allow ecosystem to adapt naturally to climate change to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. The parties to UNFCC meet annually in the form of Conference of Parties (COP). The primary task is to promote and review the implementation of the convention.

5.1 Kyoto Protocol

COP 3 is a land mark in which Kyoto protocol was signed in 1997. The major feature of the protocol is that it sets binding targets for developed countries for reducing green house gas emissions. This amounts to an average of 5% against 1990 levels over the five years period 2008-2012.

The Indian Government is clear that it shall maintain its stand based on the "polluter pays" principle heading in to the 15th Conference of Parties (COP) at Copenhagen, at which the international community will determine the shape of Climate Change policy post 2012 when the Kyoto Protocol is set to expire. The Government of India makes it clear that what is being negotiated at COP 15 is not a new international framework for climate change or a post-Kyoto treaty. Rather, the Government states that what is being negotiated is fresh emission reduction targets for the developed nations along with a second commitment period under the Kyoto Protocol, and an Action Plan that would enable more effective implementation of the UNFCCC objectives.

UNFCCC does not require developing countries to take on any commitment on reducing their Green House Gas emissions. This was also recognized in the Kyoto Protocol which only set targets for developed countries. India's per capita CO2 is only 4% of the global emissions next to US and China. The US and China account for 16% of the global emissions. But, India has declared that even as it pursues its social and economic objectives, it will not allow its per capita GHG emissions to exceed the average per capita emissions of the developed countries. India believes that investment in addressing climate change, especially in renewable energy, could create new industries, new jobs and technical innovations. Action on climate change must become part of the solution to the financial and economic crisis. In this context, that India has welcomed US President Obama's plan for 10 year, US $ 150 billion Renewable Energy initiative and expressed its readiness to become an active partner.

The Kyoto protocol also offers an addition means of meeting target by three market based mechanisms.

5.1.1 Carbon Trading

Emissions permitted to countries but not used to sell this excess capacity to countries that are over their targets. Emission trading is known as carbon trading since carbon dioxide is the principle green house gas. Carbon is on tracked and traded like any other commodity. This is known as carbon market.

5.1.2 Clean Development Mechanism (CDM)

CDM allows a country with an emission-reduction target under the Kyoto protocol to implement an emission-reduction project in developing country. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tone of CO2, which can be counted towards meeting Kyoto protocol targets.

5.1.3 Joint Implementation (JI)

JI allows a country with an emission reduction under Kyoto protocol to earn Emission Reduction Units (ERU) from an emission reduction project in another country with emission reduction targets under Kyoto protocol, each equivalent to one tons of CO2.

6.0 OZONE LAYER DEPLETION

Ozone layer is a thin layer of ozone (O3) present in stratosphere which extends from 11 to 50 km from the earth. The ozone layer is highly beneficial to life on earth as it blocks the sun's ultraviolet radiations (UV-B) from reaching the earth. Ozone is highly unstable, is produced and destroyed naturally in the stratosphere. Ozone is formed when oxygen molecules absorb UV radiation with wavelength less than 240 nanometers and is destroyed when it absorb UV radiation with wavelength greater than 290 nanometers.

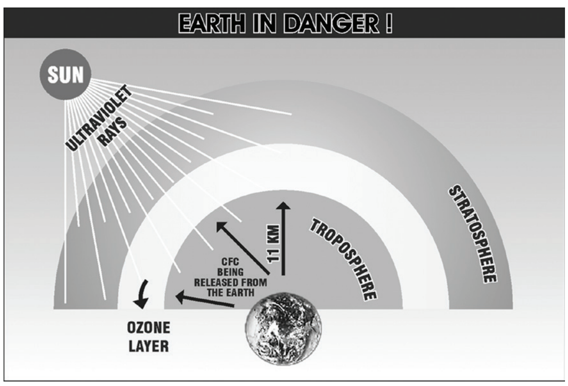


Figure - 1

In recent years, scientists have measured a seasonal thinning of the ozone layer. The phenomenon of ozone layer depletion was first observed over the Antarctic in early 1970 and later over the arctic in 1992. Ozone is easily broken down by man-made chlorine and bromine compounds. These compounds are found to be responsible for most of the ozone layer depletion.

Most of the refrigerants used in the refrigeration & air-conditioning systems have impact on the environment, in two ways – ozone depletion and global warming (green house effect).

Chemical Name	Symbol	Group	ODP	GWP_{100}
R-11 - Tri Chloro Fluoro Methane	CCl_3F	CFC	1.00	3800
R-22 – Mono Chloro Difluro Methane	$CHCLF_2$	HCFC	0.05	1700
R-123 – Dichloro Trifluoro Ethance	$CHCL_2CF_3$	HCFC	0.02	90
R-134a – Tetra Fluoro Ethance	CH_2FCF_3	HFC	0.00	1300
R-600a – Iso Butane	C_4H_{10}	HC	0.00	3

Table – 1

The ozone depletion process begins when Chlorofluoro carbons (CFC) and other ozone depleting substances (ODS) emitted into the atmosphere reach stratosphere by diffusion strong UV radiations break apart the ODS molecules. Chlorofluoro carbons (CFC), Hydro fluoro carbons (HCFC), Carbon tetra chloride (CTC), Methyl chloroform release chlorine atoms and halons and methyl bromide release bromine atom destroy ozone. It is estimated that one chlorine atom can destroy 10,000 to 100,000 ozone molecules before it is finally removed from the stratosphere.

7.0 MONTREAL PROTOCOL

The Montreal Protocol on substances that deplete the 'ozone layer' was drawn up in September 1987 under United Nations Environment Program. India signed Montreal Protocol in 1992.This Protocol required all developed countries to phase out CFC by the Year 2000 and HCFC by the Year 2030.India has to phase out CFC by the Year 2010 and HCFC by the Year 2040.All countries have already phased out CFC as per the target in the Montreal Protocol.

The impact of the emission of the various green house gases on the climate varies according to their atmosphere life. The impact of the various gases is compared with that of CO2, which is one of the main green house gases in the atmosphere. So an index relative to the impact of CO2 is used and is known as Global Warming Potential (GWP). The GWP of CO2 is fixed as "one". GWP have a time component, since the atmospheric life time of the green house gases varies. So the time component spreads from 20 to 100 years and return as GWP20, GWP100 etc.., Emission of one kg of R134a is roughly equivalent to emission of 1300 kg of CO2 in 100 years, so GWP100 of R134a is 1300.

CO2 is generated and emitted to the atmosphere by the fuel in generating energy in power plant. The average CO2 release from an electric power plant is estimated to be 0.6 kg/kW-hr of electrical energy generated.

The refrigeration & air-conditioning system contributes to global warming in two ways. The direct impact is the escape of refrigerant gas to the atmosphere from the system, while servicing and also due to leak. To minimize the direct global warming effect, the refrigeration system has to be leak tight and also calls for very careful handling of refrigerants and also alternate refrigerants with zero Ozone Depleting Potential (ODP) & low Global Warming Potential (GWP) like R134a, Hydro Carbon (HC) shall be used in the system. Environmental friendly Vapour Absorption System also shall be adopted.

The consumption of energy for refrigeration & air conditioning system operation is an indirect impact (CO2 is released for generation of energy). Thus the total effect on global warming known as, Total Environment Warming Index (TEWI) is the sum of direct and indirect effects. To minimize the indirect effect of global warming, the refrigeration and air-conditioning system should be energy efficient (kW/TR).The existing old reciprocating vapour compression refrigeration & air conditioning system of specific power consumption 1.0 kW/TR shall be replaced by energy efficient screw/centrifugal vapour compression system 0.63 kW/TR using environment friendly refrigerants like R134a.

CONCLUSION

Energy efficient renovation and modernization in the existing thermal power plants, adopting CFBC Technology and high energy efficient super critical technology in the upcoming thermal power plants and enhancing renewable energy power plants will be the Green, Clean and Sustainable Energy for Environment and Economic Development.

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UNDERGROUND MINING FOR MEETING ENVIRONMENTAL CONCERNS – A STRATEGIC APPROACH FOR SUSTAINABLE MINING IN FUTURE

Darapu Srikanth Satish Kumar[1], Darapu Swathisri[2] & Majji Anuhya[3]

ABSTRACT:

Sustainable management of resources is not just the mantra but necessity of the present day world. If our future generations have to see a world at least as beautiful as today's we must mandatorily adopt sustainable management aspects in all the fields of development. In this paper, overview of coal mining, significance, issues, sustainable technologies and practices of underground mining adopted in various regions are discussed and a parallel is drawn with the scenario in our country.

"The sustainability revolution will, hopefully, be the third major social and economic turning point in human history, following the Neolithic Revolution - moving from hunter-gathering to farming - and the Industrial Revolution!" ~ HRH Prince Charles (2009)

KEYWORDS

Sustainable Mining, IEA, Risk Mitigation, Clean Coal Technologies, Carbon Capture and Storage (CCS)

1.0 INTRODUCTION

Coal is a variety of solid, combustible, sedimentary, organic rocks that are composed mainly of carbon and varying amounts of other components such as hydrogen, oxygen, sulphur and moisture. Coal is formed from vegetation that has been consolidated between other rock strata and altered by the combined effects of pressure and heat over millions of years. Many different classifications of coal are used around the world, reflecting a broad range of ages, compositions and properties.[7] The formation of coal deposits depended on specific characteristics of tectonic setting, geographical location, climate and flora, permitting the development of swamps. There have been three main periods during geological history when these conditions existed; during the Carboniferous, Permian and Jurassic-Tertiary periods. The reason that the coal mines are sought after intensely is its energy content. Used since early 19th Century for generation of electricity, coal is one of the most significant fuels. Industries like Cement and Steel also depend on coal. [2] Coal mining industry has seen a vast development from manual extraction to longwall method to the tunnel boring machines. The factors for this modernisation are both geological and

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economical.[1] The Industrial Revolution was in fact based on availability of coal to produce steam to fuel steam engines and furnaces. [3]

Figure -1: Tunnel Boring Machine

2.0 COAL MINING INDUSTRY – AN OVERVIEW AND SIGNIFICANCE

Coal currently provides 40% of the world's electricity needs. It is the second source of primary energy in the world after oil, and the first source of electricity generation. Since the beginning of the 21st century, it has been the fastest-growing global energy source. According to 'Statistical Review of World Energy 2013' by British Petroleum, world proved reserves of coal in 2012 were sufficient to meet 109 years of global production, by far the largest (Reserves-to-production) R/P ratio for any fossil fuel. Europe & Eurasia holds the largest regional reserves while North America has the highest R/P ratio. The US holds the largest individual reserves, followed by Russia and China.[5] World coal reserves on this basis amount to some 860 billion tonnes, of which 405 billion (47%) is classified as bituminous coal (including anthra**cite),** 260 billion (30%) as sub-bituminous and 195 billion (23%) as lignite.[6] India obtained third position in the top ten hard coal producers (source: Survey of Energy Resources, 2008), and uses 68% of coal in electricity generation (source: IEA, 2008).

In India proved amount of hard coal in place is 1,05,820 Mt, proved recoverable reserves (total coal) are 60,600 Mt, production (total coal, 2008) is 515.8 Mt. Coal is the most abundant fossil fuel resource in India, which is the world's third largest coal producer. The principal deposits of hard coal are in the eastern half of the country, ranging from Andhra Pradesh, bordering the Indian Ocean, to Arunachal Pradesh in the extreme northeast: the eastern States of Chhattisgarh, Jharkhand, Orissa and West Bengal together account for about 77% of reserves. The Ministry of Coal (quoting the Geological Survey of India) states that at 1st April 2009, India's geological resources of bituminous coal comprised 105.8 billion tonnes of 'proved resources', 123.5 billion tonnes of 'indicated resources' and 37.9 billion tonnes of 'inferred resources'.

***Picture Courtesy: Chris Ratcliffe/ Bloomberg

***R/P ratios represent the length of time that those remaining reserves would last if production were to continue at the previous year's rate. It is calculated by dividing remaining reserves at the end of the year by the production in that year.

Figure-2: Reserves-to-production (R/P) ratios (2012 by region)

Several challenges are ahead of continued use of coal. The main issues are structural complexity, processing difficulties, presence of many components in organic matrix at each stage of conversion, inorganic impurities, capital investments, processing costs and environmental impact. There are a number of approaches for making chemical raw materials from coal.

3.0 ISSUES WITH COAL MINING AND PROCESSING

Coalification results in the formation of Methane (CH_4, natural gas), which is a hazard in coal mines as it is highly combustible. 90% of all the methane emissions from the coal sector are from underground coal mining. Methane is also an intoxicating GHG (green house gas) and it is surprising to know that it is 23 times more harmful than CO_2. The mean methane content (m^3/tonne of coal) increases from 0.02 at a depth of 100m to 7.09 at a depth of 2000m.[4] That is increase of whopping 35,350 %! The issues associated with coal mining are mine wall failures, gas explosions, gas poisoning, suffocation, roof collapse, coal dust explosions etc.[2] Risks are reduced due to modernized coal mining processes and enhanced safety standards, but still 'Risk Mitigation' has to take an evolutionary path. Distinctions between ranks of coal are difficult to draw; hence the breakdown for any particular region is mostly indicative. The definitions, methodology, terminology and conventions of estimation of coal reserves and resources vary widely

Research in India has indicated that only about 21% of total geological resources can be regarded as recoverable. On the basis of expert advice from an Indian research institute, proved recoverable reserves of hard coal have been estimated as 21% of the total geological resources of 2,67,210 million tonnes as at 1st April 2009, giving a (slightly rounded) level of 56,100 million tonnes. Considerable uncertainty remains regarding India's coal reserves, particularly as to (i) whether they represent remaining tonnages or need to be reduced by the subtraction of past years' production, and (ii) whether it is appropriate to assess coal resources down to a depth of 1,200 metres, when current coal mines in India do not generally exceed 300 m. Although it is not possible to draw definitive conclusions from the information available, the downside implications of these considerations should be borne in mind. Lignite deposits mostly occur in the southern State of Tamil Nadu. Although India's coal reserves cover all ranks from lignite to bituminous, they tend to have high ash content and a low calorific value. It is significant to note that coal prices declined in all regions in 2012. Without proper regulations in place mining tends to be unsustainable. Unsustainable coal mining practices causes degradation of topographical feature and land patterns. It also causes deforestation, increase water pollution, air pollution, and eco-system imbalance.

Challenges faced by Mining industry for sustainable development are:[14]

• Ensuring the long-term viability of the minerals industry

• Control, use, and management of land

• Using minerals to assist with economic development

• Making a positive impact on local communities

• Managing the environmental impact of mines

• Integrating the approach to using minerals so as to reduce waste and inefficiency

• Giving stakeholders access to information to build trust and cooperation

• Managing the relationship between large companies and small-scale mining

• Sector governance: Clearly defining the roles, responsibilities, and instruments for change expected of all stakeholders.

4.0 SUSTAINABLE COAL MINING

Sustainable Mining is the need-of-the-hour. The importance of sustainable development principles has been increasing within the mining sector over the past two decades. Coal is a finite resource. Sustainable method of extracting coal from mines depends on how better the environmental factors are made use of. The coal industry is committed to minimising its Green House Gas (GHG) emissions and action is being taken in a number of areas. Carbon Capture and Storage (CCS) will form a vital part of global efforts to reduce CO2 emissions. Carbon capture and storage, or CCS, is a family of technologies and techniques that enable the capture of CO_2 from fuel combustion or industrial processes, the transport of CO_2 via ships or pipelines, and its storage underground, in depleted oil and gas fields and deep saline formations. CCS can, therefore, have a unique and vital role to play in the global transition to a sustainable low-carbon economy, in both power generation and industry.[7] CCS uses established technologies to capture, transport and store carbon dioxide emissions from large point sources, such as power stations. CCS is a key tool in tackling climate change, providing energy security, creating jobs and economic prosperity. The International Energy Agency (IEA) states that CCS could reduce global carbon dioxide emissions by 19% and that fighting climate change could cost 70% more without CCS. CCS has a key role to play in providing a balanced energy supply, which can cope with rapid changes in demand, and intermittency of supply.[8] Addressing the challenge of climate change, while meeting the need for affordable energy, will require access to and deployment of the full range of energy efficient and low carbon technologies. Capturing carbon dioxide that would otherwise be emitted to the atmosphere and injecting it to be stored in deep geological formations (CCS) is the only technology currently available to make deep cuts in greenhouse gas emissions from fossil fuel use while allowing energy needs to be met securely and affordably. CCS is not a replacement for taking actions which increase energy efficiency or maximising the use of

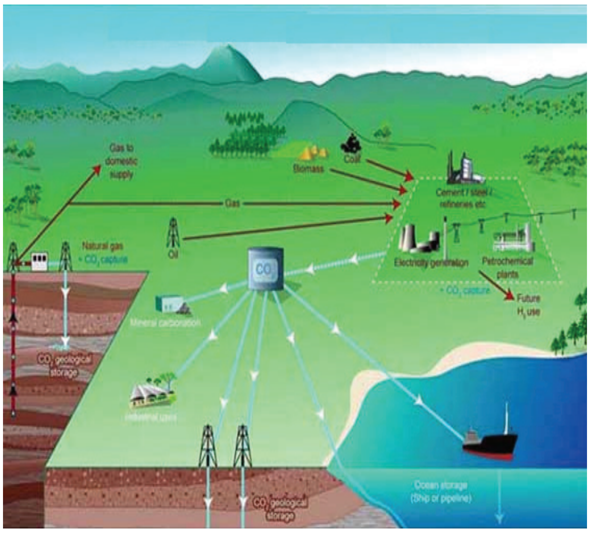

Figure-3: Schematic diagram of possible CCS systems[9]

renew-ables or other less carbon-intensive forms of energy. A portfolio approach taking every opportunity to reduce emissions will be required to meet the challenge of climate change.

4.1 Clean Coal Technologies

• SCPF - Supercritical Pulverized Fuel Technologies with steam conditions equal to or greater than 3500psig (240 bars or 24 MPa) and 1000°F (538°C). These systems have efficiencies of 40 – 45 %.

• Research and development is under way for Ultra-Supercritical units operating at even higher efficiencies, potentially up to around 50%. The introduction of ultra-supercritical technology has been driven over recent years in countries such as Denmark, Germany and Japan, in order to achieve improved plant efficiencies and reduce fuel costs. Research is focusing on the development of new steels for boiler tubes and on high alloy steels that minimise corrosion. These developments are expected to result in a dramatic increase in the number of SC plants and USC units installed over coming years.

• IGCC - Integrated Gasification Combined Cycle including coal gasification, hot gas clean up, steam turbine and combustion turbine generation. IGCC plants use a gasifier to convert coal (or other carbon-based materials) to syngas, which drives a combined cycle turbine. Waste heat from the gas turbine is recovered to create steam which drives a steam turbine, producing more electricity – hence a combined cycle system. By adding a 'shift' reaction, additional hydrogen can be produced and the CO can be converted to CO2 which can then be captured and stored. IGCC efficiencies typically reach the mid-40s, although plant designs offering around 50% efficiencies are achievable.

• PFBC - Pressurized Fluidized Bed Combustion including fluid bed combustion, hot gas clean up, steam turbine and combustion turbine generation. These systems ameliorate the environmental impact of coal-based electricity, reducing SOX and NOX emissions by 90%. The flexibility of FBC systems allows them to utilise abandoned coal waste that previously would not be used due to its poor quality. These systems have efficiency of above 40%.

• Non-Pressurized Fluidized Bed Combustion Systems have efficiency of 30 – 40 %.

These technologies achieve greater efficiency and lower emissions of CO2 and NO2. The IEA projects a significant growth in electricity demand and coal consumption world-wide, 67% and 41% respectively, between 1993 and 2010 for the "Capacity Constrained Case", which reflects a business as usual approach.

For the "Energy Savings Case", which reflects lower energy consumption, electricity demand and coal consumption increase by 46% and 32% respectively. Given the substantial global increases in the demand for coal, the potential therefore exists for these clean coal technologies to be used to supply the projected demand for electricity with greater efficiency and with a significantly lower environmental impact.[11] A programme of repowering existing coal-fired plants to improve their efficiency, coupled with the newer and more efficient plant being built, will generate significant CO2 reductions. Improving the efficiency of the oldest and most inefficient coal-fired plants would reduce CO2 emissions from coal use by almost 25% representing a 6% reduction in global CO2 emissions! These significant emissions' reductions can be achieved by the replacement of plants less than 300 MW capacity and older than 25 years, with larger and significantly more efficient plants and where technically and economically appropriate the replacement or repowering of larger inefficient plants with high-efficient plants of efficiencies greater than 40%.[12]

Coal is and will continue to be a crucial element in a modern, balanced energy portfolio, providing a bridge to the future as an important low cost and secure energy solution to sustainability challenges. Designs and systems of mining incorporating environmental compliance and sustainability aspects are required. In order to optimize the design of coal mining and reclamation operations, traditional mining engineering considerations and environmental and sustainability goals must be accounted for simultaneously. It is essential to identify all of the parameters, relationships, constraints and desired outcomes related to the widely varying factors that contribute to mine design, as well as the additional factors that should be considered as a part of a new, sustainable design approach. For successful optimization of mine design, required parameters must be identified and measured as part of mine design and planning. To build an accurate model of those operations, data must be collected on ongoing operations. This data accounts for the modification of long-term designs as a part of permitting and the acquisition of information during mine operation. The design and operation of current coal mining properties should be evaluated by looking both at permitting documents and additional data which obtained from mining companies and other public and private sources. This data reflects the mining engineering, geologic, economic and other considerations currently integrated into the design and planning process. It can then be determined how legal, policy, environmental protection and sustainability should be incorporated in mine design.

5.0 CONCLUSIONS

1. Geographically widespread and cost competitive resource base and the advanced technological state of today's coal mining and coal usage facilities are significant in overcoming the environmental barriers.
2. Closed handling systems must be installed at harbours and power plants.
3. Large investments in clean energy, including cleaner coal technologies are required.[10]

4. Advanced and Efficient Technologies must be used for new coal-fired power plant installations.

5. Mechanisms such as emissions trading, joint implementation (JI) and the Clean Development Mechanism (CDM) should be used.

6. Clean coal technologies such as SCPF, IGCC, and PFBC etc. should be adopted extensively.

7. Improving of efficiency levels increase the amount of energy extracted per unit of coal. These are mandatory for tackling climate change.[12]

8. In the post-Kyoto context, more work is required on ways effectively to internalise the environmental costs of generating electricity.[11]

9. In the long term future, the human kind may find more and more use of cleaner and renewable energy such as solar energy, even much safer form of nuclear energy such as nuclear fusion. However, the society will still need carbon-based feedstock for making organic chemicals and carbon-based materials.[13]

10. Thinking and acting based on the unique features and advantages of coals and make use of them in most effective, efficient and responsible way is the need of the hour. There are significant challenges to researchers to develop efficient and environmentally friendly reactions and processes for coal conversion and utilisation in the 21st century.

11. Expansion of the non-fuel uses of hydrocarbon resources, particularly coals, is desirable, because coal has the potential to become more important as source of both energy and chemical feed stocks in the future.

12. The coal industry should highlight how it can contribute through improving mining efficiency and educating customers on means of using coal more efficiently,promoting a more positive image for the industry. Also the coal industry should itself use more renewable energy, for example photo-voltaic, and should consider whether it would be appropriate to sell coal with 'emissions credits' (Dr. Lennon)

13. Advanced technologies to reduce the greenhouse gas (GHG) emissions associated with coal mining and power generation have to be extensively developed and deployed around the world.

14. Extreme caution and care should be taken while dumping hazardous wastes likes strip mining waste.

15. Integrated centres for Sustainable Mining Practices must be established and accredited.

16. Development of innovative, advanced, efficient, cleaner coal technologies is the need of the hour.

6.0 ACKNOWLEDGEMENTS

This paper is dedicated to my father Swargiya Darapu Apparao, mother Smt. Lakshmi, and sister Darapu Anupama.

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A " Safe Drinking Water Act (SDWA)" is need of the hour to safeguard the Public Health

Shirish J. Kardile[1]

Abstract:

Delivery of "Safe drinking water" at the taps or to consumers is essential to eliminate water borne diseases and epidemics. It is absolutely essential to improve water related public health, national health economy and the life style in general. It is high time to make our monopolistic suppliers accountable directly to consumers. A system of suitable checks and balances needs to be established so that water supply systems also become sustainable. The diverse and isolated efforts taking to improve water supply and treatment are required to be fix in this jig-saw puzzle. A regulation like "Safe Drinking Water Act" will be the right step in that direction.

Key Words: Safe Drinking Water, Our rights, Accountability, Regulations.

The Indian Paradox

The monsoon session (2006) of Indian parliament saw an interesting debate on quality of colas (caffeinated carbonated beverages) marketed by the major suppliers in the country. Our elected representatives thought it to be an important issue to debate it over several days. The state of Kerala even banned these beverages. The High Court had to intervene to lift the ban, calling it as an unjustified action of the state. The media created the hype by covering this event as if it was a issue of paramount national importance. The colas too made some publicity. The common man looked at it with his usual detached sense of amusement, while going through the daily chore of collecting his bucketful of precious water. He has been so concerned about his water taps to start running, that he has completely forgotten to look at what it is pouring or appropriately "trickling" out of it. Health of the nation (India) is infinitely more and directly related to the quality of drinking water than the quality of colas. And when was last national debate on safe drinking water? There probably never was. The rest of the world would probably laugh at this travesty or call it a great Indian humor of sense of priorities.

The consumption of drinking water must be hundred thousand times more than all the colas and soft drinks in India put together. The consumption of non-alcoholic beverages in India is roughly 50 million liters per day (Ref. 01), while city of Mumbai alone consumes 3350 million liters per day of treated drinking water. Cola is a luxury or an option, and also a status symbol of the society. Drinking water is an absolute necessity and its quality directly affects the public health which is a basic parameter of human development index. And still there is not a single regulation or law governing the quality of drinking water in India even after 67 years of glorious

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independence. If we think it is right to judge our colas with the yardstick of western or developed countries, why not our drinking water first? We have only general "guidelines" on drinking water quality, as per W.H.O. standards and they are not mandatory. It is a great paradox that we have regulations on disposal of sewage and effluents even before thinking about fundamental right of clean water.

It is a very questionable fact that, the government of India and various state governments encourage setting up of bottled water plants! The "End point use appliances" on our taps are even tax exempted!

The blame game would only prolong the agony of millions, who suffer from water borne diseases, indirectly eating in to a health economy of the nation. Collective priorities of a developing nation is a different debate altogether. But collective thinking of masses will always support a debate on safe and clean drinking water as the top most priority over Collas. Finally they are the ones paying for these great parliamentary debates and their health.

Where are our priorities gone?

Our Rights

Since we have some time or no time now (in context of India and the world respectively), can we give some attention to our drinking water quality? The October 1999 global survey finding places India 93rd out of 125 countries with respect to health and primary education. (Ref. 02). No need to say water-borne diseases contribute to our major down slide.

The United Nations General Assembly and UN Human Rights Council recognized access to Safe Drinking Water as human right in 2010. This Right based approach will lead to hold governments accountable for meeting the human rights obligations. (Ref.03). The Constitution of India makes only oblique reference to the drinking water supply, by ensuring that it is a responsibility of state governments.

According to W.H.O. (Ref.04), 900 million people in the world are deprived of Safe Drinking water. About 2.5 billion people have no access to sanitation facilities and defecate in open. UN Millennium Development Goal (MDG) targets it to half by 2015 with 1990 as a base line year.

A large range of economic and social benefits can result from Improved water supply schemes.

Treatment cost saved due to illness/disease (Health care)

Value of prevented deaths/ Reduction in premature mortality

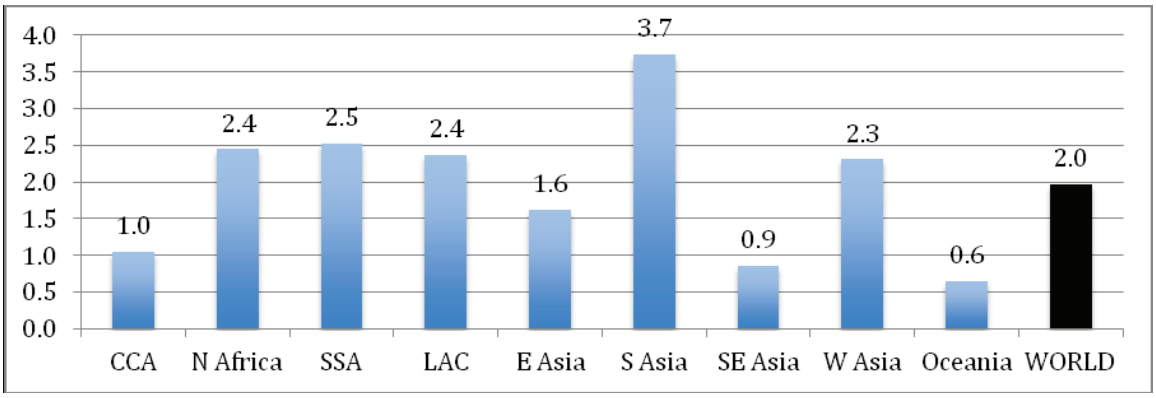
Time saving due to easier access

Gain in productivity time

Improved life style

The facts about Indian Public Health (and other developing nations)

Benefit-cost ratios of interventions to attain universal access of improved drinking-water sources, by region (2010)



(Summary results for attaining universal access to drinking-water are shown in the Figure The benefit-cost ratio (BCR) for the necessary interventions varies from 0.6 in Oceania to 3.7 in S Asia. or 1.5% of Gross Domestic Product of the countries included in this study. The economic benefits of extending services to the un-served in E Asia are negligible because two of the three East Asian countries (China and Republic of Korea) have already met the MDG target for water.) (Ref 05)

The total global economic losses associated with inadequate water supply and sanitation were estimated at US$ 260 billion annually About 2 million people die every year due to diarrheal diseases, most of them children below age 5 in developing countries. Since India contributes to roughly 30% of the world's population (2008), clearly it's the worst contributor to this statistics. The total population of India is 1.25 billion. The mortality rate under age 5 is 65-70 per 1000 berths. Water borne diseases contribute to 20-25% of these overall deaths. Diarrhea alone causes more than 1600 deaths daily. (Ref. 06). Annual investment in water supply and sanitation sector in India is USD 5/- per capita.

Key indicators of Drinking Water, Sanitation and hygiene in India

NSSO – National Sample Survey Office (Ref.07)

Category	NSSO, 69 th Round July 2012-December 2012		NSSO, 65 th Round July 2008 – June 2009	
	Rural	Urban	Rural	Urban
Drinking Water	46.1	76.8	30	74
Latrine	41.6	92.2	35	89
Garbage Disposal	32	75.6	24	79

The India Story I – Source water quality

Our traditional water sources are getting depleted and polluted rapidly. Rapid growth in population and industrialization has added a variety of contaminants in our raw waters. In addition to traditional inorganic and bacteriological impurities, we have now added worries of organics and microbial contaminations.

A classic case is NTPS (Nashik Thermal Power Station) township near Nasik in Maharashtra. Their original source was river Godavari and the intake was located on the downstream side of Nasik city. The source water is polluted by untreated sewage from Nasik City and agricultural run-offs. In the lean flow season there used to be regular epidemics of jaundice (Hepatitis virus B) in the colony of this power plant, in-spite of having a water treatment plant. Irrespective of trying out various options of treatment, they had to finally change the raw water source itself! Now they draw their water from a comparatively less polluted river Darana. They had to lay a pipeline of 18km length to pump the raw water. They constructed a new dedicated treatment plant for drinking water supply. How many cities in India will be lucky to have an alternative source? Even if they have, can they afford it?

Another case had occurred in March 2006 at Baramati, a town near Pune in Maharashtra. A part of their water is supplied from Ujani lake (reservoir). The citizens reported a yellow-brownish tinge to their tap waters. People refused to drink the water. On investigation it was revealed that the source water contained blue green algae and organic iron. Apart from improving the coagulation-flocculation processes, the other remedial measures, bleaching powder (Calcium hypochlorite) was found to be ineffective and had to be replaced with chlorine gas. Administrating chlorine gas is a hazardous task itself and is especially true for the small utilities. But there was no option. The Ujani lake receives partially treated effluents and sewage from the upstream sources. The nutrients like N & P in combination with the lake hydrology and climatic conditions cause algae bloom and it was the cause of trouble. It was found that in this shallow water reservoir, bottom layers of water were more polluted than the surface layers.

The greenish-black fibrous algae as sludge
Algae laden backwash water from filters
from Tube Settlers

The city of Agra (the Taj Mahal) which consumes about 500 mld water, is currently changing its source from polluted Yamuna river to a less polluted Ganges canal at a multimillion dollars loan from JICA.

The unabated ground water extraction in some states have led increase in TDS levels, contamination by iron, arsenic, fluoride in deep bore waters (Ref.08)

The terminologies like TOC, SOM, NOM, DBP have now found a meaning in Indian context too.

The India Story – II : Scarcity of water

The population explosion and rapid urbanization has put a tremendous burden on the drinking water demand of water supply.

Coupled with fact is seasonal variation of rain fall and artificial deficiencies in distribution of available water.

Natural shortfall: Apart from some north Indian states, most of the Indian surface water gets replenished in four months of monsoon (June – October). Prior to Sardar Sarovar project in Gujarat, we know that water trains had to be arranged to supply need of some towns in Saurashtra in summers. Chennai has finally adopted de-salinated seawater as an alternative source. Many solutions ranging from conservation of water, recycle, desalination, connecting river basins, have been tried and implemented without any overall tangible solutions or results. It is difficult to appreciate these efforts in isolation in absence of any overall frame work

One of the most progressive states, Maharashtra (Capital: Mumbai) has to depend on surface water for drinking water supplies. The river flows are only seasonal in monsoon. So it depends on the stored water like reservoirs, dams and lakes. There is a perennial shortage of water in summers. Many communities were required to be supplied water by tankers.

In order to overcome this situation, in the year 1985, Government of Maharashtra declared a program with a vision to make Maharashtra " Tanker free". It was decided to base all the water supply schemes on "permanent assured sources" like dam or reservoirs. All the major and minor irrigation dams were required to "reserve" the drinking water quota irrespective of the ownership of the source. Earlier the estimation of the water supply schemes were based on a per capita expenditure of the community's population. Since the policy change increased the cost of conveyance of water over long distances, the practice of provision for funds was altered based on the actual cost of the scheme. The state had to pay a heavy price, but today at least 80% of the population has become tanker free.

Artificial deficiency: The classic case is capital of India, New Delhi (Ref. 09). The Delhi Jal Board which supplies the water, claims to supply it to 3,500,000 souls at the rate of 220 lits/capita/day. Yet, half of the Delhi population doesn't receive piped water supply. They depend on water tankers and un-authorized ground water to quench their thirst. Distribution losses in Delhi are 52% ! One of the prominent reasons for slow progress of distribution network is "influence" of tanker mafia owned by politicians. Average water supply in Indian cities is 3.3 hr/day ranging from one hour every three days to 18 hr/day. (Ref.10)

In south India, the states of Karnataka, Maharashtra and Andhra are fighting over their share of Krishna river water over many years. Inter river basin management is not successful as there is a strong geographical-political issues influencing the solutions

Nick King's Downward Spiral

The different states have adopted different vehicles for organizing the water supply. (Example- Public Health Engineering Departments, Water Supply and Sewerage Boards, Jal Nigams, Pradhikarans, Zilla Parishads, Panchayats etc).

Water supply is traditionally divided in to two compartments, Urban and Rural. Many large cities and municipalities have been given the responsibility to manage their water supply on their own (a sort of autonomy or a part of decentralization). There is a lack of coordination between these agencies on policy matters.

Traditionally there have been always complaints by the urban citizens on shortage of water and irregularity in supply. In recent years there have been increasing incidents/complaints about the quality of water too. Summers and monsoons routinely bring in their quota of water related diseases and epidemics. On the other hand the Municipalities (suppliers) plead a lack of revenue, unwillingness of the citizens to pay, losses and theft of water, inability to raise the tariff, disproportionate growth due to urbanization and therefore the demand. In the present techno-economic-social scenario this is a never ending debate (in many other developing counties too). Nick King, ex-executive director of International Water Association (IWA) called this as a Cascading Downward Spiraling Freefall, leading to deterioration of services in this sector. The king's cascade raises a very important point about sustainability of water supply schemes

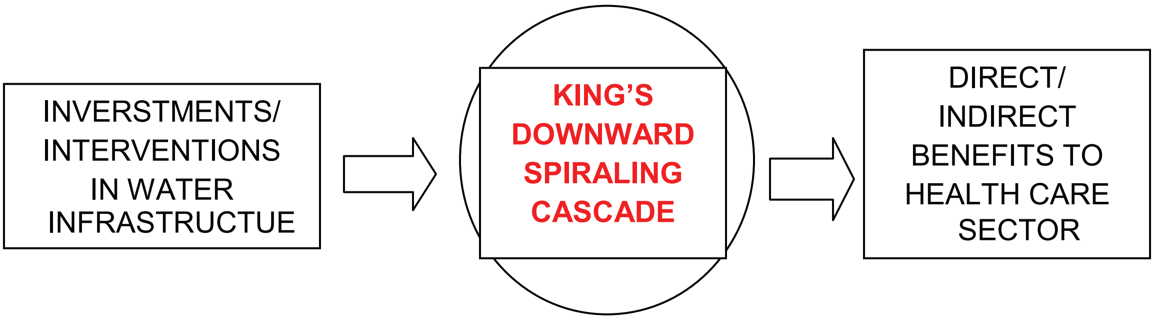
Classical case of Accountability Vs Non-Accountability .

In Indian industrial sector, where quality water is required to process the goods, the experience is that there is a very good management infrastructure. The water quality is strictly maintained as per the required norms to ensure quality production. Otherwise their product will suffer, resulting in getting their market affected. Industry cannot afford this. Hence there is accountability towards water management.

On the other hand, in municipal drinking water sector, at many places the water quality is unsatisfactory. The sufferer is the consumer, his health and health economy. The losses occurring due to this are still not quantifiable in India. This is due to the cause that water manager has no accountability. The consumers have no rights.

There is not much data available on the surveys done in India to link drinking water quality with respect to health aspects, micro-economy of consumers to macro-economy of the nation but the overwhelming evidence does not necessitate the statistical support for logical conclusion. Water is a highly sensitive issue in an ever changing socio-economic platform. Only one thing is certain that King's cascade is enormously corrupting the basic public health directly and the economy indirectly.

(It is to be noted that there are many utilities in India which are honorable exception to the general description above. However these are in minority. This discussion is mainly confided to a large majority in urban and semi-urban water sectors in India.)



Lack of sustainability

The buck has to be stopped, the rot has to be stemmed

One feels sick over the reports that in a techno-savvy country, thousands of children suffer from common diarrhea and oral re-hydration therapy is still important to save their lives.

There is no option but to ascertain accountability. Accountability will ensure good governance. Water is essential to sustain our life and the provider/supplier has a monopoly over our waters, hence logically we (the people) should have a right to ensure the water quality. In short the authority, utility or the supplier has to be made accountable. The monopoly supplier has to ensure the basic minimum quality as well as quantity, which is acceptable / affordable under relevant norms of public health.

At the center of the focus is a "safe" drinking water and not the water which we are made to drink. Over the past (since 1940), the Govt. of India (through Central Public Health and Environmental Engineering Organization, CPHEEO and Bureau of Indian Standards, BIS) has only published "recommendations" of quality standards for drinking water (largely based on W.H.O. guidelines). These need to be converted in to "regulations". This quality has to be delivered at the taps. At the risk of being slightly adventures, we need to be ready to debate A Safe Drinking Water Act?

The history of Water quality regulations in the United States

There is no shame in learning from others and especially from other developed dynamic and vibrant democracies. The United States is one such country which has similar diversities in waters and the cultures like ours. It will be interesting to have a look at the fascinating history of drinking water quality regulations and standards in the United States of America. In the year 1912, under "National Quarantine Act", the U.S. Public Health Services (USPHS) prohibited the use of common cup on carriers of interstate commerce such as trains (in order to prevent the spread of communicable diseases). The USPHS was then part of the U.S. Treasury Department. Reviewers realized that drinking water cups will not be of any value if the water placed in them was unsafe. And hence first federal drinking water standards were adopted in 1914 (also known as treasury standards) and were legally binding to interstate carriers. Since the commission that drafted these standards had been unable to agree on the physical and chemical requirements, the provisions were only related to bacteriological quality of water (E-coli or Escherichia coli, an indicator of contamination by human feaces or excreta). Many state and local governments adopted these as guidelines. These standards were continuously updated till early seventies. In addition to improving the bacteriological standards, physical and chemical standards covering 28 constituents (like lead, copper, zinc, excessive minerals etc) were included in the revision in 1962. The principle of attainability was established so that these standards could be meaningful within the limitations of existing technologies to achieve them.

The contemporary parallels and the evolution of SDWA

From 1930 to 1970 the United States underwent a major transformation through industrialization. Henry Ford introduced his first car to public in 1908. The second World War lasted from 1939 to 1945. Neil Armstrong landed on moon in 1969. Many large water supply schemes and treatment plants were constructed in these three to four decades. However various surveys (initiated by USPHS) indicated that still a significant population of the U.S. was supplied with inadequate quality and some even with potentially dangerous drinking water. Many systems were found to be deficient in aspects of source water protection, treatment, dis-infection , pressure in distribution systems or combinations of all these and they did not meet the guidelines of 1962. A significant revelation came up in 1972, when thirty six organic compounds were extracted from drinking water supplies (treated water) from raw waters of Mississippi river, Louisiana. Surveys further established that very few systems were complying with the sampling requirements as per the USPHS standards. Many plants were in need of upgrades. Public awareness about the organic compounds in drinking water increased during the early eighties. Several studies conducted by EDS (Environmental Defense Fund) and the USEPA (US Environmental Protection Agency) highlighted the adverse effects of these on public health. In Europe it was established at the similar time that Natural and Synthetic organic compounds were found to be reacting with free chlorine(in water supply systems) to form tri-halo-methanes (THM's) and other byproducts, some of which were potentially carcinogenic. On December 05, 1974 CBS aired in a prime time program nationally, titled: 'Caution, drinking water may be dangerous to your health.'

The end result of these facts, a federal legislation was enacted to develop a national program to protect the quality of public drinking water systems. The SDWA (Safe Drinking Water Act) was signed into law on December 16, 1974. (Public Law 93-523, SDWA 1974). Principally the act required the establishment of primary drinking water regulations designed to ensure safe drinking water to the consumers. SDWA mandated specific roles for the federal government

(USEPA), the state governments and for public water suppliers (local bodies). The USEPA was authorized to set national drinking water regulations, studies and research. The state governments through their health departments and environmental agencies were designated the role of primary enforcement agency as regulators. Public water suppliers were given the onus of day to day responsibility to meet the regulations, a clear cut three divisions of responsibilities. The suppliers were required to monitor the quality and report to regulators, violations were needed to be made public and corrected. Failure to perform any of these functions could result in enforcement, legal action and penalties. USEPA further contracted National Academy of Science Studies (NAS) in an advisory capacity to revise the drinking water regulations in terms various amendments (to existing recommendations).

As a result of this law the state governments and the suppliers (utilities) needed to invest huge amount of funds to make compliance with the provisions. The cost of complying with the laws in absence of un-funded federal mandates became a concern to state and local administrations. Many groups pressurized congress for the relief. The reauthorization of the SDWA in 1996 with amendments included these concerns after a protracted battle. Apart from substantial revisions, it created the provision for state revolving loan fund (SRLF) for drinking water and significant provision for infrastructure funding, drinking water research and source water protection grants. Strategic planning became significant to comply SDWA.

The progress of these regulations over the years was extremely pain staking and exhaustive. But at the hind sight there was a vision. It will be worth noting the spirit of remarks by a U.S. court (Dist. of Columbia, 1978) on advising USEPA. “The incomplete state of our knowledge regarding the health effects of certain contaminants and the imperfect nature of the available measurement and treatment techniques cannot serve as justification for delay in controlling contaminants that may be harmful”.

(It has to be noted with gratitude that most of this information is compiled with the literature published by American Water Works Association (AWWA), and it is suitably interpreted by the author.).

Can we even think of adopting such a system?

SDWA in Indian Context

The Safe Drinking Water Act requires public water systems to monitor their water supplies to ensure compliance with drinking water standards and to report monitoring results to the states. States review monitoring data submitted by public water systems, and also conduct their own monitoring, to determine system compliance with drinking water regulations. The EPA monitors public water system compliance primarily by reviewing the violation data submitted by the states. (Ref.11)

Conceptually SDWA is simple to understand. It ensures realistic quality requirement with an inherent provision to up-grade.

It's a 3-tier system of management with full accountability. It promotes self reliance of water supply schemes with only assistance on technology and infrastructure funds till the system reaches compliance. It's a combination of matured executive wing of govt with a complimentary judiciary. (And an informal platform like AWWA to debate and discuss).

It is only a question of time before we will need to adopt a similar system.

We are behind the present American water scenario by at least sixty to seventy years. Forget the numbers, since we will not be able to match those mandated by their laws. But such regulations (even diluted) can ensure a level playing field for all the beneficiaries with inherent checks and balances. It will make us (We, the people) realize our responsibilities too. Fortunately in India (in many states), a loosely held three tier management structure exists in this municipal sector to some extent (as is required by the SDWA). However it is in hibernation and needs to be mandated suitably.

Maharashtra has made at least some kind of beginning. Long back it has taken a decision to treat the surface water sources for drinking water supplies, irrespective of the size of community.

Optimism needs to be cautioned by ground realities. Essentially, gaining of confidence of the masses will be a crucial aspect. The public utilities have become lethargic and will need to galvanize into action. It will require a large gestation time and huge amount of funds. People pay for quality and reliability. The paying power differs as per the individual status. Consumers will pay but will ask justification of the tariff. It is a proven fact that urban poor sector is a reliable source of revenue if the tariff is rational. Urban rich will be required to pay higher for higher consumption. The need to make water supply schemes self- sustaining will bring in the seriousness to the planning and usher the era of appropriate, cost-saving and sustainable technologies. The govts while funding/approving the capital expenditure (in terms of a grants, loans, and borrowings) will need to ensure this crucial aspect that water supply is for the people. Once we change our mindsets to the acceptance to appropriate reforms and technologies, King's cascade will slow down and eventually stop its freefall.

The benefits for other stake holders

Improving drinking water quality will not only improve the health, micro-economy of the consumer or an individual but will also have a far reaching impact on the other aspects of macro-economy of the nation. It's for everyone to see that this would be the difference between the developed countries and the developing countries. The rejuvenated water industry will be a boon to the self esteem and new found confidence of this great nation.

The stake holders having interest in surface water protection, conveyance of water, water treatment, distribution, storage, Operation and maintenance, innovations, skilled and unskilled labor, residual management sector, quality and monitoring will all get benefited in quest of the utility to improve drinking water quality and make the schemes sustainable.

To deliver the safe water the distribution pipelines will need to be cleaned off its deposits regularly. This will be mostly a manual work. Can one imagine of the huge potential it will generate for the unemployed unskilled and semi-skilled work force in the organized sector? The encrusted, age-old arteries and machinery will get 'angioplasted' revamped.

The water treatment facilities will become temples of paramount importance. To run the plant efficiently the utilities will require educated technical man power in terms of operators, supervisors, chemists and mechanics. The regulators will then need to design certification courses for various trades. To support the logistics, automation and computerization of water supply control will come in. The strength of modern India, a vast English speaking, computer savvy professionals and students will have a new opportunity at their hand.

The contractors, manufacturers and the suppliers (service sector) of the components who will be a part of the beneficiaries will need to update themselves with appropriate technologies. Sustainability and simplicity will find a new meaning. Manufactures then can base their products on recognized Best Available Technologies (BAT). Funds will flow to the Indian research institutions and universities to do the research work which will be practical and relevant to our unique conditions. Cost benefit life cycle analysis will become practical. Utilities will need to up-grade their facilities. It has inherent meaning of reusing the existing facilities by revamping and retrofitting with appropriate and advanced technologies.

Innovations will be a key to improve the revenue. In the United States some utilities offer the space on roof of elevated tanks and towers to install wireless transmission systems. In India most of our utilities have elevated tanks for distribution systems, placed at a strategic elevation on zonal pattern. It will be a reliable source of revenue for the municipalities. The city of New York has its sewage treatment plant constructed underground (due to lack of space). They have created recreational park above it. Singapore govt. encourages the citizen and tourists to visit their sewage recycle plant and even encourage drinking the water (treated from sewage). The source water lakes have potential to become recreation centers (albeight with stringent hygienic controls). The flattening world will have great many towering ideas. We only need to ensure that these water towers and waters in it are sacrosanct, their safety and sanctity is of paramount public health importance. NGOs can then play a meaningful part by working as watch-dogs of the drinking water quality.

The first opportunity (Is it at our door step?)

And here is a first opportunity to make all concerned of our drinking water responsible. Jawaharlal Nehru Urban Renewal Mission (Ministry of Urban Development) has granted a huge amount (USD 20 billion) of infrastructure development funds to the selected 63 municipal utilities to plan their development up to 2020 (Ref.10). A certain part of the funds needs to be spent on the water supply and sanitation sector.

The capital including interest needs to be paid back to the lenders in a specific time frame. Utility needs to recover the money by levying direct or indirect taxes on the citizens. If looked upon rationally, a great opportunity in history (of water supply) to correct the fundamental deficiency in the system. Can we make these utilities at least to accept voluntary compliance to the drinking quality "recommendations" published by Govt of India? At the least, the water samples will be checked and monitored routinely and we will develop a much needed data base of drinking water quality. The Govt. can even think of giving some incentives to even attend the partial compliance. Immediate aim will be to encourage their autonomy but with a clear cut hint that big brother is watching.

A more permanent and systematic approach will be to approach various state governments and make them aware about the regulations and benefits.

Concept note by Government of Indi on regulations: (Ref. 12)

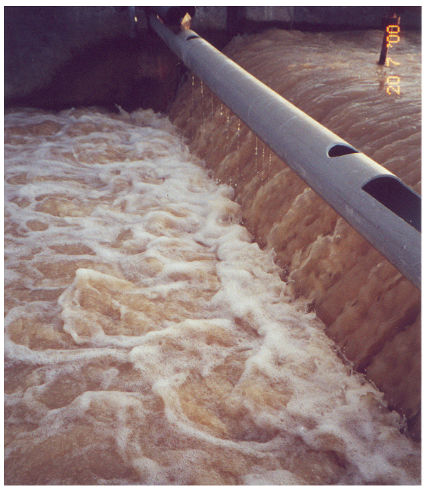
In India the drinking water supply policies are governed by Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development and Department of drinking water supply and sanitation by Ministry of Rural Development.

It was felt that the issue of drinking water is required to be considered as a separate self contained proposal, considering its desirability, feasibility and all other aspects such as standard setting mechanism, regulation of potable water, phasing of implementation and implications in Center State relations. Since water falls in the entry 17 of the State list in the Seventh Schedule to the constitution, potable water as such is regulated by various local bodies/authorities and the State Governments are responsible for proper implementation of laws made by them. It is felt that the proposals related to potable water should address all relevant aspects with a view to making it a self contained legislative proposal, in consultation with all Ministries/ Departments, as well as the states.

The alternative formulation as such would require making legislative proposals for enacting a central legislation to provide for water and its regulation through the States and its agencies.

A Cautious optimism :

Jamshedpur Utilities and Services Company Limited of Tata Steel (JUSCO), which manages the water supply of Jamshedpur town in Zharkhand, voluntarily observe W.H.O. guidelines through Private Sector Partnership. (Ref. 13).



Rapid mix weir without electrical energy

Clarifier retrofitted by tube settlers

Maharashtra Jeevan Pradhikaran (A statutory body of Govt. of Maharashtra) has standardized "Simplified water treatment plants" (Ref: 14) over last two decades. More than 500 plants stand constructed. These small capacity plants employ minimum mechanical equipment, are cheap to construct and found to be sustainable over a long period of time even in poor operation and maintenance infrastructure

(Pictorial view of small capacity " Simplified " plants

These are the just two examples, there are many more. It is worth recognizing the fact that many developments have taken place in India in drinking water sector too. However they remain piece-meal and isolated efforts. Dissemination of information will be crucial. And for the first time we have even an advantage. In the flattening world, our advances in information technology can actually shrink our real times. Thanks to Thomas Friedman for en-lighting us on our strengths (Ref.15). Can one of modern India's miracle lead to the happening of another? In India we have many individual Banyan trees of knowledge in the water sector. Only they need to come together to set the Juggernaut in motion.

One more hope! Population of 1.25 billion has successfully eradicated polio from India, a no mean achievement

India is in a unique position today to understand that we do need our colas but also appreciate the fact that "aqua pura" remains topmost priority on Indian terra firma.

The transformation in happening or waiting????

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6. American Water Works Association : All the authors of relevant literature published by AWWA

7. Indian Water Works Association: Various quarterly journals of IWWA.

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Assessment of the quality of vermi composting produced from Municipal solid resource (waste)

Gade. Venkatesham[1], M.Chandrasekhar[2] & T.Bala Narsaiah[3]

ABSTRACT:

In management of Municipal Solid Waste (MSW) by local bodies like municipalities and panchayats, there are two broad technologies. One of these is biomethanation in digesters to generate Methane gas and recovering electrical energy from it in gas engines. The other is the composting to produce compost in gardening, horticulture, kitchen gardens and farm forestry. The biomethanation and energy recovery technology is highly mechanized and requires highly skilled O&M and is hence suitable only for large municipal corporations. The composting technology is relatively easier for smaller local bodies as panchayats because it avoids complicated O&M of machines and can be managed by local semi-skilled labour. the Methane gas is a sustainable option than biomethanation because it is least mechanized. Within the composting options, the choice is Windrow composting (WC), Vermi composting (VC) and Microbial composting (MC). Between these, the VC is the simplest process where all that a labourer has to do is a periodical "turn over" of the vermi composting pits and segregation of the earth worms. Thus, it is the VC which suits the vast rural habitations in our country. In addition, these pits can be easily covered by thatched sheds in monsoons. However, when it comes to the certification of the compost for use in public, kitchen gardens, farm yards etc, there are no easily measurable parameters. Recently the Fertilizing Index (FI) and Clean Index (CI) and marketable classes (A, B, C & D) or restricted use class (RU-1, RU-2 & RU-3) have been suggested. In this study, the MSW from habitations in Hyderabad and Warangal have been collected and put through VC and the quality of the compost is rated on the FI and CI criteria. The results are presented in this paper. With similar studies from other parts of India, this will help the country to develop the standards for useable compost.

Key words: MSW, Compost, Fertilizing Index, Clean Index, Vermi composting, Microbial composting, Windrow composting.

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1 Study area

Grab samples of MSW were collected from different Municipal Corporations / Private Establishments. The raw MSW was either mixed waste or partially segregated. The non-biodegradable contents were separated before composting. The information pertaining to type of raw material used and methods involved for composting are shown in Table-1.

Table1

Sl.No	Location	Method of composting	Label
1	Miriyalguda	vermicomposting	V1
2	H.C.U Campus Hyderabad	vermicomposting	V2
3	Warangal	vermicomposting	V3

2 Parameters Analysed

The parameters tested were moisture content, volatile solids, pH, electrical conductivity (EC), total organic carbon (TOC), nitrogen, phosphorous, potash, carbon respiration and heavy metals. The derived parameter was the C/N ratio.

3Vermi Composting Methodology Used

- Waste must be free from glass pieces and plastics
- The bed is filled with waste etc .
- The top of the bed should be covered with paddy slurry.
- It is kept wet up to 30-40 days but water should not be stored in the beds.
- The bed should be maintained in cold conditions or should be in shade.
- The bed volume decreases 3 feet to 1½ feet in 15-30 days, i.e. the initial bed volume, become half.
- Then the earthworms 1kg are introduced by making

2 to 3 holes in every bed (25 kg initial)

- It is recommended to shake (stir) the bed to decrease the heat generated inside the bed.
- To maintain optimal wetness, water is sprayed in alternate days. It becomes dried 30-45 days
- The top layer is taken out and screened after 45days onwards.
- The compost will be ready within 55-60days (around 1feet).
- After the screening procedure fine powder like compost is obtained which contain

Earthworms in larvae stage i.e.300 kg/bed

- These earthworms are introduced on to the other bed. This is batch wise continuous.

Process some precautions should be taken,

- If more than two beds are maintained then 15 days gap should be given from one bed to Another bed.
- Otherwise NODE process can be preferred

The Vermi composting gives good yields

When used for mango plantation, lemon plantation, and Orange plantation than Compared to rice.

- It is batch wise continuous process

4 Assessment of Compost quality

Unlike the standards for utility items and consumables as laid down by the Bureau of Indian Standards (BIS), there are no such standards for the compost derived from MSW. The prevailing guidelines are the Fertilizer (Control) order 1985, MSW (1999) - Municipal Waste (Management & Handling) Rules, 2000 and the European Economic Community Organic rules (EOR). These guidelines prescribe the acceptable limits of parameters such as moisture content, pH, EC, volatile solids, Total Organic carbon, Total Nitrogen, Total Phosphorus, Total Potassium and Carbon respiration. While the limits are almost the same in all the three guidelines, there are huge variations in the permissible limits of heavy metals. Most European countries have their own set of standards regarding permissible heavy metal limits, while USA has an entirely different set of standards In India MSW handling rules (1999) prescribes a limit whereas the Fertilizer Control order 1985 (FCO) quality control prescribes a stricter set of limits set by MSW handling rules (2000). There is some lenience in the guidelines of USA for Cu, Cr, Cd and Ni. The Indian guidelines are neither in both extremes.

Saha etal (2009) have developed indices such as fertilizing index and clean index to grade the compost and then determine its quality based on which its use can be determined. It helps to standardize the quality of compost. And it also can be used to find the method used to get the best quality of compost from Municipal solid waste.

5 Classification of compost based on Fertilizing Index (FI) and Clean Index (CI):

The compost is graded based on the score value of fertilizing index the table gives the detailed classification based on the Score of the compost. While 'Fertilizing index' can be taken as a measure of nutrient supplying potential, 'Clean index' value can be used by regulatory authority for restricting the entry of heavy metals into sensitive components of environment (like agricultural land and water bodies). On the basis of critical analysis of 'Fertilizing index', and 'Clean index' values of MSW composts, different classes of compost has been proposed for their use in different application areas as well as for their suitability as marketable product.

The 'Fertilizing index' of the MSW compost is computed using the equation

$$\text{Fertilizing index} = \sum W_i\, S_i / \sum W_i$$

where 'Si' is score value of analytical data and 'Wi' is weighing factor. The values of Si and Wi for fertilizing index is given in Table 2. Each analytical data affecting the fertilizing value (responsible for improving soil productivity) of compost, like total C, N, P and K contents as well as C:N ratio and respiration activity, are assigned to a 'score' value as per the category given in Table 2 While assigning score values, analytical values of these fertilizing parameters obtained for source separated biogenous waste composts are considered. The minimum values of above fertilizing parameter obtained for such comp osts were placed under score value '3'. Higher value of any fertilizing parameters were assigned higher score value. On the basis of scientific knowledge on their role in improving soil productivity, each of these fertility parameters was assigned a 'weighing factor'.

The 'Clean index' of the MSW compost is computed using the equation

$$\text{Clean index} = \sum W_j\, S_j / \sum W_j$$

where 'Sj' is score value of analytical data and 'Wj' is weighing factor of the 'j'th heavy metal. Saha et al (2009). Higher score is ascribed for less heavy metal content and thus, composts with less heavy metal contents attain higher value of 'Clean index'.

6 Results

The physical and chemical parameters of all the large scale compost was tested in the laboratory and presented table5.Parameters such as Moisture content, Volatile solids, pH, EC,

Total organic carbon, plant Nutrients such as N,P& K, C:N ratio, Carbon respiration and heavy metals. All the parameters were compared with Compost guide lines given by FCO 1985.The heavy metals in the compost samples were also compared with MSW 2000 (handling) rule, USA bio solids and EEC organic rule.

S.No	Parameters	UOM	V1	V2	V3	Standards		
						FCO*	USA**	ER
1	Moisture Content	%	30	29.5	37.3	20 30%		
2	Volatile solids	%	48.5	33.2	73.3	-		
3	pH		7.6	7.8	8.5	6.5–7.5		
4	EC	(dS/m)	2.81	2.614	1.967	3.14		
5	Total Organic carbon	(% dm)	26.9	18.4	40.7	>16 (% dm)		
6	Total N	(% dm)	0.7	0.6	0.6	>0.5		
7	Total P	(% dm)	0.135	0.021	0.126	>0.22		
8	Total K	(% dm)	0.2	0.12	0.07	>0.83		
9	C:N Ratio		38.5	30.7	67.9	20:1		
10	Carbon Respiration	(mg CO_2 – C g Vs d)	0.5	0.5	0.3	2-8		
11	Zinc as Zn^{2+}	(mg/Kg)	92.1	90.6	54	<1000	2800	200
12	Copper as Cu^{2+}	(mg/Kg)	15.2	18.3	12.5	<300	1500	
13	Cadmium as Cd^{2+}	(mg/Kg)	0.3	0.1	0.8	<5	39	0.7
14	Lead as Pb^{2+}	(mg/Kg)	2.3	2.9	4.4	<100	300	45
15	Nickel as Ni^{+}	(mg/Kg)	4.2	4.6	5.5	<50	420	25
16	Chromium as $Cr3^{+}$	(mg/Kg)	3.9	4.5	7.5	<50	1200	70

Table.2: Physical / chemical parameters of Large scale Vermi Compost Samples

7 Discussions

Table 2 shows the physical and chemical parameters of the Large scale Vermicompost samples It had volatile solids ranging from 33.2 – 73.3 % dm with a median value of 45 %dm .The moisture content ranged from 16.7 – 37.3 % it was mostly found to be in the optimum range with a median value 29.5 % wm.EC ranging from 1.96 – 2.97 dS/M with a median value of 2.61 dS/m. The pH of the samples ranged between 6.5 and 8.5.

The sample had TOC (Total organic carbon) ranging from 18.4 – 40.7 % dm with a median value of 26.9 % dm. The major plant nutrients in the Vermicompost samples were Nitrogen, Potassium, and phosphorus. Total N, P, K contents ranged from 0.60 – 0.90 % dm, from 0.021 – 0.354 % dm, from 0.07 – 0.45 % dm with a median value of 0.7, 0.13, 0.2 % dm respectively. The C:N ratio ranged from 23.4 - 67.9 with a median value of 31.5.The optimum C:N ratio for a finished compost is < 20:1 (permissible range is 25:1 to 10:1or lesser).). The samples the Compost respiration ranged from 0.3 to 0.6 CO2 – C/g VS d with a median value of 0.5 CO2 – C/g VS d. The compost was ound to be stable based on the Compost respiration.

The heavy metals were found to be as in Figure 1 and are 54 -92.1 mg/kg for Zn, 12.5 – 18.3 mg/kg for Cu, between 0.1 – 0.8 for Cd, 2.3 – 5.6 mg/kg for Pb, 4.2 -6 for Ni, 3 -7.5 for Cr with a median value of 90, 15.2, 0.3, 3.1, 4.8, 4.5 mg/kg respectively. All samples showed that the heavy metals ranged within the permissible limits.

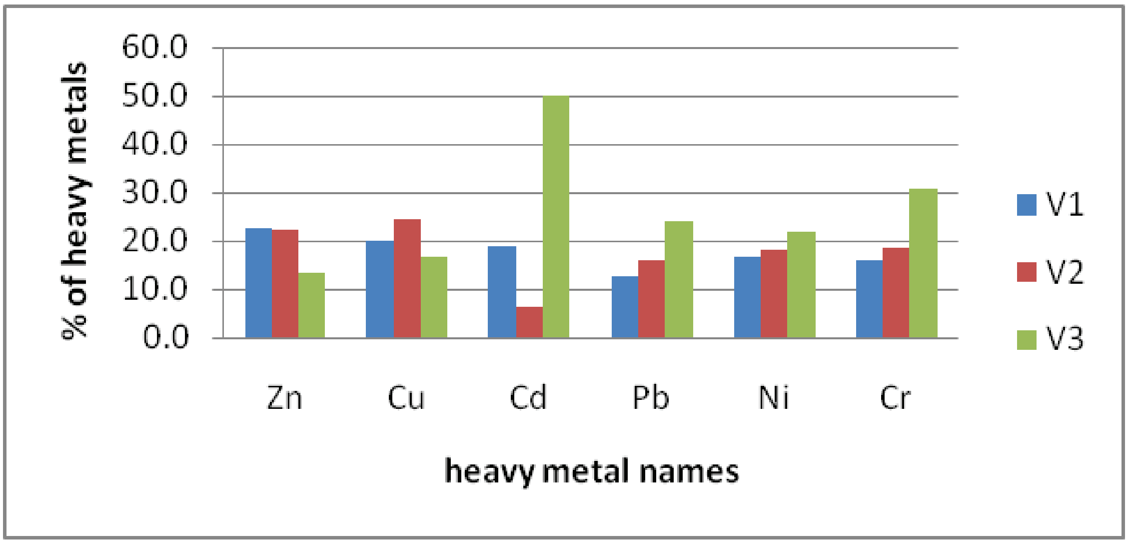

Fig1: Percent of heavy metals present in the Vermicompost samples

The FI and CI were found to be as in Table-3.

S.No	Fertility Parameters	V1 (Si)	V2 (Si)	V3 (Si)	Heavy Metals	V1 (Si)	V2 (Si)	V3 (Si)
1	Total Organic carbon	5	4	5	Zinc as Zn^{2+}	5	5	5
2	Total N	2	2	2	Copper as Cu^{2+}	5	5	5
3	Total P	2	1	2	Cadmium as Cd^{2+}	4	5	3
4	Total K	2	1	1	Lead as Pb^{2+}	5	5	5
5	C:N Ratio	1	1	1	Nickel as Ni^{+}	5	5	5
6	Carbon Respiration	5	5	5	Chromium as Cr^{3+}	5	5	5
	Fertilizing Index	3.3	3	3.2	Clean Index	4.6	5	4.3

Table 3: Fertilizing Index & Clean Index of large scale vermicompost

The FI & CI were 3.0 to 3.3 4.3 to 4.6 as in Table-4. The score value is in Table-5.

S.No	Sample	FI	CI	Class	Quality	Remarks
1	V1	3.3	4.6	Class B	Very Good Quality	Medium fertilizing potential and low heavy metal content
2	V2	3	5	RU-1	Low fertilizing Potential	Should not be allowed to market due to low fertilizing potential. However, these can be used as soil conditioner
3	V3	3.2	4.3	Class B	Very Good Quality	Medium fertilizing potential and low heavy metal content

Table 5: Classification of the vermicompost sample based on score

The samples were classified based on the score value as in Figure 2. Samples V1, V3 were classified as Class B as it had fertilizing index in between 3.0 and 3.3 and Clean index higher than 4.0. Sample V2 had a Clean index of 5 but its fertilizing index was low i.e. 3 hence it was classified as RU-1. Their use based on their class is in Table 5

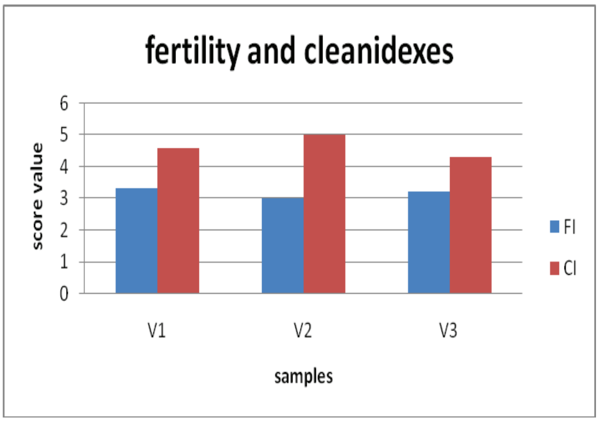

Fig 2: Graph showing Vermicompost Sample (LS) Vs. Score value of indices.

8 Conclusion

The compost produced by adopting vermi composting is assessed and reported in this work. The important physical and chemical characteristics of the compost produced indicates good quality of compost especially in terms of MC, TC, N, P, K and C:N. The results suggest vermicomposting can be suitable option as it reduces burden on landfills and is much cheaper option than incineration. Also it is suitable, clean option when compared with incineration. In terms of CI &FI also the vermi compost from V1 is very Good Quality; it has medium fertilizing potential and low heavy metal content, the vermicompost from V2 is in RU-I category meaning low fertilizing potential but it should not be allowed to market due to low fertilizing potential. However, these can be used as soil conditioner. Compost from V3 is of very Good Quality and medium fertilizing potential and low heavy metal content. Considering the existing conditions it is still a challenge in adopting composting in addition to marketing the compost. A revenue model needs to be evolved to makes this a suitable practice which loading the large quantities of MSW.

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ROLE OF ALTERNATIVE FUELS FOR TRANSPORT SECTOR - A CASE STUDY

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Abstract:

This paper presents impacts of alternative fuels such as compressed natural gas (CNG), biofuels, H-CNG blends on the emission performance of the motor vehicles. Due to burning of gasoline and diesel fuels in the motor vehicles, the quality of ambient air of major metro cities of India has deteriorated considerably. The paper discusses the viable options of fossil fuels as alternative fuels for motor cars which reduce the level of criteria pollutants such as CO, HCs, NOx, PM10 and PM2.5. The comparative study of various pollutants emitted from the motor vehicles with fossil and alternative fuels has been discussed in this paper. The optimization of hydrogen concentration in H-CNG blends has also been outlined. H-CNG blends has created positive impacts on emission performance of the vehicles as compared to CNG alone. The comparative study for particulate matters with diesel and CNG driven vehicles reveals that the PM10 and PM2.5 levels reduce with CNG.

Keywords: Air pollution, alternative fuels, vehicular emissions, green house gases

INTRODUCTION

Due to rapid growth of population as well as improvement in overall quality of life due to urbanization, the number of vehicles has increased considerably. The Delhi alone has more than 80 lakh registered vehicles. Most of the vehicles consume fossil fuels e.g. gasoline, diesel and cause vehicular emissions in the atmosphere[1]. Due to vehicular exhausts, the quality of ambient air gets deteriorated, smog formation occurs. Several types of respiratory and pulmonary diseases cause in the human bodies. With the introduction of CNG in Delhi in 2000, the emissions levels of CO, NOx, SOx, PM10 and PM2.5 reduced considerably but due to increase of diesel vehicles the positive effect of CNG diminished gradually and the environmental degradation occurs.

Environmental regulatory agencies e.g. Ministry of Environment and Forests (MoEF), Govt of India, Central Pollution Control Board (CPCB), Delhi Pollution Control Committee (DPCC) have also accepted the adverse effects of vehicular pollutants on air quality and environment at large. Several policies have been implemented. Bharat Stage IV has been introduced in the metropolitan cities. Three-way-catalytic converter has been put in the engine of the four-wheeler vehicle. The Ministry of New and Renewable Energy (MNRE), Govt of India has introduced biofuels as one of the alternatives of fossil fuels for transport sector. Bioethanol and biodiesel were developed but in spite of introduction of biofuel policy in August 2008 by the Planning Commission, Govt of India, this policy has not yet been implemented in toto. Several R&D tests have been conducted using 10% ethanol blended gasoline with vehicles and emissions performance were noticed. Similarly, biodiesel blended diesel were used in the diesel engine and emission

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emission performance were recorded. The test reports using these developed renewable fuels indicated that there has been some percentage of reductions of emissions of CO, HCs, PM10 etc.

Tables 1 and 2 give statistics of vehicle population in NCR Delhi and estimated pollution load in the major cities of India respectively.

Table 1 Statistics of vehicle population in NCR Delhi[10]

Total number of registered vehicles	Around 80 Lakh
Total number of CNG fed vehicles	4.5 Lakh
Total number of new vehicles added to city's roads everyday	1300
Total number of diesel vehicles passed through Delhi everyday	15000

Source: MoRTH Year Book 2010-11

Table 2 Estimated pollution load in the cities[5]

Pollution Load, Mt/day				
City	CO	NOx	HC	PM
Delhi	421.84	110.45	184.37	12.77
Mumbai	189.55	46.37	89.93	10.58
Kolkata	137.50	54.09	47.63	10.80
Chennai	177.00	27.30	95.64	7.29
Bangalore	207.04	29.72	117.37	8.11
Hyderabad	163.95	36.89	90.09	8.00
Kanpur	28.73	7.25	11.70	1.91
Agra	17.93	3.30	10.28	0.91

Source: CPCB report 2010

The national capital Delhi has the highest number of registered vehicles as compared to other metros namely; Mumbai, Kolkata and Chennai and consequently the pollution loads for CO, NOx, HC and PM are the highest as compared to other metropolitan cities.

VEHICULAR EXHAUSTS EMISSIONS DUE TO DIFFERENT FUELS

Petrol Fuel

Petrol consists mainly of aliphatic hydrocarbons having carbon atoms between 5 and 12 per molecule. Hydrocarbons are volatile organic compounds (VOCs) that include benzene, toluene, ethyl benzene; etc, if petrol alone is burned in an internal combustion engine, incomplete combustion takes place and produces CO, water, HCs etc. When added with ethanol as oxygenate the level of CO and HCs reduces. In USA, the ethanol blend with petrol is mandatory as per EPA.

Diesel Fuel

A large number of vehicles run on diesel fuels in India. Diesel fuel after combustion in the engine of a car emits CO, NOx, SOx, PM etc. After improvement in the quality of diesel (ULSD) i.e. ultra low sulphur diesel in 2006 and becoming mandatory on June 1, 2010 as per EPA, the level of SOx emission reduced considerably. However, emissions of particulate matters are still more in diesel fuel as compared to gasoline.

CNG Fuel

It is environment-friendly fuel. It can be considered as an alternative fuel for petrol and diesel but combustion of compressed the combustion of CNG takes place at higher temperature with optimum air-fuel mixture ratio. Due to high temperature, the levels of CO and HCs are low as compared to liquid fuels i.e. petrol and diesel. But NOx emissions are high. Since, the major component of CNG is methane which is a green house gas. Due to tail pipe emissions, CNG give emission of green house gas in the atmosphere[2].

MAJOR AIR POLLUTANTS DUE TO VEHICULAR EMISSIONS

Automotive vehicles emit various types of pollutants which depend on the quality of vehicular fuels. The major pollutants released due to vehicular emissions include carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (benzene, aldehydes, 1-3 butadiene), oxides of sulphur, organic compounds, particulates matter, etc. The vehicles driven with gasoline/petrol emit CO and HCs as major pollutants whereas with diesel fuel, the major pollutants are NOx, PM10 and PM2.5 (particulate matters). Benzene is one of the major toxic air pollutants due to burning of vehicular fuels. This is also emitted due to evaporation from petrol filling stations.

Table 3 gives an idea about emissions of CO, NOx, SO2 and PM pollutants from different sources in Delhi and Mumbai metropolitan cities.

Table 3 Emissions of pollutants in Delhi and Mumbai[3]

		Delhi			Mumbai		
		Sources			Sources		
Sl. No	Pollutants	Transport,%	Industrial, %	Domestic and other sources,%	Transport,%	Industrial, %	Domestic and other sources,%
1	CO	66	24	10	92	8	Nil
2	NOx	66	31	3	60	40	Nil
3	SO_2	10	85	5	4	82	14
4	PM	20	75	5	16	80	4

Source: Auto fuel policy report

EFFECTS OF VEHICULAR POLLUTANTS ON HUMAN HEALTH AND ENVIRONMENT

The emissions of pollutants due to vehicles have adverse effects on human health as well as environment. The effects may be direct as well as indirect. The degree of effects can cover right from reduced visibility to fatal disease like cancers and even death in some cases due to prolong exposure of CO. The overall effects of vehicular emissions are given in Table 4. Table 5 give information about health effects due to major pollutants of vehicular emissions

Table 4 Overall effects of vehicular emissions

	Health effect		Ecological effect			Climate change	
Pollutants	Direct	Indirect	Acid rain	Eutrophication	Visibility	Direct	Indirect
CO	✓						✓
HC	✓	✓ (due to O_3 formation)					✓
NOx	✓	✓ (due to O_3 formation)	✓	✓	✓	✓	
PM	✓				✓	✓	
SO_x	✓	✓			✓		✓

Source: CPCB Report 2010

Table 5 Pollutant's adverse effects on human organs

Pollutants	Kinds of disease
CO	Affects the cardio vascular system, angina, nervous system, etc. lowers the oxygen level in the blood, headaches etc.
NOx	Pulmonary disease, impairment of lung function and eye, nose and throat irritation.
SO_2	Affect lung function adversely
PM (PM_{10} and $PM_{2.5}$)	Fine particulate ($PM_{2.5}$) may cause carcinogenic effect and can alter the immune system. Coarse particulate (PM_{10}) may affect nose, lungs etc.
Benzene	Toxic and Carcinogenic. May cause leukemia
HCs	May cause cancer.

Source: CPCB report 2010

GLOBAL EMISSIONS OF GHGS FROM TRANSPORT SECTOR

During the past three decades, carbon dioxide emissions from transport have increased tremendously as compared to other sectors and it is expected to increase further more rapidly in future also. The road transport alone emits around 16% of the global CO2 emissions. The International Energy Agency (IEA) has indicated that the transport emissions have increased by 29% in industrialized countries and 61% in other countries[1]. It has also been indicted that global CO2 emissions are going to get stabilized in the developed countries in the near future but the CO2 are likely to increase in the developing counties owing to its due economic growth as well as rising human population.

EMISSIONS OF GHG - INDIAN PERSPECTIVE

It has been reported by the Delhi based organization that the emissions of CO2 on Indian road is expected to reach a value of 1212 Mt during 2035 from a value of 208 Mt during 2005. Figure 1 gives an insight about total CO2 emissions (well to exhaust) on Indian road.

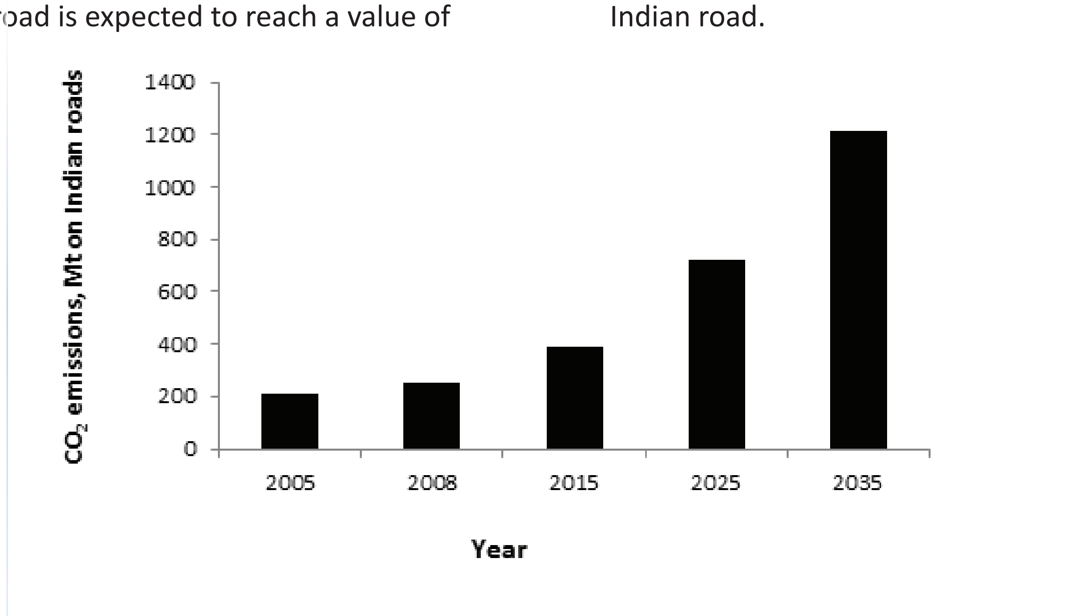

Figure 1: CO2 emissions (well to exhaust) on Indian roads

Air Quality Index (AQI)

"National Air Quality Index" has recently been launched by the Government of India which is an easily accessible way of informing people about the air quality in their respective cities. As per this index, six categories have been identified e.g. good, satisfactory, moderately polluted, poor, very poor and severe depending on the concentrations of eight major air pollutants such as PM10, PM2.5, SO2, NO2, O3, CO, Pb and NH3. But benzene has not been included, however, its concentrations are higher as per several literatures. The AQI deals with the pollutants that have immediate short-term impacts like respiratory and cardiovascular diseases. World Health Organisation (WHO) has already highlighted the poor air quality in India. The table 6 gives details of air quality index whereas table 7 gives impacts of six categories of levels of air pollutants on human health.

Table 6 Index categorising air quality.

Categories	Air pollutants							
	PM_{10}	$PM_{2.5}$	NO_2	O_3	CO	SO_2	NH_3	P_b
Good	0-50	0-30	0-40	0-50	0-10	0-40	0-200	0-0.5
Satisfactory	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5-1.0
Moderate	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
Poor	251-350	91-120	181-280	169-208	10-17	381-800	801- 1200	2.1-3.0
Very poor	351-430	121-350	281-400	209-748	17-34	801-1600	1200-1800	3.1-3.5
Severe	430+	250+	400+	748+	34+	1600+	1800+	3.5+
Units CO (mg/m^3) for 8 hr avg, other pollutants $\mu g/m^3$ for 24 hr avg								

Source: www.moef.gov.nic.in

Table 7 Impact of six categories of air pollutants on human health

Categories	impacts on health
Good	minimal impact
Satisfactory	may cause minor breathing, discomfort to sensitive people
Moderate	may cause breathing discomfort to people with lung disease
Poor	may cause breathing discomfort to people on prolonged exposure
Very poor	may cause respiratory illness prolonged
Severe	possible respiratory impact even on healthy people

Source: www.moef.gov.nic.in

The 'severe' category is associated with respiratory problems even among healthy people. The information of AQI will certainly benefit the people of Delhi to be cautious in winter and to take precautionary measures. Table 8 gives details about AQI for four stations of Delhi in the months of July and Nov 2013 at different dates.

Table 8 Air Quality Index (AQI) for Delhi in 2013

Area	Monitoring dates, July	AQI, July	Monitoring dates, Nov	AQI, Nov
Anand Vihar	26-30	moderately polluted	10-14	Severe
R K Puram	15-19	moderately polluted	10-14	Severe on most days
Punjabi Bagh	30- Aug 3	severe on one day	10-14	very poor on most days
Mandir Marg	26-Aug 1	moderately polluted	10-14	very poor on most days

Source: CPCB

Six stations of Delhi were identified namely; Civil lines, IGI airport, Mandir Marg, Punjabi Bagh, R K Puram and Anand Vihar where major air pollutants; PM10, PM2.5, SO2, NO2 and CO were measured in the year 2010, 2011, 2012 and 2013. At Anand Vihar station, the pollutants were measured for the year 2012 and 2013 only. Figures 2 and 3 show the air pollution levels for the above-mentioned years at those stations.

ROLE OF ALTERNATIVE FUELS FOR TRANSPORTATION SECTOR

The economical viability of production of ethanol and biodiesel is also a matter of concern. In India, there is no scarcity of raw materials for production of ethanol, methanol and biodiesel. Biofuels covers bioethanol and biodiesel both. The production of biofuel is considered as relevant technologies by both developing and developed counties. They include energy security reasons, environmental concerns, foreign exchange savings and socio economic issues related to the rural sector. The advantages of the biofuels include (a) biofuels are easily available from common biomass sources (b) act as an oxygenate when blended with gasoline for transport fuel (c) environmentally benign being renewable (d) being biodegradable and hence contribute to sustainability .CNG plays an important role as an alternative fuel .H2-CNG blend has also an possible option for environmentally benign transport fuel.

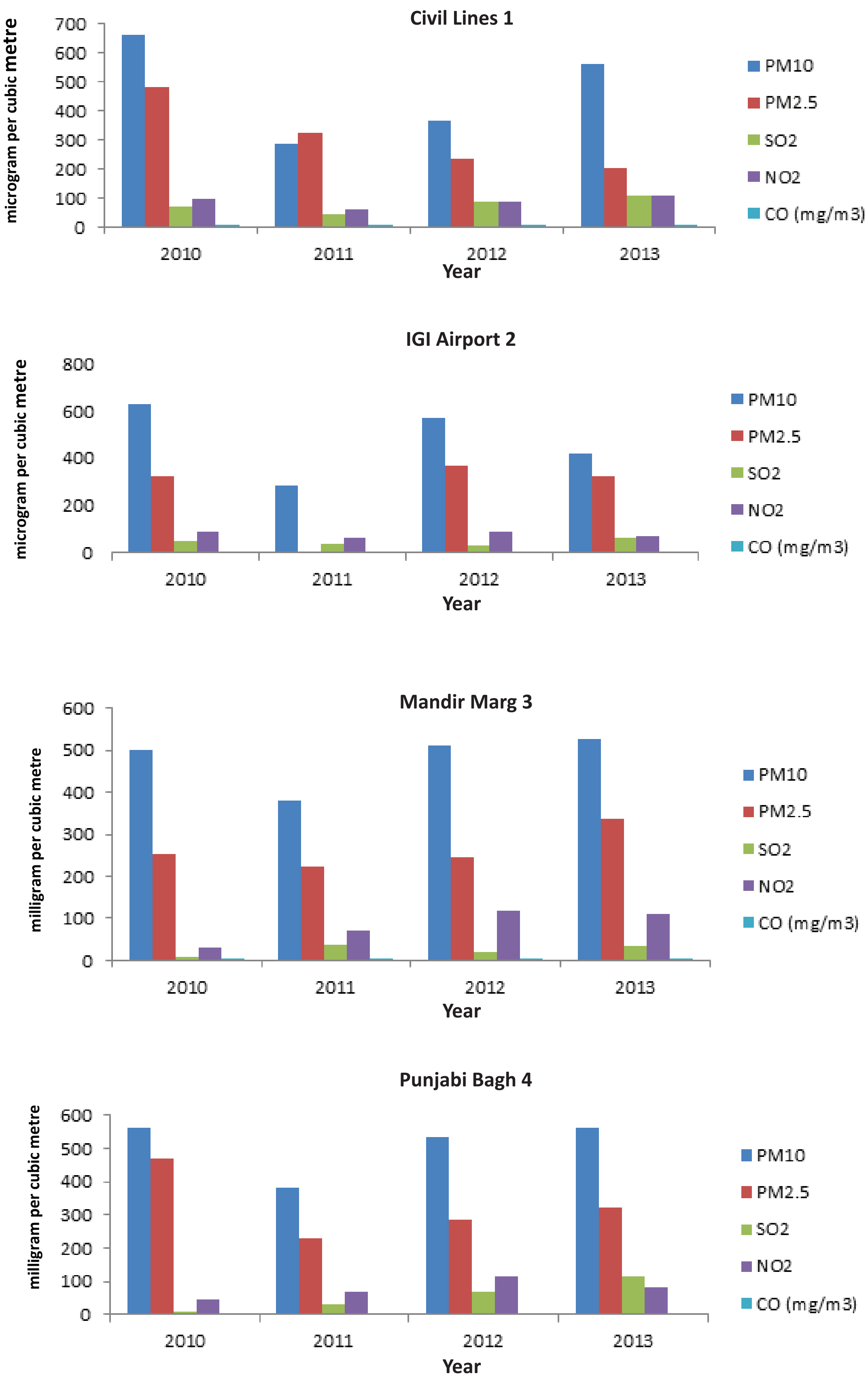

Figure 2 Major air pollutant levels at different stations of Delhi

Figure 3 Major air pollutant levels at different stations of Delhi

Biofuels

Biofuels include bioethanol, biomethanol and biodiesel. These fuels are renewable and reduce vehicular emissions as compared to gasoline, diesel alone. Bioethanol is preferred to biomethanol for environmental points of view.

Bioethanol

Ethanol made from cellulosic biomass materials instead of traditional feed stocks (starch crops) is called bioethanol. Bioethanol acts as an oxygenate when blended with gasoline. Blending of ethanol with gasoline increases the octane of the fuel and improves the emission quality of gasoline. Several R&D studies have been conducted for optimizing percentage of ethanol blending with gasoline suitable for transport fuel. E10 (10% ethanol and 90% gasoline) has been found the most optimized blending to reduce vehicular emissions. Production process of ethanol is shown in figure 4.

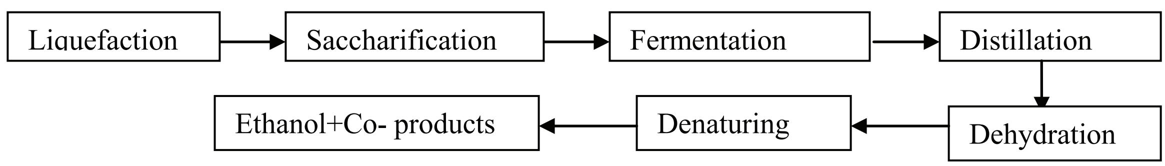

Fig 4: Ethanol production process

With E10 the reduction in emissions of Co, hydrocarbons, 1-3 butadiene, benzene are 32%, 12%, 19% and 27% respectively. The NOx emissions with this fuel is higher since the combustion in the engine takes place at higher temperature. The control of NOx emissions is done by other technologies like optimization of air fuel ratio etc.

Biodiesel

When vegetable oils which are basically triglycerides molecules are mixed with diesel fuels, it is called biodiesel. Vegetable oils can be produced from renewable oil seeds. Biodiesel operates in compression ignition engines like petroleum diesel engine thereby it does not require any additional engine modifications. It is the only alternative fuel to have a complete evaluation of emission results and potential health effects submitted to the USEPA under the Clean Air Act Section 211(b). Table 9 gives the comparison of emission from biodiesel and petro diesel.

Table 9 Biodiesel emissions compared to conventional diesel

Emission	B100	B20
Regulated Emissions		
Total unburned hydrocarbons	-93%	-30%
Carbon monoxide	-50%	-20%
Particulate matter	-30%	-22%
NOx	+13%	+2%

Source: CPCB report

Biodiesel is the only alternative fuel and from renewable energy source which runs in any conventional, unmodified diesel engine. It is non toxic and biodegradable. Its cetane number is significantly higher than that of conventional diesel fuel. It has a higher flash point of about 1500 C compared to that of conventional diesel, which has a flash point of nearly 520 C.

COMPRESSED NATURAL GAS (CNG)

After introduction of CNG in the public transport in 2001 in Delhi, the air pollutants particularly CO and particulate matters reduced considerably but NOx emissions increase due to burning of CNG in the vehicle engine since combustion of CNG takes place at higher temperature. To reduce NOx emission, air-fuel ratio optimisation is one of the important aspects for making CNG as an environmental friendly transport fuel.

HYDROGEN

Hydrogen is the only fuel which contains zero carbon atom and is having highest amount of energy content. However, its energy content compared to volume is rather low[6]. Hence there is a big challenge in regard to its storage. After combustion of hydrogen only water is formed and hence it is environmentally benign. No CO2 is formed, only NOx will be formed at high temperature.

CNG-H2 blend can also be used as transport fuel. Blending of 5% H2 with CNG improves the combustion performance of CNG due to its physical properties. With this blend the levels of CO, particulate matter etc. get reduced. However, R&D work for optimisation of percentage of H2 with CNG is under trial.

ROLES OF REGULATORY AGENCIES FOR PROMOTION OF ALTERNATIVE FUELS

In view of the growing demands of fossil fuels for transport sector, the concerned regulatory agencies like MoEF, MNRE, MoPNG, CPCB, etc have to play an important role in development and promotion of various alternative fuels particularly fuels produced from renewable sources. For want of proper implementation of the policies for promotion of biofuels for transport sector the emissions of pollutants are increasing day by day. The role of various ministries in promotion of alternative fuels is given in table 10.

Table 10 Role of implementing agencies

Legislation/Act	Authority	Responsibility/Notifications
The Environment (Protection) Act, 1986, amended in 1991 further am-ended in 2001, 2002, 2003, 2004.	Ministry of Environment & Forests (MOEF)	From time to time respective notifications regarding specifications of emissions from motor vehicle need to be published. Policy and regulations for alternative/clean fuels need to be implemented.
The Central Motor Vehicles Act, 1988 (second amended in 2009)	Ministry of Road Transport and Highways	To make rules regulating construction, equipment and maintenance of motor vehicles.
Biofuels and Hydrogen	Planning Commission	Overall policy direction and funding for alternative fuels.
Solar energy mission	MNRE	Promotion of solar energy hybrid vehicle etc.
Commercialization of ethanol blended gasoline, hydrogen	Ministry of Petroleum and Natural Gas	Implementation of ethanol-blended gasoline as transport fuel, hydrogen etc.

Conclusion

In order to achieve the desired emission performance with biofuels in the vehicles, adequate optimization studies for blending grade of ethanol with gasoline and biodiesel with diesel are to be carried out vigorously. The implementing agency has to implement 10% ethanol blending with gasoline and 10% biodiesel with diesel across the country as transport fuel. 5 % hydrogen with CNG as blend fuel can also be a substitute for transport fuel. This will not only reduce the burden of fossil fuels but also improve the emission performance and thereby makes the environment clean.

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WATER FOOT PRINT AND CONCEPT – A TOOL TO REDUCE WATER CONSUMPTION

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ABSTRACT

Water is required directly or indirectly for any job/ activities or process. Water required for commercial, domestic, agricultural & industrial activities is derived from underground & surface water. Depending on requirement water is used as such or after treatment. Water demand is being measured as actual water consumption, e.g. as per National Building Code the water consumption in urban area is 135 LPCD & 1 Kg of paper manufactured by Kraft process requires 350 lit/ kg of paper produced. This is actual water consumption during the process, activities or job being carried out. However there are direct/ indirect water consumptions at various stages before the process begins or the products manufactured. The summation of the water consumption before, during & after the process gives the correct figure of the water consumption. This is called as Virtual Water Footprint. This helps for calculation of total water demand for the given geographical boundary or defined set of activities. Water Footprint is further divided into three types as Green (direct use of rain water), Blue (use of naturally & manmade stored water) & Grey (water required to counteract the impact of pollutant in receiving water body) water footprint. Importance of Water Footprint, frame work to calculate Water Footprint & methods for reducing Water Footprint are discussed in this paper.

Key words: Green, Blue & Gray Water Footprint, manufacturing process, direct & indirect water consumption.

Introduction

Water is used for agriculture, domestic & industrial activity. Total water requirement is defined as Water Footprint. It is categorized as Green, Blue & Gray Water footprint. Green water represents direct consumption of precipitated water. Blue water is the consumption of water from manmade & natural water storage. Traditionally resources are filled by precipitated water (fresh water) in the form of rain & ice. The amount of Blue water required for dilution to bring down the concentration of pollutant in waste water (generated during activity) to its acceptable level in the receiving water body is called as Grey Water. The total Water Footprint is the summation of Green, Blue & Grey water.

After independence the Indian economy has gone through revolutionary changes. From 1990 onward many products (food, cosmetics, electronics & automobiles etc.) are available on the shelf. The product which earlier confined to homemade or cottage industry has taken the form of medium & large scale industry e.g. Food processing industries. Majority of products are being manufactured under the different brand names. Increasing demand coupled with excellent marketing & easy access to finance is inspiring the Indian consumers to acquire more than the basic

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needs. Obviously each product comes along with actual & virtual water consumption thus making the total Water Footprint of Indian larger.

❖ Water Balance of Catchment Area

Conventionally in calculating water balance moisture in agriculture, soil vegetation, biotic life, & loss of water by Evapo-transpiration is not considered. The water demand is considered only for agriculture, domestic & industrial activities. The water is also lost from the catchment area by evaporation. A critical evaluation of Blue, Green & Grey Water Footprint of given catchment area can help to assess the total water demand for present & future. The Green, Blue & Grey Water Footprint in relation to water balance in catchment area is given in Figure - 1.

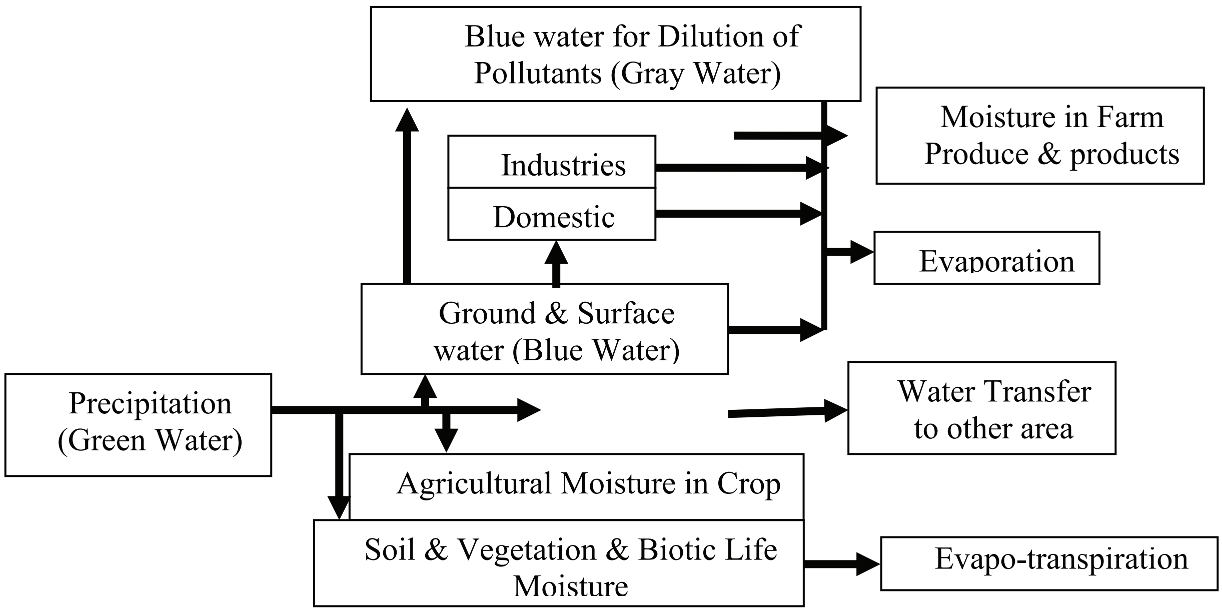

Figure- 1.Green, Blue & Grey Water Footprint in relation to water balance in catchment area

❖ **Input Output Analysis**

Input Output Analysis for defined geographical boundary is given in Figure – 2. Three possibilities are a. system is comfortable when Input>output, b. manageable when Input = Output & c. fragile or water deficient when Output> Input

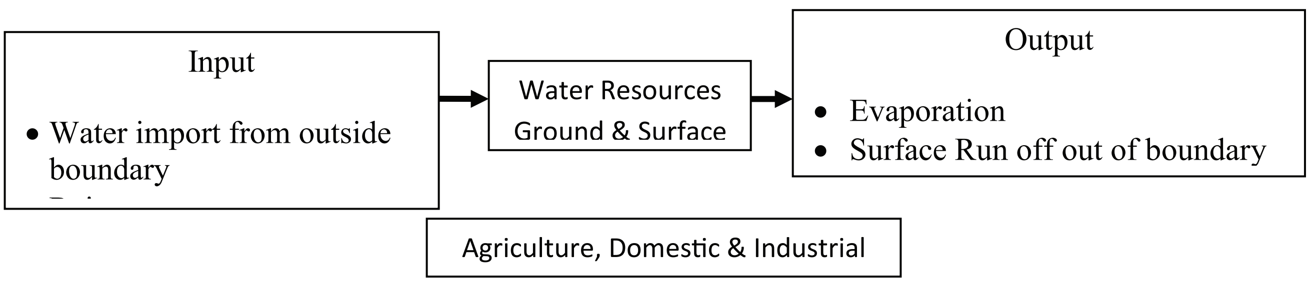

Figure - 2. Input output analysis

The water required is drawn from available resources. Conventionally water consumption is measured as the metered volume of water received for the job activity or process. The conventional water consumption is also followed by waste water generation. This Waste water generated shall be treated before disposal to bring down the level of pollutant to natural level in receiving water body.

❖Direct Water Consumption in Manufacturing

The typical water input output analysis of manufacturing process is shown in Figure – 3. All the values of water volume Q either can be calculated or measured. This gives direct water consumption of process.

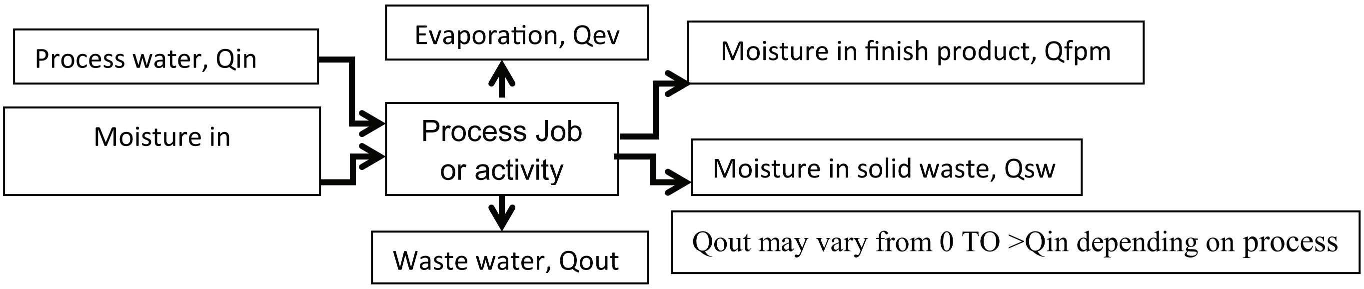

Figure - 3. Water input output analysis for manufacturing process

❖ Indirect Water Consumption

The raw materials are received at site, processed to make products & products reach the consumer through supply chain. The water is required at various stages in the chain. This is illustrated with typical example of Ketchup – a product from tomatoes in Figure 4.

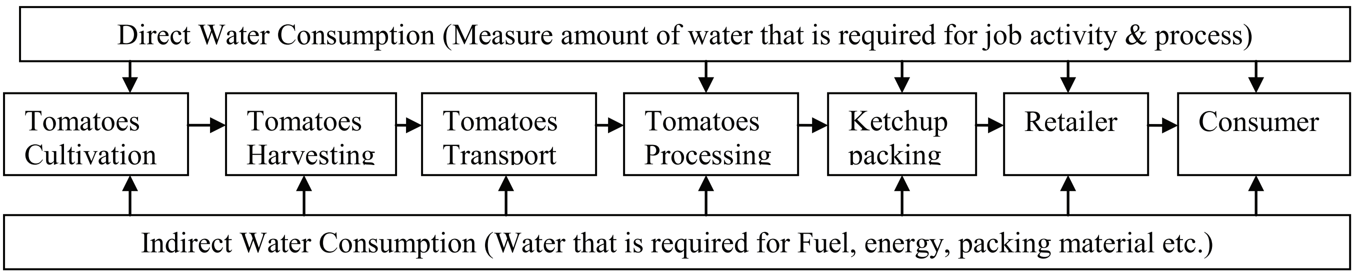

Figure- 4. Direct & Indirect Water Consumption in Ketchup

Water requirement in raw material to consumption chain for Ketchup is given in Table – 1

Table – 1 Water Requirement from Offsite to Consumer site for Ketch up

Site	Activity	Water requirement	Site	Activity	Water requirement
Off	Cultivation	Growing Tomatoes	Production	Processing	Washing, heating, cleaning
Off	Harvesting	Drinking, washing	Consumption	Retailer	Drinking, Transportation
Off	Transport	Packing & transport	Consumption	Consumer	Washing & cleaning

Conventionally water consumption at production site is only considered. Summation of offsite,

❖ Water Footprint

Water Footprint is the term that is similar to well established term like Energy & Carbon Footprint. Water Footprint concept gained interest after it was introduced in 2002 by Hockstra. Water Footprint is consisting of Green, Blue and Grey Water Footprint & details are given in Table - 2.

Table – 2 Green Blue & Gray water Foot print

Water Foot Print	Resource & Usage	Example
Green	Precipitated water available for direct use before it gets stored or recharged.	Indian Rain Fed- Farming, Animal grazing, Forest produce
Blue	Surface & Ground water Resources available round the year	Irrigation, Domestic, Industrial, Commercial
Gray	Blue water required for dilution to prevalent river water quality standards	Waste residue from Agricultural, Domestic & Industries. Scope for Treatment, reuse & recycle

❖ Water Footprint of Manufacturing Process

Raw material(s) is passed through unit processes to get the finished product. This may be either a straight chain from raw material to finished product or branching may take place at any of the unit process. Besides water electricity, labor & other semi finished or finished products (e.g. packaging material) are required at various unit processes.

◆ Water Foot Print of Unit Process

◆Water is required for cleaning, washing, heating, cooling, cooking etc. It can be directly measured by the flow meter. It is given as Water Foot Print per unit output of the process. Summation of water Footprint of all unit processes gives Water Foot Print of Product.

◆ Water Footprint of Energy

Water Footprint of energy can be calculated on the basis of Energy Footprint of a product

WFep = EFp X WFe

WFep= Water Footprint of energy (e) required per unit of product (p), l/unit

EFp= Energy footprint of product, kwh/unit of product

WFe=Water Footprint of energy, l/unit of energy

◆ Water Footprint of manpower

Water consumption for drinking, washing, WC flush etc. shall be considered as Water Footprint of manpower. . Besides, to counteract the sewage generation, Grey water Foot print is to be added.

◆ Water Foot Print of straight Chain & branch chain Manufacturing process

It is respectively given in Figure – 4 & 5

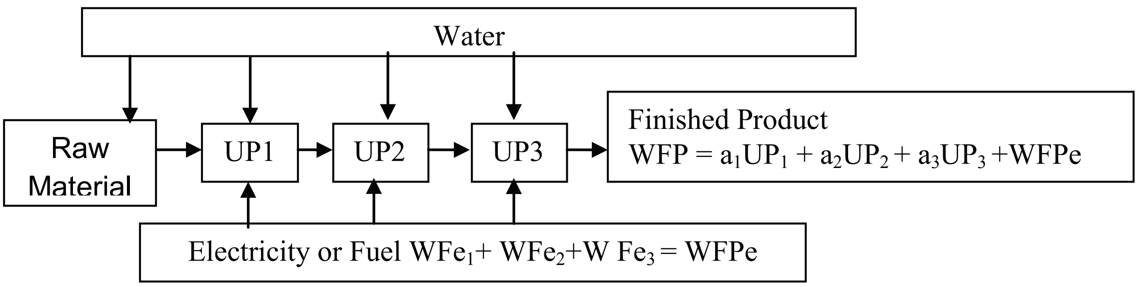

Figure – 4 Straight Chain Process

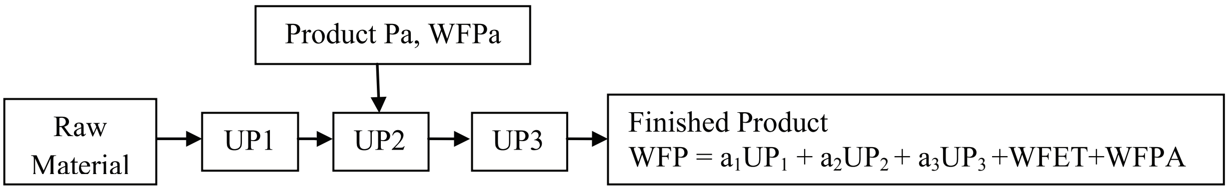

Figure – 5 Branch Chain Process

Up = Unit Process (1 to n)	WF = Water Foot Print
a_n = WF / unit output of unit process	e_n = Energy Foot Print / Unit (1 to n) Product
WFe = WF of energy,/unit product	WFPa = WF of Product a
WFPe = WF energy /unit product	WFP = WF of Finished Product

Value of an & en can vary from 0 to +0. Zero value is to be assigned for the input which doesn't require any water e.g. Sun drying. The influencing factors in deciding the values in Water Footprint are climate, geographical conditions, human behavior, attitude & understanding, water stress & awareness of water conservation. However the value can be assigned for the given geographical boundary & the efforts are to be made for its acceptance in larger boundary.

❖ Water Footprint of Water

The water is pumped from the source to the Water Treatment Plant (WTP). From WTP it goes to the tap at consumer end through water distribution system. The water is lost in pipeline leakages, as drain out from sedimentation tank & backwash & rinse water from the filter. Leakages are also to be accounted in distribution system. The leakage varies from +0 to +20 % depending on the location. This is shown in Figure– 6. 1000 lit of water accounts to 1250 lit of Blue water.

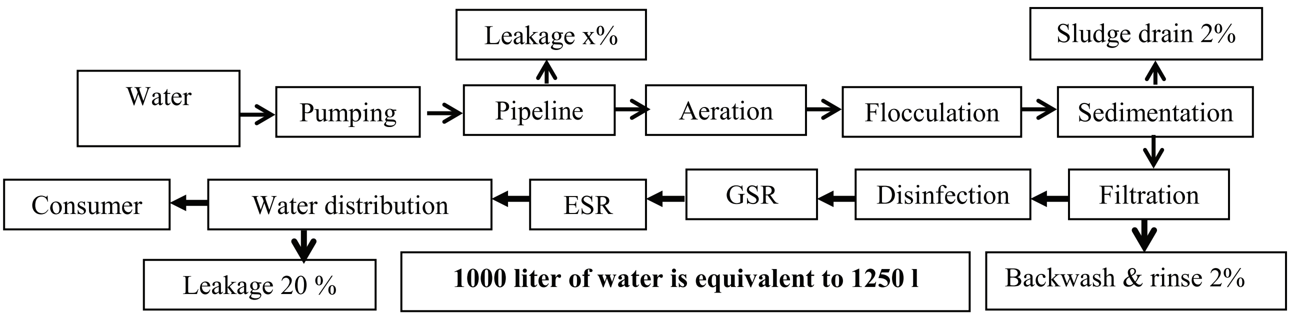

Figure – 6 Water Footprint of Water

❖ Water Footprint of Agriculture Produce

Traditionally Indian farming is rain-fed. However dams & ground water exploitation have brought more area under irrigation. This has increased the crop yield & has given adequate food in the bowl to have self-dependence. However it has disadvantages of increase in salinity, dependence on power supply & the bigger footprint of Blue Water of agricultural produce. Water is used for the plant growth & it gets incorporated in produce as moisture. There is loss of water by natural evaporation & evapo-transpiration. Water Footprint of produce is calculated as below.

$$WF_{Green} = GW_{Evaporation} + GW_{incorporated}$$

It can be assessed by using the crop model for evapo-transpiration based on input data of climate, soil & crop characteristics. Global average of Water Foot Print of some of Agricultural produce is given in Table - 3

Table – 3 Global Average Water Footprint of Agricultural Produce

Item	Water Footprint , l	Item	Water Footprint , l
Rice, 1 kg	3400	Banana, 1 kg	790
Wheat, 1kg	1300	Cabbage, 1 kg	237
Tomato	180	Potatoes, 1 Kg	287

❖ Water Footprint of urban dweller:-

• Water Consumption Only Calculations are given in Table - 4

Details	Value
Green Water Foot print, LPCD (Direct rain water is not used)	0
Water supply as per National Building Code, LPCD	135
Water Footprint of Water, l / l of water	1.25
Blue Water Footprint, LPCD (Drawn from natural/ manmade water source)	168.75
Sewage Generated, % of water supply	85
Water (Gray) Required to Dilute BOD raw sewage 200 to 5 mg/l, LPCD	4475.25
Total Water Footprint, LPCD	4644

◆ **Water Foot print of Food & Beverages.**

It is very difficult to arrive at the correct figure for Water Foot Print of Food consumed by Indian. This is due to varying diet & habits throughout the country. Table – 4 gives the example of some of the food & beverages we take daily. This gives an idea that our Water foot print is above 5000 l/day

Table – 3 Global Average Water Footprint of Agricultural Produce

Item	Water Footprint , l	Item	Water Footprint , l
Coffee 1 cup	140	Coca-Cola 1 l	55
Chicken, 1kg	3900	One Slice of bread	40
Potato Chips, 100 g	185	Groundnut oil refined, 1 Kg	7529
Egg one	135	Chicken 1 kg	3900

❖**Problems in Water Footprint calculation**

◆ Adequate data are not available both for agricultural & industrial sector.

◆ The values can widely differ because of different types of the process used for same product.

◆ Exclusively Blue water consumption for agriculture produce is very difficult to assess because different types of irrigation practices are followed.

◆ Water Consumption depends on availability of water & water conservation awareness.

◆ Water supply is not yet metered in all sectors of agriculture, domestic & industrial.

◆ The characteristics of receiving water body changes geographically. A few rivers in in India are perennial. Some of rivers virtually carry waste water during the summer. Therefore the calculation of dilution water required to bring down the pollutant level to the natural level in the water body after considering its self-purification capacity is very difficult in India.

◆ A mathematical model is to be developed to assess Grey & Blue Water Footprint where reuse & recycle are being practiced.

◆ In case of reuse of waste water from one industry in other industry, the detailed calculations are required to compensate the reuse of waste water value against the Blue water.

◆ Lots of efforts are being made in European countries to find out the global average value. However the application in India cannot be considered as it is. We have to consider three tier values for Water Footprint.

◆ Small catchment or field specific

◆Local, regional, national or catchment specific

◆ Global average

◆ Because of the observed water stress in all segments, efforts are being made to minimize the water consumption by adopting conservation measured, reuse & recycling of waste water. These efforts are ongoing. Therefore the values of today may differ tomorrow.

❖ **Water Footprint Response Option**

✓ Water Footprint of a product, consumer, community, business & nation shall be determined to get gross water consumption & check it with total water availability.

✓ The responsibility of reduction in Water Footprint from product, consumer & finally to Nation shall be shared at all the levels.

✓ The product shall be assigned the value of its Water Footprint & consumer shall be motivated to buy product of least Water Footprint. The government & media have to play major role to do this.

✓ Company shall allot the fund & act to increase Green Water Footprint, reduce Blue Water Footprint & treat & reuse waste water to reduce GreyWater Footprint

✓ In agriculture, scientists & technocrats shall work together for efficient use of rain water to optimize Green Water Footprint & better Crop & water management practices to minimize Blue Water Footprint.

✓ Planner shall consider Embeded water Footprint for proposed development plan for national water policy making

✓ The financing authority shall give weightage to Water Footprint value of the said project.

❖ **Further Exploration**

▪ To develop Methodology for Water Footprint calculations with Indian context

▪ Application of Water Footprint to assess the sustainability for gross water consumption required for development.

▪ Incorporating the Water Footprint in environmental accounts and reports similar to Energy audit.

▪ Inter linking Water Footprint to ecological, energy and carbon footprint methods, to bring them all in one consistence.

▪ Linking of Water Foot Print to material flow analysis, input-output modeling and life cycle assessment.

❖ **Recommendations**

1. Increase water productivity in rain-fed Agricultural areas. Selection of crop pattern & optimization of the rain water use shall be practiced to increase Green Water Footprint.
2. Encourage organic farming and efficient system of irrigation to reduce Gray water foot print.
3. Depending on geographical location, rainy days vary from 30 to 90. Rain water can be collected, stored & used as such or after the treatment for domestic & industrial application. This will reduce the Blue water footprint.
4. Blue water is finite & totally depending on the rains. If the rainfall is less, then Blue water source becomes critical. Therefore all efforts are to be made to minimize the Blue water consumption wherever possible, e.g. swiping out the floor with brooms followed by wiping out with the wet cloth.
5. While selecting the process & product, Water footprint of each alternative shall be studied. Alternative with least Water Footprint shall be selected. Always cost becomes the dominating factor in selection of alternative, however Water Footprint shall be given due weightage.
6. Water conservation, treatment, reuse & recycle of waste water to reduce Blue & Gray Water Footprint in Domestic & Industrial sector shall be followed & encouraged.
7. Similar to energy footprint, Water Footprint values shall be assigned to consumables.
8. Similar to Star Rating (for energy consumption) product shall be rated on the basis of its Water Footprint.
9. The Grey Water Footprint shall be considered as the efforts of corporate and manufacturers to reduce waste water generation, efficient waste water treatment, optimum reuse & recycle.
10. Urbanized areas draw their water from natural or manmade water resources. Waste water generated shall be treated & made available for agriculture & industrial activities at downstream. This will reduce the Grey Water Footprint of urbanized area & will reduce BlueWater Footprint of agricultural produce & industrial product.
11. Single or multiple recycling of the packaging material shall be promoted to reduce the Water Footprint of an individual & community.
12. Unaccountable losses like leakages, spillages etc. shall be eliminated. For example leakage in water distribution system sometimes amount to 20%. It shall be preferably stopped or minimized to reduce the Water Footprint of water supplied.
13. Support or force businesses to make annual water footprint accounts and to implement water footprint reduction measures.
14. Cluster of industries using the waste from other industries can be established to reduce Gross Water Foot Print of Growth Center.

❖ **Conclusion**

Energy & Carbon footprint are well established terminology in product assessment. Water footprint an upcoming concept & it shall be taken seriously. Efforts are to be made to develop mathematical models to calculate the Water Footprint. Blue, Green & Grey Water Footprint can help to reduce the use of declining surface & underground water resources (Blue Water) in India. Green Water Footprint can promote direct use of rainwater. Blue Water Footprint can assess the fresh water conservation measures. Grey Water Footprint serves as indicator of waste water reduction, treatment, reuse & recycle. There is urgent need of recognition of Water Footprint by government & similar authorities. Collective efforts are required to develop the methodology for the determination of Water Footprint in India. This will become a very useful tool to reduce water consumption.

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Energy and Feasibility Based Simulation of a PV-Wind Grid Interactive Hybrid System

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ABSTRACT

lobal energy shortage has dragged the eye of many technocrats, regarding the usage of energy, conservation of energy, and controlled utilization and distribution of energy. The conventional way of transmitting electrical energy through transmission line leads to a large amount of loss and also inefficient use of energy. Energy produced from the conventional thermal power plant produces a large amount of toxic gases. From estimation it has been calculated that the total available amount of fossil fuel will last for another 50 years. So create a sustainable environment and some means for energy conservation we have to think for some other renewable sources.

Index Terms—AC and DC link, Charge Controller, Hybrid

I. INTRODUCTION

Hybrid Energy Systems or Green Energy Systems are the systems which uses two renewable energy sources to produce a single renewable energy source. Basically, we can use solar and wind to create a single hybrid energy systems. It is used to save fossil fuels which are depleting day by day. These are clean energy systems as they are less sound polluting; maintain perfect ecological balance with nature, not polluting the air. A total renewable energy system cannot be employed as the capital cost will be very high. The Diesel Generator and the Hybrid Power Pack work together to supply maximum load. This modification allows Diesel Generator not to operate during peak demand and allows use of a smaller unit .hybrid energy systems can be used to feed household appliances by converting to A.C using a inverter. Using the clean energy systems we can recharge batteries which are further used to operate household appliances during a load shedding schedule. In U.S.A the wind speed is very high during winter, Low in summer and in summer the sun shines brightly. So hybrid energy system can work on alternate basis without any blackout. We have to achieve economic penetration so that there will be maximum permissible reduction in KWh cost of hybrid energy systems .In sunny days, the output solar power would be very high so the buffer amount of energy produced as compared to rated amount of energy may be used during a overcast condition.

II. SYSTEM CONFIGURATION

A hybrid system generally consists of some AC source like alternator, diesel generator and some DC source like PV; wind some kind of fuel cell and battery storage equipments. All these equipments

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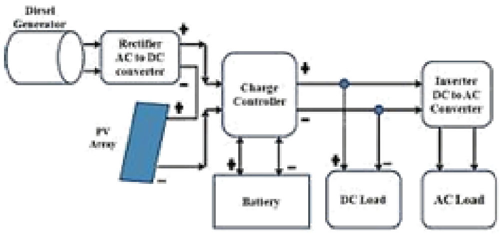
together form the hybrid system by creating one AC and DC link or bus which is connected by a converter for allowing the bi directional flow of energy.

I.Series Hybrid Configuration System

In series hybrid configuration, two power generating sources are connected in series to supply the load. They are connected to a common bus which supplies the load, so appropriate conversion of AC to DC or DC to AC of supply is done before connecting power sources in series. The AC or DC loads are supplied by the help of power electronic converting devices depending upon from which type of bus they being supplied. Reliability of series hybrid system is low as the power sources are connected in series, if one of the sources fails then the whole system gets interrupted.

In PV-Diesel series hybrid system the power generated by the diesel generator is converted to DC by a rectifier and then converted back to AC through an inverter. The inverter which is designed in such a way so that it can meet the maximum load, and converts the DC into AC, and supplies the AC loads. The PV source is connected in series with diesel generator and then connected to the charge controller which controls the charging and discharging voltage levels of the battery. The Battery is used to store or supply the excess or deficit power and also to help during instances like the starting of the diesel generator or load changes.

Similarly PV-Wind series hybrid system both the PV ar-ray and Wind Turbine-generator set (through a rectifier) are connected in series with each other. PV-Wind hybrid Power system is the combined power generating system by solar energy PV array panel and Wind mill. It includes a battery which is used to store the energy generated from both the sources as a back-up power option. Both units generate power when both sources are available. By facilitating the battery, uninterrupted power supply is possible when both or any one source is idle or not sufficiently available. The PV-Wind series hybrid system favors that type of conditions where both sunlight and wind are available for a reasonable period of time in a day.



II.Parallel Hybrid System Configuration

Whereas in parallel hybrid configuration, two power generating sources are connected in parallel to supply the load. So if one the system fails then the power will be supplied to the load from other source.

In parallel configuration the generator and PV array are connected in parallel to the DC bus. The power supplying capacity of the parallel configuration is much more which is equal to the sum of the capacity of individual sources. However proper synchronization is required between output voltage of inverter and diesel generator.

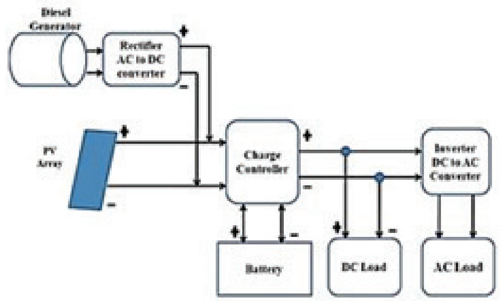


Fig. 2. Parallel Hybrid System

III. SYSTEM CONFIGURATION

To find an solution for a small hybrid grid connected system first we have to provide some kind of information to the designed system like initial cost of each component for both solar PV and wind system, the net solar radiation of the system and wind speed of the considered area, the annual operation and maintance cost of the system throughout the year.

The system to be consider in this design consist of two buses namely AC and DC bus. Ac bus is supplied with Hydro plant and two generators. Similarly the DC bus is connected with PV and Wind turbine. For the thermal load one boiler is also fitted. Converter is used in between AC and DC bus so as to provide bi directional energy flow between the two buses. The converter is considered to be as large as possible so as to meet the peak load demand and as well as must be cost effective. The system consists of Hydro power plant which acts like an base load for the entire system. In order to meet the peak load demand by the system it is connected to two numbers of diesel generators. The boiler and thermal load acts like a combined heat and power system for the integrated system.

Component	Production(Kwatt)	fraction(percent)
PV Array	898,831	61
Wind	0	0
Hydro	0	0
Generator-1	165,137	11
Generator-2	421,251	28
Total	1.485.219	100

Table-1 shows the net production result from which it can be seen that during the absence of the wind speed the load demand can be meeting by the hydro and PV. However if it is Required to maintain the Power supply during the peak load demand condition then battery can be provided so as to maintain the power supply.

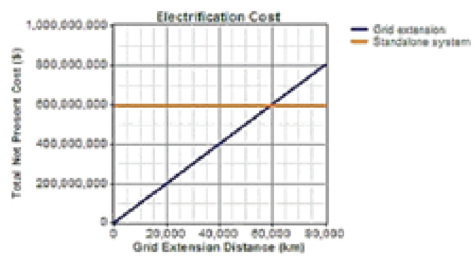


Fig. 3. Grid Extntion Curve

Component	Capital (Rs)	Replacement (Rs)	Maintance(Rs)
PV	40,000	24,944	63,917
Generic 1Kw	143,000	5,966,895	5,369,012
Hydro	580,000,000	0	1,917,505
Generator-1	152,000	24,778	0
Generator-2	138,000	140,753	0
Converter	95,000	27,966	31,958
System	580,567,396	6,185,337	7,382,393

The grid integrated Hybrid power system provides a better solution for energy as compared to only the diesel system. The use of the diesel generator in the integrated system produces toxic materials. However the grid integrated renewable energy not only reduces the harmful gasses like carbon dioxide, sulphur monoxide and some particulate matter but also increase the reliability of the system. The fuel consumption by the diesel system is also reduced and helps in energy conservation. The data used in this system can be used to analyze the stability and economic benefits of the hybrid system.

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29th Indian Engineering Congress

Technical Session III

ENGINEERING EDUCATION, R & D AND SKILL DEVELOPMENT - NECESSITY FOR RE-VISITING

The Institution of Engineers (India)
Andhra Pradesh State Centre

INVITED TALK

Engineer Education in the knowledge society - A way forward

Prof. D N Reddy[1]

Introduction

Education today is the key driver for Economic development of any country. India has been bestowed with a large Human resource base in the world next to China. There are 55 million youth between age group of 18 and 23 in India and only 15% of them have opportunity to pursue Engineering Education. Though the Focus is to provide access to many but equally important is to ensure quality of education. Engineering graduates today require not only adequate technological ability and problem solving skills, but also must be equipped with soft skills, business skills, IT skills, inter personnel and intercultural adaptability.

Now, the emphasis should be on self-learning and the role of teacher is redefined as facilitator to enable the students to be more involved in active learning through laboratory. Project work, assignments and case studies Life-long learning and continuous learning are key aspects of teacher and student.

International collaborations are essential for better student development. In view of the globalization, the role of ICT is the key enabler for enhanced student learning. Apart from F2F learning, Blended learning through online, web based methodologies will provide better opportunities through International collaborations for student development.

Innovative models of undergraduate and graduate students is desirable through International collaboration to enrich the students of better understanding and level of competency can be developed.

21st Century Career Outlook for Students

The fast paced world is changing the way Engineers think and work. Engineering graduates in the past preferred to work with one large employer, almost for life, concerned largely with the technical feasibility. They worked and were judged as individuals. However the demands on Engineers in the 21st Century are diverse. They need to work as Engineers and Non-Engineers being concerned with market, technical and societal feasibility. Rapid advancements in ICT and Globalization and reduction in transaction costs have created opportunities for the formation of more agile organizations and Dynamic Workforce beyond geographies. The challenges for Engineering graduates are also on the high and in addition to the technical skills, they have to be equipped with the requisite Soft-Skills to succeed in their career. The graduates will have to work and are evaluated on interdisciplinary teams, may be cross-border. They will have to work for a number of firms of different size and maturity. The Millennium Engineer should therefore be additionally equipped with soft skills, business skills, problem-solving, communication,

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Former Vice-Chancellor, JNTU Hyderabad

teamwork, self-assessment, change management, lifelong learning, inter personnel and intercultural adaptability Skills in global setting. Several International accords have taken shape and graduate attributes for the 21st Century Engineer have been identified [Outcome Based Education (OBE)]. India for the past decade has not only been the major contributor of global workforce but has demonstrated partnerships in Research and Innovations, solving many of problems faced by world over.

Engineering Education in a Knowledge Society

Rapid advances in Information and Communication technologies have helped nations all over the world in accessing information and knowledge created anywhere in the world and using them for the prosperity and well being of its people. They have also given a major fillip to the creation and dissemination of knowledge inside the country and using it extensively for economic, social, cultural and other human activities.

Knowledge Society normally refers to any society where knowledge is the primary production resource instead of capital and labour and where due importance is given to the use of knowledge and information in all economic activities. Creation and utilization of knowledge have been a feature of all modern societies and have always received due importance and respect, but have remained mostly localized in the community. Current technologies have eliminated the constraints of localization and geographical proximity and have provided increased opportunities for sharing, storing and retrieving knowledge and for marketing domain specific knowledge and skills required for the country and also across the globe.

While all knowledge is important and useful, engineering education plays a very dominant role in developing knowledge and skills which are vital to the growth and maintenance of knowledge, knowledge-based and knowledge processing industries. Apart from providing specific domain knowledge in different engineering disciplines and producing experts in computer science and engineering, and information communication technologies, all engineering graduates irrespective of their fields of study are given education and training to acquire a reasonable level of competence in problem solving skills, software development, computer applications, modeling and simulation, and environmental impact analysis areas, which are important in creating new applications for knowledge and in marketing them both for domestic applications and for export. In recent years with the advent of the knowledge age, there has been a significant increase in enrolment in engineering programs all over the world including India in computer and information sciences, software engineering and information and communication technologies. India has taken a major lead in this area and is exporting both manpower and skills in IT to most countries in the world. To maintain its leading position in this area, the engineering education system in the country has to continuously improve quality, upgrade facilities, and produce graduates with globally marketable skills.

Innovation and Entrepreneurship

Engineering Education offers enormous opportunities for promoting creativity and innovation since the process of innovation are identical to those of problems solving and design which are the basic focus of all engineering education. Fostering a culture of innovation among students would require training in critical thinking, encouraging, thinking out of box, looking at problems from multiple points of view, generating ideas and solutions including those which appear at first sight to be highly improbable, providing access to experimentation.

Engineering graduates to-day require not only adequate technological ability and problem solving skills, but also be endowed with soft skills like co-operative working, communication and presentation skills, business ethics and Inter -personnel relationships and posses a deep commitment to safety, reliability, quality and sustainability of all engineering activities.

Challenges

There are two parts of the challenge we are confronted with. Firstly, how students and academicians can keep abreast with latest developments in the respective field? And, secondly, how should the students remain relevant once they graduate and become professionals in the chosen areas of their study.

Friends, if you are prepared to think big and act in time with conviction, you will be rewarded. You should hold on to your goals even if you stumble here and there, and learn your lessons. You are the stewards of this nations and custodian of very rich tradition of antiquity with modernization. As we march towards becoming a developed nation, your role as that of 540 million youth of the country, becomes increasingly important. One of the hurdles which often work as a speed breaker is our mental block to think and consider higher targets and goals to be impossible.

During the last 62 years, our country has made conspicuous and significant progress in the growth of Agriculture, Industry Infrastructure, Information Technology, R&D and knowledge Wealth. Today, Indian industry is not only growing in size but also in its level of operation. Excellences of Indian professionals in different fields are to be well imprinted on wide canvas of the globe. This process is already on. One can see that in more recent times, outsourcing of R&D talent in India by global industries has been significant. Still, there is immense potential for India to transform herself into a global R&D platform. It is imperative at this juncture those frontier areas of technology like Nano-technology, Bio-technology and Bio-engineering are pursued aggressively in Colleges and Universities. For which we need to redefine our education system.

We all know that the country today has a very large youth population of productive age group of 18-23 years, ambitious and looking for suitable opportunities, so that they can contribute to the developmental efforts of the country. Many National and International agencies have been looking at India to be a major source of the skilled manpower to meet the requirements of the developed and the developing countries.

It has been projected by ILO, that by the year 2025 the world's top industrialized countries would need about 60 million skilled workers to maintain the productivity, even at the current level of output, in these countries. India on the other hand, would be having a surplus of about 56 million youth who can fit this global need, provided they have the right skills, knowledge and cultural foundation, required to make them into a productive workforce suitable for this great role internationally.

Need for Skill Development

The training on employability skills will help them connect with industry before they step into employment. Providing such training would have twin benefits, firstly, the students are well-prepared to enter the job market, which will positively impact their productivity at the workplace and secondly, companies will be spared of the huge amounts of investments required in pre employment training, especially in areas like soft skills. The programme will give them self confidence in their profession.

INVITED TALK

REVITALISATION OF TECHNICAL EDUCATION

C.R. RAO[1]

ABSTRACT

1. INTRODUCTION

India, 67 years after attaining independence, is still a predominantly agricultural country. At the same time, it is also one of the top ten industrial powers of the world, possessing well-trained manpower capable of developing indigenous technology in certain areas, comparable to that available in developed nations. The role of technical institutions in imparting the required knowledge through well-designed curricula and producing qualified and competent engineers to meet the required demands in this regard is laudable.

However, during the last 15 years, there had been an exponential growth of technical institutions all over the country, in the form of self-financing institutions, resulting in engineering graduates output whose number is far in excess of the available jobs in the government and private sectors. This situation led to the criticism that the quality of graduates emerging from the institutions is much below the expected level and their knowledge of engineering subjects and attainment of skills is very poor. Statistics reveal that not even 10-15% of the graduates annually produced by the various institutions, barring a few, are fit for employment, as expressed by the prospective employers.

Prime Minister Narendra Modi, in his Independence Day speech of this year, gave a call that the nation should strive for excellence in all fields and "MADE IN INDIA" mark on the products, manufactured in India and the technologies developed here, must receive acclamation in the world market. The Institution of Engineers (India) too chose "Making Indian Engineering World Class" as its theme for the engineers day celebrations (15th September) of this year. In order to achieve this goal, the industry must play its part and the technical institutions have to realign the academic processes so as to produce competent graduates with the relevant skills, who are in no way inferior to those graduating from world-class institutions.

2. STATUS OF INSTITUTIONS

At present, in India, there are different grades of institutions offering a variety of undergraduate programmes.

(a) Institutions of national importance: IIT, NIT& and centrally funded institutions and universities.

(b) State level technical institutions and universities, financed mostly by the state governments.

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(c) Private Institutions, which receive assistance from Central and State Governments for some of their Programmes.

(d) Private institutions, which are conferred autonomy or university status, and are self-financing in nature.

(e) Private institutions, which are affiliated to the University of the Region, and are self-financing in nature.

The UG programmes run by the institutions are in general recognized by the AICTE and some of them are even accredited by the NBA. It is gratifying that some of the private institutions produced highly competent graduates, who are employed by prestigious organizations in India as well as abroad. However, a large majority of the institutions of self- financing nature failed to rise to the expected level of academic performance even after several years of existence, which is a matter of concern. Their products showed very low level of academic performance which led to lack of job opportunities or under-employment.

3. REASONS FOR LOW LEVEL OF EMPLOYABILITY

Several factors contribute to the low level of employability of graduates of institution, some of which are:

(i) Liberal sanctions for establishment of institutions by the concerned authorities without regard to the manpower needs.

(ii) Commercial attitude of management of institution.

(iii) Inadequate infrastructure.

(iv) Lack of competent faculty and support staff

(v) Admission policy of state/institution, resulting in admission of students who are academically weak and incapable of acquiring the needed skills.

(vi) Recruitment/promotion/retention policy of management

(vii) Non-attractive pay structure, much below the norms and in comparison with other job opportunities.

(viii) Lack of encouragement for skill upgradation and improvement of qualifications of staff on rolls.

4. EXPECTED COMPETENCIES OF GRADUATES

4.1 As Prescribed by NBA

The National Board of Accreditation (NBA), a statutory body of India to grant accreditation to an institution, has prescribed that an engineering graduate must attain the following capabilities after following an engineering degree programme.

The National Board of Accreditation (NBA), a statutory body of India to grant accreditation to an institution, has prescribed that an engineering graduate must attain the following capabilities after following an engineering degree programme.

(b) Ability to design and conduct experiments, as well as to analyze and interpret data

(c) Ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

(d) Ability to function on multidisciplinary streams
(e) Ability to identify, formulate, and solve engineering problems
(f) Understanding of professional and ethical responsibility
(g) Ability to communicate effectively
(h) Broad education to understand the impact of engineering solutions in a global, economic, environmental and social context.
(i) Recognition of the need for and ability to engage in life-long learning.
(j) Knowledge of contemporary issues
(k) Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The NBA is also negotiating to become a member of Washington Accord, which permits an engineering graduate of any member country to work and practice in any other member country without any further tests.

4 .2 VIEWS OF INSTITUTION OF ENGINEERS (INDIA)

Institution of Engineers (India), a professional body of Indian engineers, established in by the Royal Charter, is one organization which interacts with other professional bodies of the world and is trying to get recognition for its members to practice in any other country without any further eligibility requirements. It has chosen as its theme "Making Indian Engineering World-Class" for its 47th Engineers Day (Celebrated on 15th September every year) of the year 2014. It has identified the following activities to be taken up in right earnest to produce competent engineering and technical personnel through transformation of curriculum and upgradation of skills.

(a)General awareness about the global nature of the profession in tune with growing challenges and opportunities.
(b)Develop a comprehensive understanding in the respective engineering discipline to tackle complex, real-world problems.
(c)Accept challenges and solve them with wisdom and shared knowledge.
(d)Acquire knowledge and expertise through life-long education and continuous reading
(e)Build familiarity in other engineering and scientific disciplines so that inter-disciplinary solution approaches can be evolved.
(f)Pursue opportunities to apply skills in both traditional and non-traditional fields to address societal challenges
(g)Communicate and interact with other highly recognized international leaders in engineering
(h)Establish themselves as personalities with ethical and noble values.

It can be observed that there are many common expectations from the above organizations. The role of educational institutions in transforming the content and laying stress on the skills is vital for global acceptance of our engineering graduates. Some of the actions that can be implemented at the institution level are discussed below.

5. REMEDIAL MEASURES NEEDED

Initiatives are to be taken to correct the present situation if the quality of the graduates has to be lifted to greater level and to make them competitive.

Some of them are discussed below.

5.1 NUMBER OF INSTITUTIONS AND PROGRAMMEMES OFFERED

The number of technical institutions to be newly set up in a state should be based on the developmental needs of that state and the jobs likely to be created, by the actions of the state, both in governmental and private sectors. States must identify institutions which have established reputation for better academic performance and encourage them with additional intakes; in the same way, those which fail to achieve the expected performance levels should be penalized with either with reduced or nil intake by the regulating authoritiesViz. university or AICTE or the state government. Implementation of these measures entails long-term planning by the State and commitment of the government irrespective of the political party in power, which means that they should be planned by arriving at broad consensus among the political class.

Secondly, the programmes of study should be carefully planned based on the competences available and can be pooled in tune with the developmental plans of the state. The annual intake to any programme may also be kept variable, rather than sticking to the same number every year to meet the job potential.

Thirdly, a review is needed of the programmes that are presently offered or the UG level and those with narrow specialization should be discontinued to protect the interests of students, following them. It is desirable that UG programmes are broad – based in a particular branch of engineering covering different streams, encompassed by it, so as to develop a strong base; to it can be added introductory courses of higher level in the form of electives, so as to enthuse the student and create an appetite for furthering his knowledge. The curriculum should lay stress on achieving the prescribed objective of the programme, as enunciated by NBA or Institution of Engineers (India), rather than on rote learning.

Fourthly, a periodic monitoring process of the functioning of the institution should be set up which is transparent in nature with a view to help the institution to apply required mid-course corrections and to justify its existence. Regulatory authorities should be able to exercise their power in broader national interest rather than succumbing to the dictates of the political powers.

5.2 STUDENT QUALITY

Admission to engineering programmes in India is based on the aspirations of the parents and the societal perceptions rather than on the capacity and inquisitiveness of the engineering studies, much against his/her will in many cases. Added to this is the mis-match between the number of seats available and the number of aspirants, the former being far in excess of the latter in many States. Another factor which contributed to the rush for engineering admission is the feeling that it is more useful in getting job as compared to 3-year science or arts or commerce degree programme.Some states introduced a fee waiver scheme for some sections and this incentive facilitated some weak students to opt for engg. course, even though they know that they do not possess the required levels of preparatory knowledge to pursue them.

Some states introduced a fee waiver scheme for some sections and this incentive facilitated some weak students to opt for engg. course, even though they know that they do not possess the required levels of preparatory knowledge to pursue them.

(a) Students with low level of performance at first year are not allowed to prosecute further studies.

(b) Students who have successfully completed some identified courses and wish to withdraw before the completion of the 4 year programme are awarded certificate of proficiency /diploma so that they can seek jobs relevant to the skills acquired

5.3 FACULTY

The strength of an institution depends on the competence of its faculty. At present there is acute shortage of faculty in all institutions and there is reluctance on the part of persons with higher degrees (M.Tech./PhD) to join the teaching profession in view of lower salaries and stringent promotional opportunities in the form of research publications, research guidance, execution of research projects, consultancy work etc.,

The following actions are suggested

(a) Conduct training programmes to improve the competence of the faculty

(b) Faculty is encouraged through financial help to acquire higher qualifications.

(c) Arrange for interaction of faculty with professional organizations/industry/R&D for learning the field practices.

(d) Facility for serving in professional organization/industry/ R&D for longer periods on deputation.

(e) Recognize the faculty with potential for quality performance and nurture them

(f) Provide incentives in the form of awards for good work share in consultancies, grant of sabbatical etc. to high achievers through a transparent assessment procedure.

5.4 TECHNICAL SKILLS

One of the major shortcomings about engineering education is that it does not provide enough opportunities to the student to acquire the skills required by the profession. Stress is laid on theoretical courses and designs based on assumed and sometimes, ideal conditions. The student is well trained to arrive at design of a machine, product or structure or to check its safe performance. He is not exposed to practical aspects or field conditions, which may warrant an altogether different solution than what is conceived. It is however impossible to expect that the institution will be able to train the student in theory as well as practical aspects as interaction between institution and the profession is non-existent in most of the institutions and the faculty do not possess the necessary skills to provide the necessary linkage.

The following initiatives are suggested to fill the gaps

(i) Involvement of professional engineers in the development of curriculum

(ii) Development of design and other practice-oriented courses with the required skill orientation in collaboration with field engineers, where required.

(iii) Conduct of project work at the project site/design office under the joint supervision of faculty and the professionals

(iv) Lectures by professional engineers.

(v) Field visits to installations

(vi) Internship of faculty and students for longer duration in Industry/professional organization.

(vii) Reorientation of laboratory courses with emphasis on applications.

5.5 INTERNSHIP

As discussed above, internship provides an opportunity to the faculty as well as the student to be aware of the professional practices and to improve the quality of academic processes. Following actions are suggested.

(i)Internship for faculty should be well planned so that the desired outcomes are achieved in a short period of 2-3 months, which can be repeated at regular intervals of 3-4 years.

(ii) Faculty internships, where required, can be of longer duration, to improve the competence of the faculty. Such internships should invariably lead to joint collaborative projects which bring revenue to the institution and benefit to the collaborating professional organization. These actions will result in exposing the students to the skills expected by the profession and in personal satisfaction to the faculty.

(iii) Internship for students can be arranged at the end of 2nd& 3rd years of programme based on the knowledge so far gained by then at the institution and to fill the gaps in the professional orientation. In the final year the emphasis during internship is on executing a meaningful project, based on theoretical and field practices.

5.6 COMMUNICATION SKILLS

Many students lack the basic skills of oral and written presentations in English. Institutions have in general, prescribed courses on communication skills along with a practice course in language laboratory. While these courses are intended to act as catalytic agents, the initiative has to be taken by the student to acquire these skills through self-efforts. The following actions may help the student in this direction.

(i) Participation in debates, group discussions and seminars seeking the help of teachers in preparing for these activities.

(ii) Usage of modern tools Viz power point presentation etc. for effective oral communication.

(iii) Term papers, as part of assignment of a course work, to improve writing skills.

(iv) Seminar talks on a chosen topic which involves collection of material from different sources, synthesis of different ideas and also to prepare a written report in it.

5.7 VIDEOS ON SPECIALISED TOPICS

Owing to the rapid technological developments, radical changes have taken place in the industrial processes, design, instrumentation and control, and use of sophisticated machinery in the professional sphere. Institutions are not able to expose the students to these developments. It is therefore suggested that industries/professional organizations may prepare videotapes on them and supply them to the institution. Further, information on case studies involving design, fabrication, production, retrofitting, strengthening of existing structures (eg.roads for additional loads), etc. is not available at institutions.

Information on such topics, where Indian engineering techniques were employed and projects successfully executed will encourage the students to learn about developments on their own, beyond the curriculum.

5.8 LECTURES BY INDUSTRIALISTS/PROFESSIONALS

It is proposed that at least 2 lectures by leading industrialists/professionals may be arranged in a year at each institution to create general awareness and appreciation among the students about the achievements, developments, and manpower needs, expectations from graduating students ,future direction the profession is embarking upon etc.

Such visits will also enable the persons from profession to interact with the management and academia of the institute and to arrive at possible collaborating arrangements and the orientation of R&D activities at the institute.

6 CONCLUSION

It is high time that steps are taken to improve the quality of engineering graduates so that they become competitive at the global level and to make Indian engineering world- class. Measures suggested in the paper are indicative and by no means exhaustive.

WORLD CLASS ENGINEERING EDUCATION TO MAKE INDIAN ENGINEERING WORLD CLASS

Prof O R S Rao[1]

ABSTRACT

World Class Engineering refers to adherence to the best Global Quality Standards in every phase of Engineering from R&D till manufacturing, testing and commisioning. Engineering profession in the next two decades will undergo dramatic changes, driven by not only technological developments but also societal transformation. Besides increased globalization , more acute concern for environment for sustainable development will characterize changes and challenges for future engineers in their roles. As industry increasingly looks at Corporate Social Responsibility not just as mandatory but as key to success, future engineers should change their mind sets and incorporate sustainability and corporate social responsibility as key parameters in their day-to-day working as well as decision making framework. As roles of future engineers expect different sets of competencies from the graduating engineers, it is the responsibility of the educational institutions to reinvent themselves and brace themselves for a paradigm shift in the way, students are groomed to match the changed expectations. Consequently , the way the components of education namely , knowledge, skills and attitudes & values , are to be imparted has to be different. Contents as well as pedagogy will need to be changed accordingly. This tectonic shift will pose challenges to all the stake holders - educational institutions, industry, government , teachers and students . All of them need to work together as partners to address the challenges. It also calls for change in mindsets of all stake holders so that the transition is smooth and successful. Concerted and synergistic efforts from all of them will help to make Indian Engineering Education world class so that Indian Engineering becomes truly World Class , which will enable the dream of seeing "Made in India" products all over the world, a reality. fatigue resistance as the honeycomb panel facings are continuously bonded to the core and therefore no stress concentration is seen.

Keywords: Engineering Profession, Future Engineers, Problem Solving, Components of Education, Role of engineering education, Digital Age, Teaching-Learning, Blended Learning, Life long learning, MOOC, Sustainability, Green Technologies, World Class Engineering.

1.0 Making Indian Engineering World Class

World Class Engineering refers to adherence to the best Global Quality Standards in every phase of Engineering – starting from product innovation, design, analysis , manufacturing ,testing , delivery , commissioning and maintenance of products , wherever they are made. It is in line with the recent clarion call of our Honorable Prime Minster Sri Narendra

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Modi to produce "Zero defect" products in India and dream of seeing "Made in India" products all over the world. It is possible only when we understand how the engineering all over the world is moving forward , crystal gaze the Engineers of the Future and what it takes to produce them in India. Unless our Engineering Education is world class, our engineering can not be World Class.

2.0 Engineering Profession of the Future

We need to ask ourselves the basic questions about future engineers - who they will be, what they will do, where they will operate , why they will do certain things , and what they imply for Engineering Education. We should also anticipate the environment in which they will operate and the challenges , they will be facing.

The changes and challenges faced by future engineers in the next decade may be classified into following categories:

1.Technological Developments: In most part of the 20th century, developments in Technology were essentially in well defined disciplines like Civil, Mechanical, Electrical, Chemical etc. However, last 25- 30 years have seen growth in multiple directions. Besides specializations under each discipline like (Electronics, Telecom , VLSI, Embedded systems etc),specific application domains like Automobile, Aeronautical ,Oil and Gas started developing, A more important development has been the emergence of multi-disciplinary and interdisciplinary areas like Mechatronics, Auto Electronics, Bio-medical , Robotics etc. Convergence of IT, Internet, Telecom and Electronics and its impact on all disciplines is mind boggling, with emergence of areas like automotive telematics ,mobile info-tainment , Intelligent Power Grids etc. For instance, autonomous self driving car was developed by Google (and not any of the auto majors). It is Google and Apple that are setting standards for Embedded Infotainment systems in a car. In this environment, any engineer can not afford to live in his "own world" but should be open to learn other disciplines and work together with them to evolve solutions to day-to-day problems.

Globalisation : With increased globalization, companies compete globally for every thing ranging from products, markets, resources etc. As Indian companies set up and scale up global operations, engineers are called upon to work anywhere in the world . In order to be successful in these markets, engineers need to be culturally adaptive.

3. Concern for Environment and Sustainability : for the past over 150 years, most of the remarkable Engineering / technological achievements of were based on the paradigm of controlling Nature rather than co-operate with it. Ironically, the same successes like fossil fuels, automobiles, plastics etc have endangered human life. For the last few years, there has been more awareness and concerns among people and governments on conservation of Nature and sustainability of growth. So much so, some companies started focusing on Triple Bottom Line (Profit, People and Planet) objectives that are essential for sustainability . In the next few decades, engineers must change their mind sets to contribute to building a

more sustainable world. In this context, it will be mandatory for the Engineers to adopt Green Technologies for design of products addressing industry/social problems.

It is these developments that have been driving the recent fast pace of R&D in areas like Electrical Automotives. China is planning to have at least 2 million Electrical Vehicles on its roads by 2020 (which will be the largest EVs in any country) . No wonder, Samsung is setting up R&D labs in China to produce cost effective batteries for EVs and a lot of R&D going on for wireless charging of EVs. During Oct 2014, Chen Xiaodong and his colleagues at the Nanyang Technology University in Singapore, announced the development of a battery that is a substantial advance on existing batteries. It will charge 70% of its capacity in just two minutes and it could last as long as two decades. Both the properties are invaluable for electric cars, but are also useful for the next generation of devices too.

Renewable Energy and Solar energy , in particular, could be the top source of electricity by 2050, due to fast declining costs of the solar equipment like Photovoltaic Panels and Systems. Batteries will store the solar energy at night and allow us to use it when the sun does not shine. For the first time after the industrial revolution, we will have a viable alternative to coal for electricity and alternative to oil for transport. As per the report from the International Energy Agency (IEA), dated 29th Sep 2014,Solar Energy could scale up from less than 1 % global capacity today to 27% (16% from PV systems and 11% through Solar Thermal Energy (STE) . As per the report, Solar energy expansion will be led by China, followed by the United States, Africa, India and the Middle East.

4.Corporate Social Responsibility: Industry converts natural resources into socially or commercially useful products and services using human resources. In this process ,it is likely that day-to-day lives of people are adversely affected . In some cases, people are displaced in projects like exploration of natural resources (like Coal, Iron ore, gas etc) or setting up infrastructure projects (like power) . Industry has to take the responsibility to address the consequent social problems. Last decade has seen increased awareness and sensitivity to such issues . Next decade will see Corporate Social Responsibility not just mandatory but a key parameter for success of organisations and engineers , as professionals.

5.Abrupt changes: Current century is characterized by sudden and dramatic changes in economic and social environment due to factors like terrorism, European Economic Crisis, Social upheaval in Middle East etc. The world will witness more such cataclysmic changes , in the years to come, The future engineers need to acquire skills to anticipate such changes and more importantly, adapt themselves and mange them successfully.

3.0 Role of Engineering Education in grooming Engineering Professionals for future:

As the environment in which engineers will operate in future will be different , role expectations from them and challenges faced by them will also be different from what they were in the last century. Roles performed by fresh engineering graduates in the last century were mostly routine and technical in nature, pertaining primarily to a single discipline of Engineering studied by them. Engineering students acquired the requisite knowledge through class room lectures and skills through working on experiments in laboratories and workshops . However, role expectations from fresh engineering graduates in future will be more complex - interdisciplinary in nature and must have skills to use latest technology tools and interact more intensely with society . Accordingly, components of education (Knowledge, Skills and Attitude) that need to be imparted will be different ,though certain fundamentals remain unchanged. Likewise , the way learning will take place, in terms of Teaching-Learning-Assessment processes also will be different.

2.1 What to teach-learn?

Components of education that need to be taught /learnt can be classified into Knowledge, Skills and Attitudes and Values .

2.1.1 Knowledge: Amount of new knowledge created has been increasing exponentially every passing day, in every discipline of Engineering / Technology . Besides it is easily accessible to any one through Google. At the same time, knowledge requirements for different industries and different roles vary widely. In real life, problems will not surface with the tag of specific disciplines. There is no way that any Engineering educational program (under graduate or post graduate) can cover or impart all knowledge required ,as a part of its curriculum.

A pragmatic way to address the issue could be : to teach core fundamentals of requisite sciences and engineering ,besides social sciences and students are enabled and encouraged to learn new knowledge ,on their own, as and when needed . Every student must be made conscious of the imperative for Life-Long Learning and ways and means of self study for continuous learning. Encouraging students to register for Massively Open Online Courses (MOOC) like edX, Coursera, Khan Academy , NPTEL etc to supplement class room learning will initiate them to continue similar means for self –learning , after they graduate.

Besides, the students should be equipped to diagnose real-life problems , identify the type of knowledge needed and more importantly, how to integrate the relevant “pockets of knowledge learnt” to solve the problem on hand.

2.1.2 Skills: While during the last century, Engineering Education focused primarily on imparting technical skills to the students, in future, there is need to focus more on cognitive and behavioural skills in areas like critical thinking, problem solving, self-assessment, integrative thinking, self-learning, inter-personal, communication and change management. Industry is increasingly looking for Higher Order Thinking (HOT) skills like Analysing, Evaluating and Creating.

Besides looking at the requirements of the industry, with a view to make the graduating students employable, educational institutions in future , must also impart requisite skills to make the students self-employable , either as entrepreneurs or as freelance independent professionals. Essential skills in this regard include Entrepreneurship, Finance and Marketing.

2.1.3 Attitudes , Values and Ethics : Failure of the education system to systematically address the issues of attitudes and ethics has already created adverse impact on the society . The World as well as India have witnessed how the greed of a few individuals , in whatever walk of life- business men, professional managers, entrepreneurs, bureaucrats, academicians or politicians- caused immense hardship to the entire society by way of collapse of companies, loss of jobs ,turbulence in financial markets or slow down of economies.

In view of this, it is becoming increasingly critical for Educational Institutions to put in concerted efforts to shape the character of the students , by inculcating positive attitude, with good personal values so that the graduating students can become not only competent professionals but also good human beings and lead a happy life and more importantly allow others to lead a happy life . Students must be made conscious of social, moral and ethical considerations in their day-to-day working as well as in decision making. It is too simplistic to assume that a course on humanities in the curriculum is adequate to bring about such an attitudinal change . It needs systematic inputs , followed by practice , accompanied by patient counseling so that the principles are ingrained in the minds of the students and become part and parcel of the personality of the students. There is no other better way of doing this than by teachers being the Role Models of personal values and ethics.

2.2 Teaching-Learning-assessment processes

Pedagogy to be adopted needs to be different in the context of the changed environment , in which the students are groomed . Students born after 1995 were brought up in a digital age , wherein technology has been an integral part of their day-to-day life . Information and Communication Technologies (ICT) can help in improving the effectiveness of Teaching-Learning processes. Audio-Visual technologies can help in enhancing retention levels whereas online learning can facilitate convenience enabling a learner to study when he wants or where he wants. Virtual Class rooms can help in simulating real class room environment facilitating interactivity among the student-teacher-other students. Virtual Laboratories can facilitate conduct of experiments that may not be feasible to do physically because of reasons of cost or hazard.

Blended Learning, wherein technology and traditional teaching methods can be judiciously combined , can get the best of both worlds. Flipped Classrooms (also called Inverted Classrooms) approach can be used to make students learn the concepts at home , using technology and practice the same in the class room, under the guidance of the teacher.

However, no amount of technology , however sophisticated, can substitute a teacher, though the role of a teacher will undergo a dramatic change , in future. It will be the teacher that has decide on the most appropriate method for teaching, depending on the subject and the profile of the learners and act as a facilitator and a coach , by guiding and monitoring their learning.

While imparting knowledge may be relatively easier, it will be more difficult to impart skills, more so , in the case of soft skills and cultivation of attitudes. Teacher has to identify clearly the skills to be imparted and communicate the importance of the same to the students convincingly. Besides, he/she has to design appropriate action learning activities to get them practiced by the students . Grading system to evaluate the performance of students for such activities should be more on the process , rather than on out comes . Assessment of the students should be continuous and students should be given feedback at every stage and are counseled for better performance.

4.0 Challenges:

Future engineering education will be able to meet the aspirations of the new age students , only if all the stake holders put in concerted efforts in a synergistic manner . However , each of the stake holders will face challenges , which need to be addressed.

3.1 Educational Institutions :

Educational Institutions have to invest adequate resources in terms of money and quality human resources to ensure a paradigm shift from current system to the a new system. Next few years will also see a shake out in Engineering Education, which has scaled up capacity very quickly in the last decade ,without taking care of quality. The shake out has already started in 2013 , which will accentuate in the next five years . Only such of the institutions with commitment to quality education ,without looking for quick financial returns will survive. It is upto the educational institutions to interact more actively with industry and society and identify the changed expectations from the students. They should bench mark themselves with the best-in-class institutions globally , get accredited by international agencies and can target global rankings.

There is need for the Institutions to seek partnerships with industry so that competency of the graduating engineers is in line with the expectations of the industry. Involvement of the industry should be broad based and should start from curriculum development , guest lectures , hands-on projects etc.

3.2 Industry :

Industry needs competent engineering manpower not only to produce quality products and services but also for its growth. Today the industry is pending a lot of money to recruit and train the graduating students so that they can be deployed productively. So, it is in the interests of the industry to work hand-in- hand with the educational institutions , for mutual benefit. Industry , over a period of time, can look forward to centres of competence in education to help solving their technical problems.

3.3 Government policies and regulation :

Government and regulators will face the challenge of increasing Gross Enrollment Ratio (GER) without compromising on quality. It will also be challenging to set standards of quality , in an environment , where there is wide disparity in quality of education in institutions across the country. Regulatory framework , in future, should be more facilitative than restrictive. It should encourage innovation rather than control centric . Government will also face the dilemma of how much autonomy to be given to institutions versus how to ensure maintenance of minimum standards . While there are benefits in welcoming foreign institutions into India in engineering education, government policies have to ensure that they should help in improving the quality of education . Success in future engineering education will depend on how government will be able to strike a fine balance among the key legs of the tripod - Expansion, Equity and Excellence, while formulating and implementing its policies.

3.4 Role of Teachers

Teacher is the fulcrum , on whom quality of future education lies, particularly in highly knowledge centric area like engineering education. A teacher has to equip himself well in the same three components of education (knowledge, skills and attitude) so that he can be more effective in the changed environment. Besides acquiring higher qualifications, he has to keep himself abreast of the latest developments in his field by attending seminars and short term programs. Pursuing online MOOC courses can be an excellent opportunity not only to enhance his knowledge but also get insights into more effective pedagogy. In order to leverage technology for effective teaching-learning, a teacher must know about the range of technology tools available and also acquire skills to blend them with traditional teaching methods. Unless the teacher is perceived as a role model by the students, in his values and ethics, he can not inculcate the same in the students.

3.5 Students

Ultimately, it is upto the students to take the ownership for their own careers (and Life ,as a whole) and make the best of the opportunities to learn. They should understand that learning does not stop with their formal education and have to strive for life long learning. They should be conscious that skills and attitude are more important than merely getting good grades / marks in the examination. They should update themselves on the fast changing industry environment and the consequent changes in skill requirements and acquire the same . They should be realistic with regard to their career expectations and must be adaptable to seize the career opportunities, as they beckon. Next few years will present exciting opportunities for self employment, which need a change in mindset of the students.

4,0 Conclusion

Next few decades will see major changes in the environment ,driven by not only technological developments but also changing society . Future Engineering Education must reinvent itself and re-engineer itself to make it relevant for the industry and society, at large. It needs concerted efforts from all the stake holders to effect the transition smoothly and successfully and build a strong edifice for the Future of Engineering Education so that Indian Engineering can be made truly world class and realise the dream of seeing " Made in India" products all over the world.

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CROSS DOMAIN PRIVACY PRESERVING SEARCH FOR POLICY ANOMALIES IN FIREWALL

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ABSTRACT:

Most of the business services have been performing very effectively by using some of the evolving technologies like cloud computing and other architectures. But still they have been suffering from security problems due to the undesired actions in their services. So, in this situation firewalls can plays a vital role. Firewalls can ensure the security of private networks in organizations by providing some of the security related mechanisms. So, in this paper we proposed the latest developments in anomaly management framework which works on a rule-based segmentation technique for correct detection of anomalies[1] and for the effective anomaly resolution and this can also be extended to the other types of policies.

Keywords: Anomalies, Firewall Policy, Security

1. INTRODUCTION:

The migration of security threats had become a necessary action for networks of all sizes today. The increasing trend of target network attacks has not been decreasing down. Most of the company networks are especially in danger because of their, malicious breach of security. This may be a serious business problem. Internet usage has been increasing now-a-days and its attention is drawn towards the research and business communities'. Generally to provide security to the internet is a challenging task to most of the administrators. So, Firewalls can play a vital role. Firewalls can act like barriers for the most of the enterprise and business networks from any type of attacks. A Firewall is a software which is used to filter and to control the traffic as shown in the figure [1].The firewall decision is based on a set of filtering rules which can be specified in the form of Access control policies (ACP). However the designing and managing of these policies can be crucial due to the improper policy management techniques and the tools. Managing these policy rules especially in the single and multifirewall environments is also crucial. So, properly configuring the firewall policies based on technique for the anomaly problem may have an idea to develop the correct algorithm to reconfigure the firewalls. The goal is to have an algorithm which can withstand with any type of attack.

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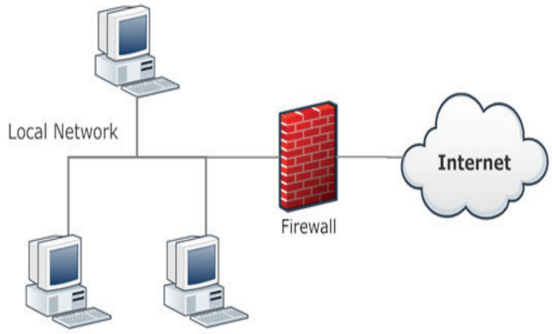

Figure.1: An Example Firewall

A firewall is software or a hardware system that prevents malicious and unauthorized access from a network. Firewalls are used to filter and to control the traffic from the unwanted Internet users from accessing their networks connected to the Internet. The firewall can check each and every data and checks its criteria that have been set by the specified firewall. Another use of the firewall is, to protect against unauthenticated logins from the outside world. This helps to prevent the threats on our network. Most of the firewalls can permit only a limited number of users from the outside world. A firewall is a part of a network that has been designed to block undesired access while providing permission to the authenticated users.

2. BASICS OF FIREWALL RULES:

2.1 Firewall rule set:

The Firewall filtering decision is based on set of specified rules. Each rule has a <predicate>over a multiple packet header fields and a <decision>where <predicate> is a Boolean value consisting of certain variables which it assign to each packet as true or false and <decision> specifies whether to "accept or deny".Eha[6] mention the packet header fields as(Source IP address, Destination IP address ,Source port, Destination port, protocol type)as shown in Table.1

Rule	Protcol	Source IP	Source Port	Dest. IP	Dest Port	Action
r1	TCP	162.11.1*	*	162.32.1.*	80	allow
r2	TCP	162.11.*.*	80	162.32.1.*	80	deny
r3	UDP	142.11.2.*	*	192.168.*.*	53	allow
r4	UDP	100.11.1.*	*	192.168.1.*	53	allow

Table.1: Example of firewall rule set

The most commonly used fields in a firewall policy are the multiple packet header fields [7,8].The format of the policy are rules in each and every <rule> <protocol><source_IP><-source_port><destination_ip><destina-tion_port><Action>.The rule specifies the name of the rule .Port can be a specific port number and IP address can be host or a network. Firewalls use the first match mechanism to decide which should be applied first to which packet. the main important characteristics of a firewalls is to first we have to maintain the orderness of their rule-base because each firewall has to check the packets in the sequence for each and every new session.i.e., the rule that its matches first. The deny option is mainly used to support some of the errors due to some of the conflicts.

3. EXISTING SYSTEM:

Previously we have focused on intrafirewall optimization in a single firewall environment by removing the redundant rules but the privacy is not at all concerned. As a result conflict detection [4] will be more complex and this may occur due to the overlaps i.e. the same rule matching more than one filtering rule can occur. To solve these conflicts we have used the first matching strategy mechanism in which each packet can be processed by a firewall mapped to the decision of rule with highest priority. So to overcome this type of conflicts we approach the goal by" how to decrease the errors when a firewall policy rules have been designed".

Drawbacks:

• Detection of anomalies is incomplete and not accurate.

• Misconfiguration will be more between the rules and it cannot accurately identify the anomalies.

• The increase in number of rules can significantly affect its throughput.SS

4. PROPOSED SYSTEM:

In the existing approach, we can detect only conflicts and other type of anomalies but it can't able to resolve them accurately. So in this proposed system we are using a novel anomaly management framework to accurately identify the anomalies and to effectively resolve them using a rule-based segmentation technique. This technique can easily identify the relationships among the rules as subset, superset or overlap, partially match, exactly match Policy Anomaly algorithm can be used to find out the anomalies from the rules and eliminate these anomalies which has a time complexity of O(n2 log n). In this we are using a cross-domain search[2] to overcome the drawback of existing system. The proposed system can provide evidence to the administrator about the ma licious activity.

4.1 Firewall policies and anomalies:

Generally when a data packet enters into a network, the packet has to satisfy the criteria of the firewall. The criteria consist of multiple packet header field and decision. Every firewall policy has an important characteristic is the adoption of correct policy and correct ordering of filtering rules. Anomalies in firewall policy may occur due to existence of two or more policy filtering rules that may match the same packet. The main aim of discovering anomalies is to determine if any two rules coincide each other in a policy. Based on the comparison of each field with the other fields in a firewall, the classification of anomalies are of five types as shadowing anomaly, Correlation anomaly, Redundancy anomaly, Generalization and Irrelevance anomaly[3][5].

• **Shadowing Anomaly** — Suppose when a rule which is positioned after the first rule matches all the packets in which it matches the rule is then shadowed by the before rule and it will never be active.

• **Correlation Anomaly** — Suppose when the first rule matches some packets and second rule also the packets that have been matched by the first rule and performing different type of actions, then these rules are correlated.

• **Redundancy Anomaly** — If two rules perform same type of actions such that removing one rule does not affect the other rule and security policy will not be affected.

•**Generalization Anomaly** — Suppose the first rule match the packets that have been matched by the second rule and at same time performing different types of actions there generalized..

• **Irrelevance Anomaly** — A rule in a firewall is irrelevant if this rule does match any rule in the given time interval due to some network connectivity. This may happen when both the source and the destination address fields of the rule do not match any domain.

4.2 Advantages:

• Easy to understand policy anomalies with the help of grid like representation.

• Can accurately indicate all rule that involve in policy anomaly.

• Firewall makes secure and trusted access..

• Easy to detect predefined rule and rearrange them.

• Examines both preceding rule and subsequent rule while performing an anomaly analysis.

• Allowing us to create the inbound and outbound r**ules.**

5. METHODOLOGY:

In the proposed work, rules and actions are generated or modified according to the changes in the requirements of the dynamic environment. When a client sends a data packet to network, firewall checks the packet characteristics and decides to allow/deny the packet flow into the network. The firewall rule anomalies are identified using packet space segmentation technique, and then the risk of anomalies is assessed, based upon the risk, the firewall rules are re-ordered. Risk assessment is measured using an upper bound and lower bound threshold values.

The architecture as shown here in Figure2.

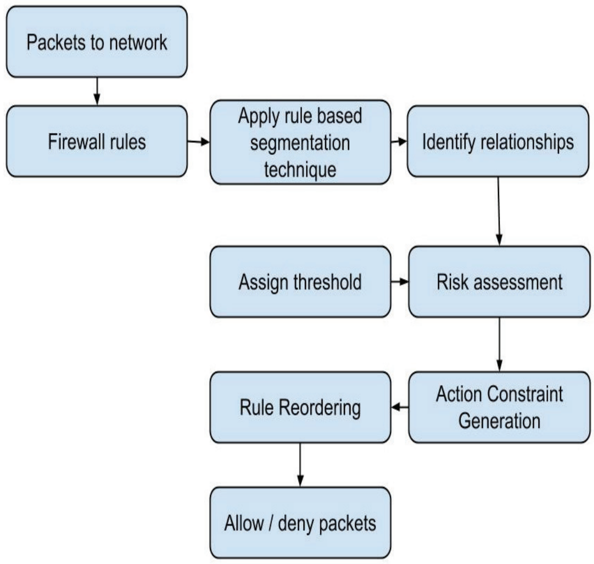

Figure. 2: Architecture of proposed system

5.1 Modules:

• Rule generation

• Correlation of Packet SpaceSegment

• Action Constraint Generation

• Rule Reordering

• Data Package

5.1.1 Rule Generation:

When we want to send the data packets to a network, the packets have to satisfy the rules of a firewall. Here the rules can be generated by taking some of the specifications and constraints. The rules can be generated in rule engine, action can happen when data packet has been sent to rule engine.

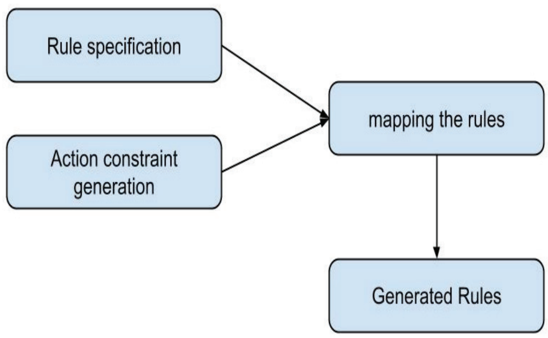

Figure. 3: Generation of rules

5.1.2 Correlation of Packet Space Segments:

Here we use the rule-based segmentation technique to identify the correlation groups for the analysis of anomalies with each independently based on the conflicting rules. Correlated rules can also be generated independently. The searching space can also significantly decreased as shown in Fig.3

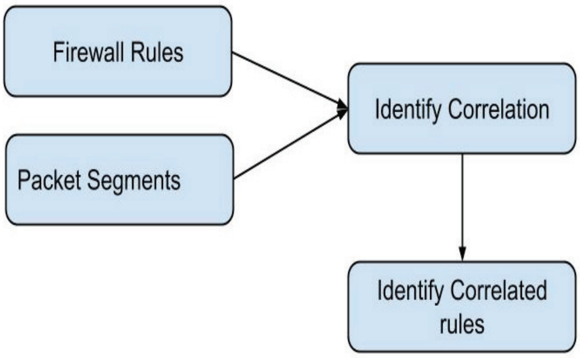

Figure. 4: Packet space segments

5.1.3 Action Constraint Generation:

Here we first identify the correlated groups and we assess the risk value of each conflict. Each conflict risk value can be utilized for automated and manual selection and here we set the threshold value based on different situations. The system administrator can set this threshold value. If the risk value is low, the expected action will be taken. if risk is high then we generate action constraints based on resolution strategies considering the protection of network perimeter. The basic idea can be as shown in Fig.4.

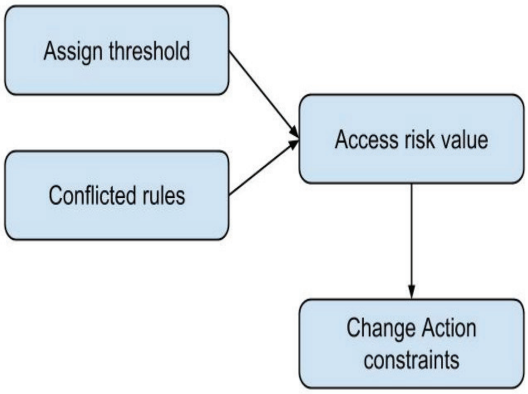

Figure.4: Generation of constraints

5.1.4 Rule Reordering:

To resolve conflicts, every conflict has to satisfy the action constraints that have been generated for the Reordering conflicting rules and this provides an minimal solution for the conflict resolution

5.1.5 Data Package:

When all the conflicts in a policy has been resolved, the risk value can be compared with the original polices based on the threshold value when data has been received in to a server as shown in Fig.5.

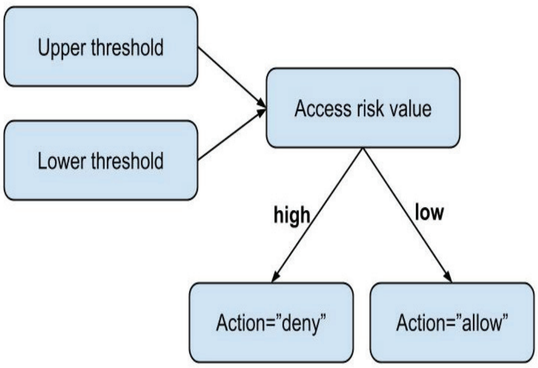

Figure. 5: Data Package

5.2 Algorithm:

Policy Anomaly detection is mainly used to identify the anomalies and conflicts that may exists in the firewall rules. These algorithms not only detect the anomalies but it also provides effective resolutions for the identified anomalies by considering the protection of network perimeter. Generally each policy in a firewall follows he first-match semantic mechanism in which it has to match the packets to which it first applies.

Algorthim.1.Firewall anomaly discovery algorithm

Input: rule, field, node

Output: anomaly

1.FunctionDecideAnomaly(rule,field,node, anomaly)
2.if each feld,node has branch_list then
3.branch=node.branch_list.first()
4.if anomaly←CORRELATION then
5.if rule.action≠branch.value then
6.branch.rule.anomaly←CORRELATION
7.report rule rule.id ← Correlation ← branch.rule.id
8.else anomaly=NONE
9.else if rule.action≠branch.value then
10.anomaly ← SHADOWING
11.report rule rule.id ← shadowed ← branch.rule.id
12.if branch.rule.anomaly=NONE then
13.anomaly←NONE
14.if branch.rule.anomaly←REDUNDANCY
15.rule branchrule.id ← redundant ← rule rule.id
16.end
17.if else if rule.action=branch. value then
18.anomaly←REDUNDANCY
19.else anomaly←NONE
20.else if anomaly←GENERALIZATION and rule.action≠branch.value then
21. .branch.rule.anomaly=SPECIALIZATION
22.end if
23.end if
24.rule. anomaly=anomaly
25.end function

Algorthim1 is mainly used for can be discovered. If a rule does not coincide, then we conclude that there are no anomalies. First we start with no relationship between the rules. Each field in the rule is compared to the corresponding fields to identify the relationships. Suppose if some fields in the rule are subset to the corresponding fields and performing same type of actions then these rules are redundant. At the same time when their actions are completely different then the rules shadowed to one another. If some fields are supersets and some fields are subsets while performing different types of actions then the rules are correlated to each other. to identify the rules that are irrelevant we require the knowledge of network connections.

6. CONCLUSION:

Network security area has made many developments in the areas of research, industrial communities etc. Generally, firewall may require some proper management of tools and techniques to provide security for such type of services. One of the major challenging tasks with the firewalls is managing and designing of the firewall rules. This technique can help the system administrators to have some evidence about the anomaly. So we have proposed an anomaly management framework which can handle this type of tasks and provide a effective anomaly resolution. This proposed system helps in the real and fraud users and provide the secure access to both the public and private network.

7. FUTURE ENHANCEMENT:

In future, our work can be extended to evaluate the functionalities of policy approaches. It includes extending our anomaly analysis to handle distributed firewalls and for the other types of access control policies and it can be used for hacking prevention on individual machine.

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INNOVATIVE APPROACHES IN ENGINEERING EDUCATION FOR ENHANCING EMPLOYMENT

Dr.S.R.Balakrishnan[1]

Abstract

The student body is the most critical organ of our system for inculcating engineering education. While the students choose engineering under the pressure of their peers and parental and relative circles, they seem to lack the basic interest and aptitude for joining this professional course. To a very great extent, the general approach is to obtain an engineering degree and use it as a passport to join an industry. Many companies have reported that on appointment, engineering graduates do not possess the necessary skill sets for being assigned any work. This necessitates the company to set up initial training programmes to ensure that the graduate engineers are employable. Resource deployment for such activities is an avoidable activity that would add to a possible cost increase of the product or system delivered by the company.

The faculty will also have to measure up to certain standards so that they are able to bring out the right type of engineers. Fortunately for us, we have a body like the AICTE that stipulates the guidelines and framework for the engineering college managements to function and operate the colleges with the essential infrastructure. Therefore, we have the challenge to innovate the approach for imbibing the required engineering knowledge to students with the right admixture of teaching resources. A management system that can guide, motivate and deploy resources for knowledge transfer between the taught and the teacher and employment thereafter is the need of the hour. It is necessary that there be an apex body that can ensure an amalgam of requirements in terms of quality and quantity in consonance with the employer bodies.

This apex body could possibly comprise of AICTE, MHRD, Academic bodies (including faculty from IITs',IISc, etc), Industry, R & D organizations that would need to put their minds together to evolve a national approach for bringing out professional engineers. This may sound to be a tall order. We need to have an integrated system engineering approach so that all connected departments of the society ensure that the Indian engineers can really fuel the economy with their professional contributions. A few thoughts, a road map in this regard and setting up the National Approach Plan for Engineering Education for Employment Enhancement (NAPEEEE) are suggested in this paper.

Keywords: Innovation, Engineering education, Skill sets, Internship, Employability, Government, Industry, Academic bodies, AICTE, MHRD

1.0 Introduction

The Yashpal committee report, the

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Knowledge Commission report(Mr.Sam Pitroda), the Rashtriya Uchchatar Shiksha Abhiyan(RUSA) report of the AICTE have all given definitive approaches for imparting of knowledge to the aspiring student population. There are several reports and articles that project the requirements of the engineering manpower over the next few years [1 to 10]. These reports also indicate the nature and quality of the engineering graduates. Presently, the engineering graduates are found to be not in possession of the required skill sets that would be useful to the company or organization. There have been excellent reports from the MNRE, the NTPI, etc. that have provided a thorough view on the projected requirements and methods to improve the skill sets of the engineering graduates.

In a broad and brief manner, recommendations on the following lines have been indicated:

- At present, majority of the engineering graduates is not employable.
- Internal training and/or induction programme is required to ensure that they are employable in the company. The company will need to deploy appropriate training resources of the company.
- Jobs could be created in the scale required only with changes in policy framework for education and workforce management.

2.0 General approach to improve knowledge base of the students in engineering institutions

2.1 Student bent of mind at school level.

It would augur well, if the bent of mind of the student could be gauged at the secondary school level. It is suggested that this could be done at the higher secondary school level by exposing them to

- An optional engineering stream as part of the curriculum.
- An optional pure science stream as part of the curriculum
- An optional arts stream as part of the curriculum

The author had gone through a diversified (engineering) course at school in the 1960's. This was useful in writing the 'Drawing paper' of the IIT entrance exam then. The recent announcement by the Government to invite scientists from National laboratories to deliver lectures to the school students is very encouraging.

Aptitude of engineering student

In the Indian scenario, the aptitude of the student for engineering education is not established and more so for the choice of branch by the student. Further, in the very large number of engineering colleges, the faculty has just the time to finish the designated portions in the subjects. This is also 'all theory' with a few laboratories, the illustration of industry type examples would be hard to come by. The following suggestions may be considered:

- Adapt syllabus content to include industry applicable examples.
- Mandatory lectures from industry/practical experts to support the syllabi.
- The normal lectures by the college faculty to draw support from NPTEL material.
- Formation of engineering clusters between IISc/IITs'/NITs'IIITs' and local colleges, region,

for transfer of knowledge to faculty of the local colleges.

2.3 Support from Industry/ CSIR/DRDO/DST

Ultimately, the engineering student has to become the supporter of the engineering profession in Industry-Public or Private, Laboratories in CSIR/ DST/ DRDO, Services (Army, Navy, Air force), etc. It would be therefore in the fitness of things, that these bodies support the student in the 'engineering studies' phase of life. The following suggestions may be considered:

- Internship during the vacation periods from end of II semester.
- This internship could also be meshed towards the final project.
- This student gets automatically mentored to the industry's requirement and becomes employable.
- The student could also be offered a stipend or visible service benefits after absorption. This would be akin to the 'University Entrance Scheme' offered by the Services,where the student after joining the services is given some benefits.
- The industry could also offer a 'system type' project to a multi-disciplinary faculty team of the college and of a nature useful to it; growth of 'system level' teams could be encouraged for the long term association with the industry.

3.0 Initiation of the change process

At the outset this seems to be a very tall order, but the way this has been approached to certain organized levels by MNRE, NPTI, Agricultural manpower forecast, etc.it appears that the challenge to the change process can be accomplished. It would be a marathon effort to integrate the efforts of Government agencies, AICTE, MHRD, Information Technology, Industries represented in great measure by their prominent associations, Academic institutes(IISc,IITs', NITs') and the body of engineering colleges.

This would necessitate the formation of a high level apex body that would lay down the policy which would be in the nature of a 'National Approach Plan for Engineering Education and Employment Enhancement'-NAPEEEE. NAPEEEE should be the funding authority and ensure implementation through its member bodies.

3.1 Process and the Implementation

The industries, public and private would need to make a clear forecast of the manpower requirements in all disciplines of engineering and the clear expectations in terms of employability skills. Big Data Analytics could be used to source and analyze the enormous amount of data effectively. Then a unified approach has to be evolved by all the agencies regarding, academic content of courses, internship programs, approach for enhancing employability skills, career growth of engineers, methodology to motivate and retain them to ensure continued optimum delivery of products and systems.

It is imperative to focus along the entire value chain of employability skills, mobilization to placement including post placement support and making the system scalable and sustainable. This is not a purely financial effort as it demands a great deal of understanding and social engineering as well. The whole engineering landscape has to be transformed. This philosophy and integrated approach by all stakeholders put together can enable us to boost our economy to very great heights in the decades to come.

4.0 Conclusions

Some suggestions to bring in process changes for tuning engineering education for enhancing employment have been highlighted. The whole team comprising Government departments, industries, academic bodies and engineering colleges will have to work in unison to bring out engineers who would help in the boosting of the Indian economy with systemized engineering education. This integrated action plan is penned as 'National Approach Plan for Engineering Education for Enhancement of Employment'-NAPEEEE.

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Quantitative and Qualitative Analysis of Fibonacci & Linear Array of Solar Panels

Prerna Gaur[1] & A.P Mittal[2]

Abstract:

This paper shows the potential of solar energy and a new method to enhance the efficiency as one of the renewable sources of energy. Solar energy is in abundance and is considered a clean energy source.

The problem with exploiting solar energy includes the cost to setup a solar farm and costly solarpanels. Also, reduced output during winter season of the year adversely affects the efficiency.The objective is to examine the feasibility and viability of solar panels arranged in a Fibonacci patternas in trees and plants. The research aims to compare, both quantitatively and qualitatively, the Fibonacci array of pattern with conventionally used linear array. By arranging solar panels in the form of leaves of a tree, replicating nature phenomenon which leaves use to capture maximum sunlight. By this we tend to not only reduce the area required but also increase the efficiency and effectively the cost to setup.

INTRODUCTION:- This paper holistically explains the context of project while highlighting the potential of solar energy in India and its advantages as one of the renewable sources of energy. Using the RET Screen data, insulation values of the area where the project is being implemented is provided. The methodology and objective with the significance of end result of the project are explained in this paper.

1. Fibonacci Numbers

In mathematics, the Fibonacci numbers or Fibonacci sequence are the numbers in the following integer sequence:

1,1,2,3,5,8,13,21,34,55,89,144, … ….

By definition, the first two numbers in the Fibonacci sequence are 1 and 1, or 0 and 1, depending on the chosen starting point of the sequence, and each subsequent number is the sum of the previous two.In mathematical terms, the sequence F_n of Fibonacci numbers is defined by the recurrence relation

$F_n = F_{n-1} + F_{n-2}$ (1)

With seed values

$F_1 = 1, F_2 = 1$ Or $F_0 = 0, F_1 = 1$

The Fibonacci sequence is named after Fibonacci. His 1202 book Liber Abaci introduced the sequence to Western European mathematics, although the sequence had been described earlier in Indian mathematics. By modern convention, the sequence begins either with $F_0 = 0$ or with $F_1 = 1$.The sequence can also be extended to negative index n using the re-arranged recurrence relation.

1.1 Fibonacci Series in Nature

Fibonacci sequences appear in biological settings, in two consecutive Fibonacci numbers, such as branching in trees, arrangement of leaves on a stem, the fruitlets of a pineapple, the flowering of artichoke, an uncurling fern and the arrangement of a pine cone, and the family tree of honeybees. However, numerous poorly substantiated claims of Fibonacci numbers or golden

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sections in nature are found in popular sources, e.g., relating to the breeding of rabbits inFibonacci's own unrealistic example, the seeds on a sunflower, the spirals of shells, and the curve of waves.

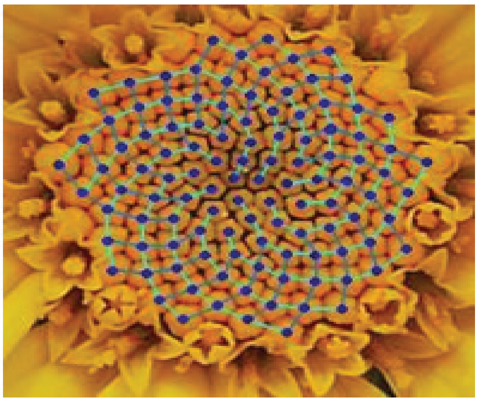


Figure 1 Yellow Chamomile head showing the arrangement in 21 (blue) and 13 (aqua) spirals.Such arrangements involving consecutive Fibonacci numbers appear in a wide variety of plants

[1]The Fibonacci numbers are Nature's numbering system. They appear everywhere in Nature, from the leaf arrangement in plants, to the pattern of the florets of a flower, the bracts of a pinecone, or the scales of a pineapple. The Fibonacci numbers are therefore applicable to the growth of every living thing, including a single cell, a grain of wheat, a hive of bees, and even all of mankind.

Plants do not know about this sequence they just grow in the most efficient ways. Many plants show the Fibonacci numbers in the arrangement of the leaves around the stem. Some pine cones and fir cones also show the numbers, as do daisies and sunflowers. Sunflowers can contain the
number 89, or even 144. Many other plants, such as succulents, also show the numbers. Some coniferous trees show these numbers in the bumps on their trunks. And palm trees show the numbers in the rings on their trunks. Why do these arrangements occur? In the case of leaf arrangement, or phyllotaxis, some of the cases may be related to maximizing the space for each leaf, or the average amount of light falling on each one. Even a tiny advantage would come to dominate, over many generations. In the case of close-packed leaves in cabbages and succulents the correct arrangement may be crucial for availability of space. In the seeming randomness of the natural world, we can find many instances of mathematical order involving the Fibonacci numbers themselves and the closely related "Golden" elements.

1.2 Fibonacci in Plants

Phyllotaxis is the study of the ordered position of leaves on a stem. The leaves on this plant are staggered in a spiral pattern to permit optimum exposure to sunlight. If we apply the Golden Ratio to a circle we can see how it is that this plant exhibits Fibonacci qualities.

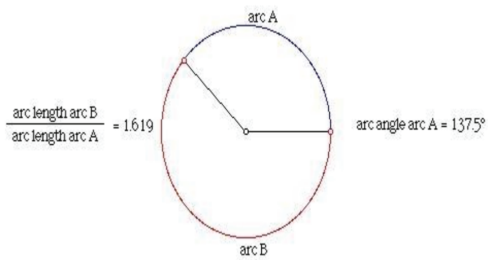


Figure 2.Golden Ratio Calculations [2]

By dividing a circle into Golden proportions, where the ratio of the arc length is equal to the GoldenRatio, we find the angle of the arcs to be 137.5 degrees. In fact, this is the angle at which adjacent leaves are positioned around the stem. This phenomenon is observed in many types of plants. In the case of tapered pinecones or pineapples, we see a double set of spirals – one going in a clockwise direction and one in the opposite direction. When these spirals are counted, the two sets are found to be adjacent Fibonacci numbers. Similarly, sunflowers have a Golden Spiral seed arrangement. This provides a biological advantage because it maximizes the number of seeds that can be packed into a seed head. As well, many flowers have a Fibonacci number of petals. Some, like this rose, also have Fibonacci, or Golden Spiral, petal arrangements.Branching plants also exhibit Fibonacci numbers. Again, this design provides the best physical accommodation for the number of branches, while maximizing sun exposure.

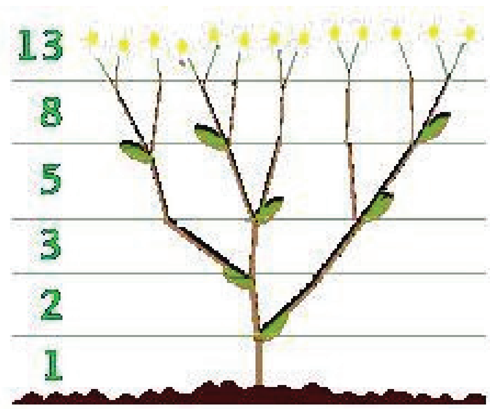


Figure 3 Fibonacci Petals [3]for a solar

3 petals lily, iris

5 petals buttercup, wild rose, larkspur, columbine

8 petals delphiniums

13 petals ragwort, corn marigold, cineraria

21 petals aster, black-eyed susan, chicory

34 petals plantain, pytethrum

55, 89 petals michelmas daisies, the asteraceae family The occurrence of Fibonacci Numbers in Nature is interesting but the ratio of consecutive Fibonacci Number is important.

2. DIFFERENT TYPES OF CONNECTIONS OF SOLAR CELLS

2.1 Series Connection

1. This solar panel diagram shows 2 solar panels connected in series which means the combined voltage is 24, which is the sum of both the solar panel's voltage (12 plus 12) Again we need to calculate the power rating of the charge controller by dividing the Power (Watts) by the voltage (Volts) so In this solar power kit it's 120 / 24 = 5 Amps. The Steca PR1010 will be fine for this purpose as it's a 10Amp solar charge controller. Because it's a 24 volt solar power system, we will need 2 batteries. Notice that the batteries are also connected in series and the second battery is the opposite way round to the first battery so it's easier to connect the cables.2. When you put batteries in a flash light or torch you invariably put them in with the positive end touching the negative end. This is exactly the same principal because the batteries or solar panels are connected in series to provide a higher voltage for the bulb or solar power system.

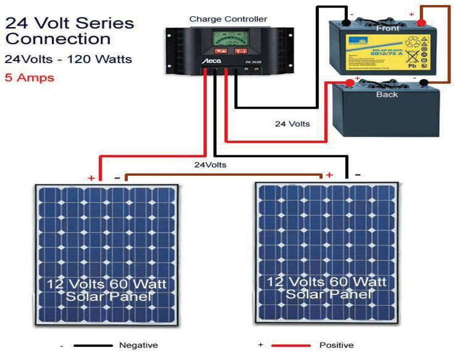
Figure 4 Solar panels connected in series

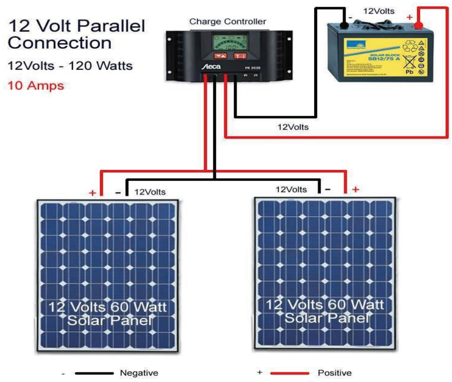
3. It's also worth noting that because the current in the first 12 volt solar kit is higher, it's important to pay attention to the size of the wires. 12 Volt solar power or lighting kits that have a high current require much thicker wires between the battery, charge controller and solar power inverter.

4. Figure 5. Solar panels connected in parallel

2.2 Parallel Connection

3. The diagram shows two solar PV panels connected in parallel so the voltage is the same.To calculate the power rating for a solar charge controller we need to calculate the current flowing in the circuits. Current is always Power (Watts) divided by voltage (Volts) so in this example solar power system it's 120 / 12 = 10 Amps.





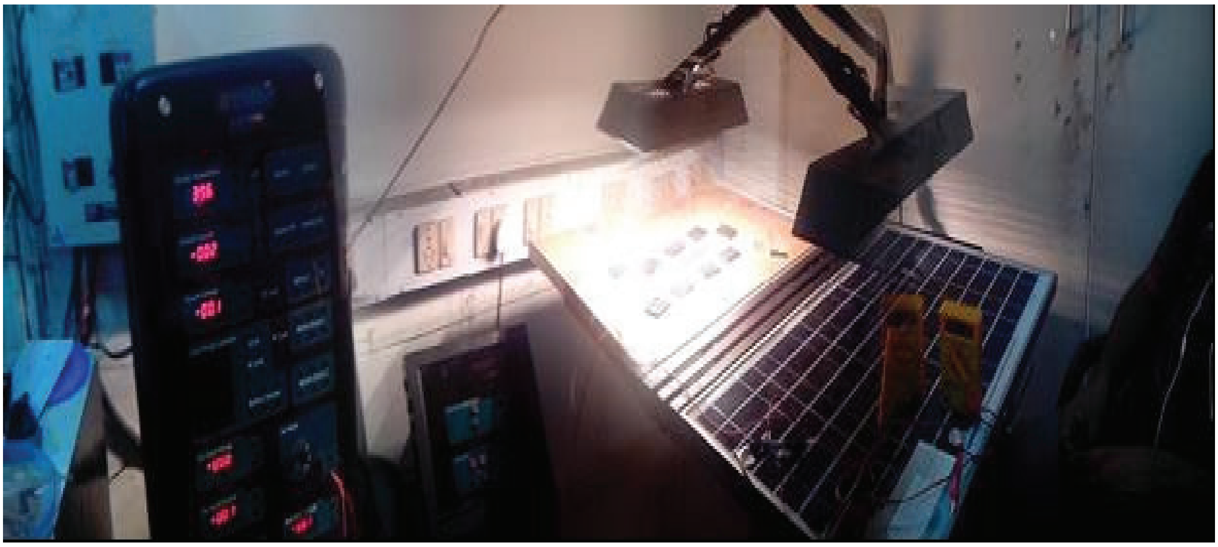
3. Maximum Power Point Tracking Algorithms

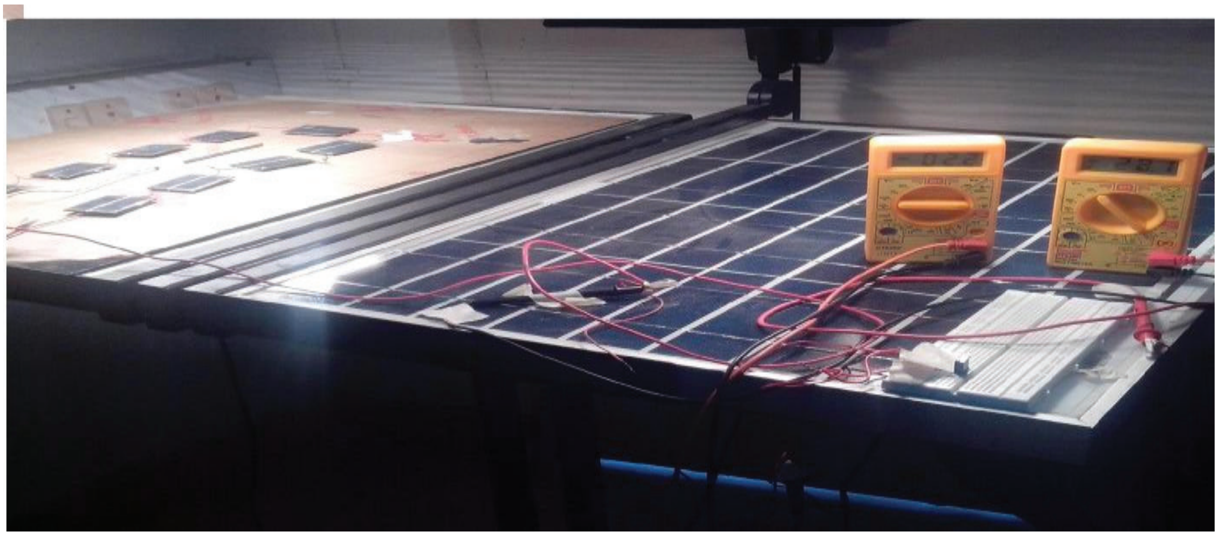
As was previously explained, MPPT algorithms are necessary in PV applications because the MPP of a solar panel varies with the irradiation and temperature, so the use of MPPT algorithms is required in order to obtain the maximum power from a solar array.

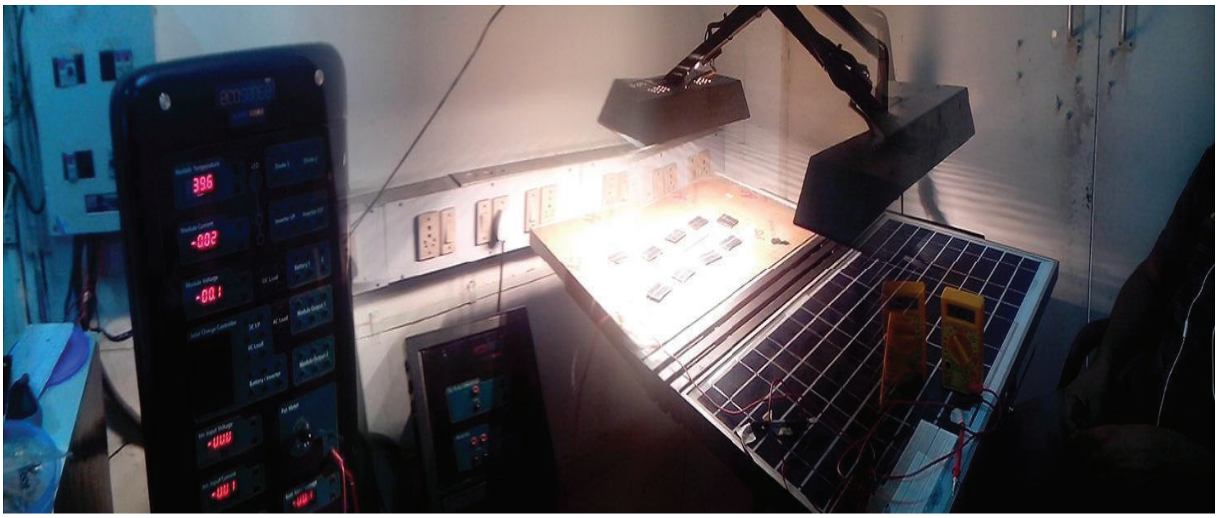
Over the past decades many methods to find the MPP have been developed and published. These techniques differ in many aspects such as required sensors, complexity, cost, range of effectiveness, convergence speed, correct tracking when irradiation and/or temperature change, hardware needed for the implementation or popularity, among others. Among these techniques, the P&O and the In Cond algorithms are the most common. These techniques have the advantage of an easy implementation but they also have drawbacks, as will be shown later. Other techniques based on different principles are fuzzy logic control, neural network, fractional open circuit voltage or short circuit current, current sweep, etc. Most of these methods yield a local maximum and some, like the fractional open circuit voltage or short circuit current, give an approximated MPP, not the exact one. In normal conditions the V-P curve has only one maximum, so it is not a problem. However, if the PV array is partially shaded, there are multiple maxima in these curves. In order to relieve this problem, some algorithms have been implemented. In the next section the most popular MPPT techniques are discussed.

4. Solar Panel Connection

The setup showing a set of readings for linear array of solar panels with source of light illuminated as well as ecosense module which displays temperature. The multimeters are used for measurement of current and voltage respectively. The ecosense setup is available in the lab.Figure 6. The setup showing a set of readings for linear array of solar panels with source of light illuminated. The multimeters are used for measurement of current and voltage respectively. The potentiometer is mounted on breadboard.







5. Fibonacci arrangement of solar panels

Construction of Fibonacci Solar Tree Model: Materials Required: Solar cells, a wooden stick, asolid Base and a full protractor, or a double-D, Several meters of iron wire and Masking tape Figure.7. Shows the procedure followed in the laboratory.

Step 1: The wooden stick is screwed to a small square base.

Step 2: The hole was drilled across the center of full protractor.

Step 3: Then, full protractor was inserted inside the wooden stick.

Step 4: The iron wire was then carefully bent along the required angles, in this case it was 137.5 0 .

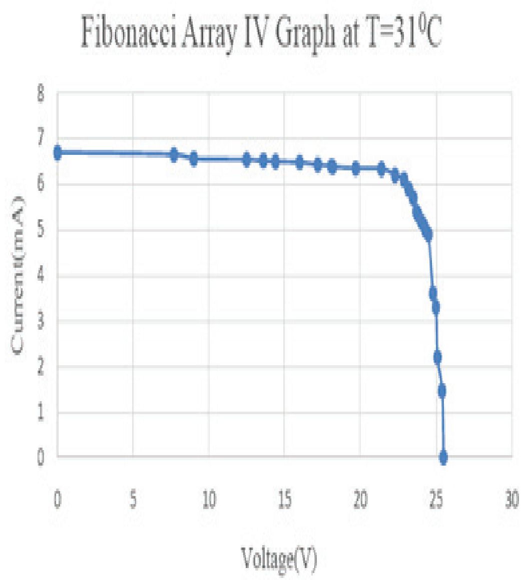
Step 5: Masking tape was pasted on one of the ends of iron wire to prevent it from bending further or falling down.

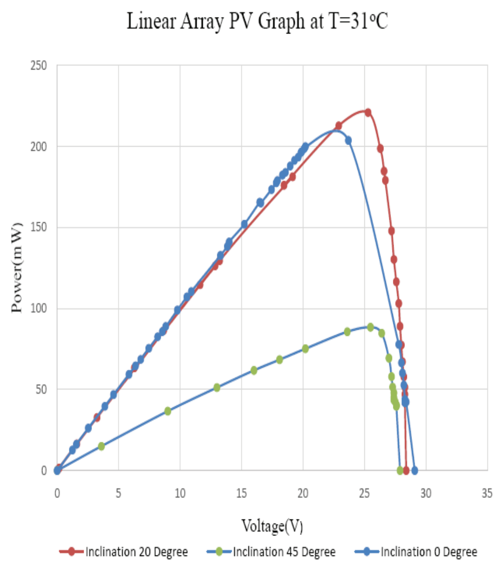
Step 6: The steps 3 & 4 were repeated again, until all the wires were bent at appropriate angles.

Step 7: The discrete solar panels were fixed using masking tape at the loose end of wire. The setup showing a set of readings for fibonacci pattern solar panels with source of light illuminated. The multimeters are used for measurement of current and voltage respectively. The potentiometer is mounted on breadboard.

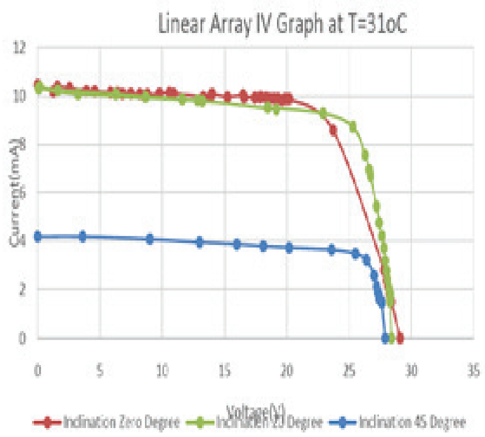
6. RESULTS and Discussion The Figures show the Output IV & PV Graphs

The two graphs show the relative comparison of IV curve of Linear array of solar panels at different inclinations starting from zero degree to 45 degree.The inclinations were measured with the help of protractor attached to the ecosensemodule. The temperature at which reading were taken was 31 o C which correspond to a power input of 347.87 W/m 2 and the second graph show the relative comparison of IV characteristics of Linear array of solar panels at different inclinations starting from zero degree to 45 degree.The inclinations were measured with the help of protractor attached to the ecosensemodule. The temperature at which reading were taken was 40 o C 359.98 W/m 2 which correspond to a power input of The above two graphs show IV & PV curves for Fibonacci pattern of solar cells. The readings are taken after trying many different placement configurations of solar cells.





1. T=31°C AND Inclination=0°,20°,45°



6.1 Graphs for Fibonacci arrangement

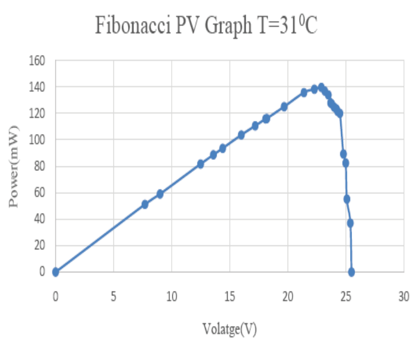
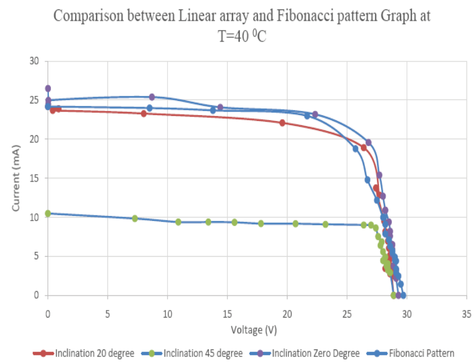


Figure 9. Shows the PV graph for Fibonacci arrangement of PV Cells

a. Comparison between linear arrangement and Fibonacci

This graph shows the relative comparison of IV curve of Linear array of solar panels at different inclinations and Fibonacci pattern at temperature 31 o C.The setting of the halogen lamp was kept to maximum. The short circuit current of Fibonacci circuit is quite less than linear array.



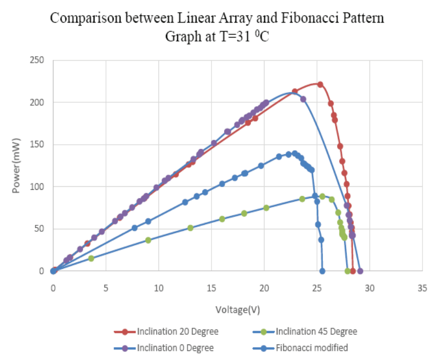
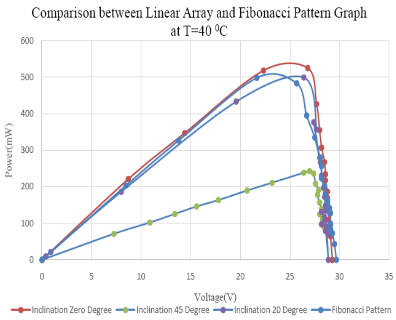


Figure 10. This graph show the relative comparison of IV curve of Linear array of solar panels at different inclinations and Fibonacci pattern at temperature of 40 o C.The setting of the halogen lamp was kept to maximum. The short circuit current of Fibonacci circuit is comparable to that of linear array.Figure 11. This graph shows the relative comparison of PV curves of Linear array of solar panels at different inclinations and Fibonacci pattern at temperature of 31 o C. The peak power of Fibonacci circuit is quite less than that of linear array in 0 o and 20 o but is great than that of 45°.

Figure 12. This graph show the relative comparison of PV curves of Linear array of solar panels at different inclinations and Fibonacci pattern at temperature of 40 o C. The peak power of Fibonacci circuit is comparable to that of linear array in 0 o and 20



[7. Conclusions

Since the concept is a combination of myriad of factors which affect the net output. The results as of nowseem to be in slight favour towards Fibonacci pattern array considering high land costs. However,the cost and feasibility of them would vary from location to location as it depends on the physical terrain and external environment of the area. For example, if the cost of land is less in a particular area, linear array arrangement is preferable otherwise Fibonacci pattern can be used while partially comprising efficiency.

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An Analytic Research on HTTP ,Web Servers, Web-Services & Efficient DNS Querying

P V S Srinivas[1] and Shaik Khaja Hafeezuddin[2]

Abstract:

This electronic document is intended to give an overview on HTTPS, web-services, web-protocols, and their interaction with DNS Servers for efficient query processing. Efficiency is achieved by directly sending the query to top level Domain name servers. These top level domain name servers database and cache memory containing the address of the hosting systems, replies authoritatively to the user's query with the web-hosting address. Thus query sent by the user is processed efficiently in time by the top level domain name servers. The number of top level domain name servers are to be increased accordingly to handle the requests made by the users..

Keywords

HTTPS,Web-services,Web-servers, Web - protocols, DNS, DNS Querying.

INTRODUCTION:- Web services provide a standard, reliable and efficient means of interoperating between different software applications, running on a range of different platforms and frameworks. This document is intended to provide a basic definition of a Web service, and define its place within a larger Web services framework to guide the technical community. The relationships among HTTP, Web Server and Web Services are a complicated set of functionalities where exchange of information takes place very rapidly and with zero scope for redundancy and information loss. Each of these segments are very clearly explained and documented such that they are understandable by the beginners too. Each component have many important roles and thousands of functions which users can access and utilize on the Internet. HTTP allows users to interact with Web Servers and access information through the Internet. Web servers are the source to serve data and files to users who request them. Web Services allow cross-system, cross-language, cross-language communication among various kinds of machines and thus enabling wide range of inter-business transaction. Each technology works on its own set of principles, have own set of requirements, and also performs many useful functions as per user requirement, it is the combination of these technologies that has created the dynamic functionalities of the Web which are available today. This research paper will explain in depth about the Interrelationship between HTTP, Web Servers and Web Services technologies that have facilitated the functionalities and convenience of the Web.

HTTP

HTTP, is the standard protocol which is currently used to access the Internet. According to the World Wide Web Consortium, "HTTPS is an application-level protocol for distributed, collaborative, information systems or machines." [1]. It is a very simple protocol that allows raw data to be transferred over the Internet

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in the form of packets. From this simple data transfer protocol, users of the Internet can easily perform functions and give commands to the Web Servers through a GUI.As Web page viewed through a browser and the users need not worry about the details and the process of how the command is going to be transferred or interpreted by the computers involved within the network. HTTP is enhanced with a facility of exchanging the information between the user's computer and the Web Server rapidly and efficiently.

As HTTP allowed the World Wide Web and the Internet to become such a global need, the World Wide Web and the Internet also helped HTTP to become the global standard of data transfer protocol over the web platform. The World Wide Web global adopted HTTP as the basic data transfer protocol from the year 1990, allowing HTTP to develope into a global standard of data transfer. However, just because HTTP is the current global standard it does not mean that it is flawless or do not have any short comes. An example of HTTP's drawbacks would be that HTTP is a stateless protocol, which means HTTP treats each command independently. In another words, HTTP does not have any storage or cache memory. HTTP does not remember past commands and will forget the current command as soon as it is executed. As such, it is very hard to make HTTP to be more interactive and dynamic without additional technologies such as JavaScript, cookies, PHP and other programming scripts. To put it simply, with pure HTTP user will not be able to customize their online shopping cart.

Many efforts have been made to improve HTTP. From the first HTTP 0.9, through HTTP 1.0, to the latest version HTTP 1.1, numerous and many countable improvements have been made. Some of them are:

•Faster response.

•Greater bandwidth savings, by adding cache support.

•Faster response for dynamically-generated web pages, which supports chunked encoding, and allows a response to be sent before its total length is known.

•Efficient use of IP addresses available.

Web Servers

A server is a system or a machine or a device on a network that manages network resources accordingly.[2]. There are many different kinds of servers which are categorized based on the requirements, dataset, and usage. They are the dial-up servers that serves as a gateway for the user to access the Internet; a printer server, and a Web Servers or information storing servers that stores web pages and other data and information that are provided to users upon request or when the query is passed to the server to serve the information.A Web Server is the central system of Web Site i.e a web server is a place where the pages related to the website are hosted. These web pages are served to the user when the user request the data through the browser. It is the Web Server that hosts both the components of a Web page such as the actual Web page HTML files, JSP files, JQUERY files, CSS files and templates and all other essential technologies that make a Web site function in a way that it has to be.

All the Web servers may function similarly, the way of setting up and the way a server can be varied accordingly.

There are two mostly used ways in setting up Web Server: One is P2P type of set up, and other is Client-Server type of setup. P2P (Peer-to-Peer), follows a direct connection of individual computers to one another where each computer can specify what data it is willing to share with the other computer on a network. [3].This kind of web server set up is very easy and cheap. Further, the speed of file transfer in a P2P type network is not constrained by the capability of any single server. Here each computer in the network is capable of becoming a server, such that it is able to share and transfer a file from multiple servers at the same time, this in turn increases the file transfer rate between the two nodes. However, since each computer in the network is a server, each computer on a particular network needs to be set up manually to achieve the intended functionality. The responsibility of managing the server or system lies with the owner of a computer that is connected to the network. But, the management of a P2P network is very much difficult. Due to the decentralized management of the network, servers with a P2P connection are prone to virus and worm attacks, which if affected may collapse the entire network over any topology.

In a Client-Server network, on the other hand, it is a highly centralized network system with one main central computer as the server unlike P2P type. This type of set up is easy to manage and is very secure when compared to others. Yet, maintaining a centralized network requires much amount of resources ranging from huge manpower to high hardware. This results in increase in the cost of a client-server network. Another drawback of a client-server set up is that the speed of file transfer between the client and the server slows down when the number of clients accessing the server at a time increases. Exception is that, it is very easy to manage and is very much secure, client-server network is still the dominant set up of Web Servers. Apache, which is a free server technology, is currently one of the most popular server technologies because of its ease of usage and flexibility till date.

The first version of Apache is based on the NCSA HTTPd Web Server, which was developed in 1995 by a "loosely-knit group of programmers (20 in number)." [4].Apache server provides full source code and an unrestrictive license to users. Apache users can easily change, modify, or adapt, the software in accordance with the needs of their particular organization or as per their requirements. There is an option of Additionally many modules, either written by the user or downloaded free of charge from the vast Apache module library online database, could easily be added to accommodate any specific needs of the users. Apache is also capable of performing many functions such as DBM database unlimited flexible URL rewriting and aliasing, authentication, multiple Directory Index directives, content negotiation and virtual hosts.

Web Services

Web Service is a very powerful tool that has enhanced the efficiency in communication among fields and domains. According to the World Wide Web Consortium, a Web Service is a intelligent software system meant to support inter-operable machine-to-machine interaction over and within a network. Web Services is a software system that allows systems & machines (including servers) to communicate with each other regardless of each individual machine's operating systems and programming languages. According to Symon's Extensible Markup Language (XML) page there is a formula that neatly defines the major components of Web Services: "Web services = XML + SOAP + WSDL + UDDI" [6].

Extensible Markup Language (XML) is the universal markup language that all machines are capable of understanding. The process of inter-machine communication via Web services, XML is used to tag the data involved in the communication between two communicating nodes. Web Services Description Language, is being used for describing the services available. The Universal Description - Discovery & Integration list out the services available from a particular machine. Simple Object Access Protocol is used to transfer data for each exchange of information between machines and servers, which typically involve HTTP in conjunction with XML serialization other Web-related standards. Web Services are completely independent of operating system, programming language." As a result, through the Web Services, there is a facility of Java based programs will be able to communicate to servers that are running C++ based programs and a Windows machine will be able to communicate with a LINUX machine or server. Which means web services and completely platform independent.[8].

Though web and web services serves a similar function, Services do have some most significant differences. One of the most prominent difference between Web services and the Web is that instead of a user interface, Web Services functions through/via application interfaces. In other words, it can be stated as the machines communicate with each other from application to application between two active nodes. Here communication takes place between the applications of one machine to the other machine. Such exchanges limit possible user errors and thus increase the efficiency of the exchange.

How HTTP, Web Servers and Web Services Interact Together.

The interaction between HTTP, Web Servers and Web Services is very simple and can be documented in a lucid way as follows: HTTP is a simple protocol through which browsers use to communicate with Web Servers. Web Servers, on the other hand are responsible for fulfilling the user's request's and store the information users provide. Web Services allow different Web Servers to communicate and interact with another in order to process the request and/or commands given by user through browser or any GUI.

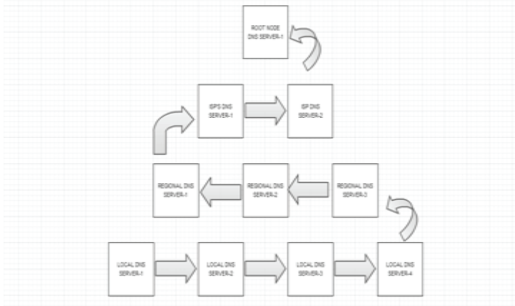
The interconnectivity among the three technologies works can be explained by using an example where a user is trying to buy a plane ticket online. The user will be accessing a travel agency web site to query for the availability of seats on the required date and time. Here HTTP acts as the language through which the users will be able to communicate with the Web server that actually can access the information of flight date, time, seats, price from the airlines database. According to the values given by the user to the Web page and transmitted to the Web server through HTTP protocol, the Web server performs the command of search by sending out the commands of this query to each individual airline's schedule databases using an application to application interface (Web services). Web services translate the markup language the Web server uses into the universally understood XML that is given as input to the databases of all the available active airlines. When the XML is received by the airline databases, Web services translates the xml into the programming language that each one of airline database is using so that the database would be able to understand the command the Web server sent out. After the execution of the query, the result would be transmitted back to the Web server through Web services. Then the Web server would be able relay these search results to the user through HTTP which would present the information to the user through an HTML file that could be interpreted by any of the browsers.

In total, the function of querying requires all three technologies, HTTP, Web server and Web services, have to work together for a success full outcome. Without any one of these technologies, the query would fail or may have very limited scope.

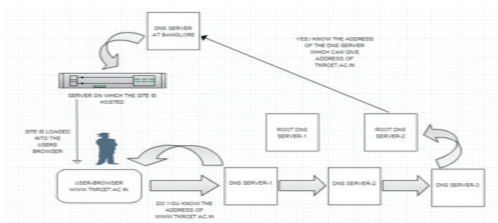
Request processing by DNS servers

Traditional:

When the DNS server receives a query, it first checks and see if it can answer the query based on resource information and available records that contained in a local zone of the server. If the queried name matches a corresponding resource record in local zone information, the server answers to the user request using this information to resolve the queried name.

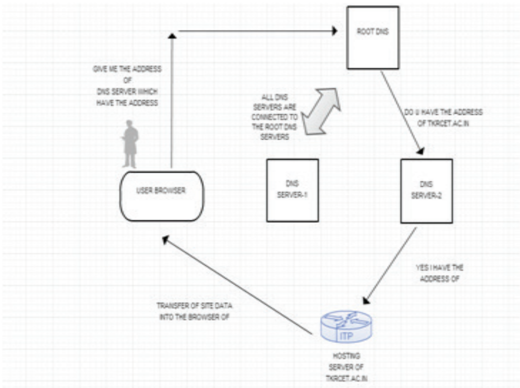


If no information exists for the queried name by the user in a particular zone, the server then checks to see if it can resolve the name using the local cached information from previous queries which it stores when it gets the answers from the other servers for a particular query. If any match is found, the server answers with this information. Again, if no match is found the process continues till it reaches the top level domain name servers where every address can be fully resolved as these top level (total 13 in number across the world) DNS servers holds all the data of addresses zone wise. By default, the DNS Client service asks the server to use a process of recursion to fully resolve names on behalf of the client before returning an answer. In many cases, the DNS server network is configured, to support the recursion process as shown in the following figure



Proposed DNS Querying Model

When the local DNS server receives a query, it first redirects the query to the top level domain name servers where the address is checked for the relevant location of the local server address on which the site or webpage is hosted. After locating the hosting server the DNS server answer the query authoritatively based on resource record information. The user is redirected to the address of the local server which serves the user request.



The Role of Humans

Although the main purposes of Web services is to automate processes that might otherwise be performed manually, humans still plays an important role in their architecture designing, maintaining and use, notably in two ways:

1.Humans have to agree on the semantics and the service description. Since a humans (or let's call an organization) is the legal owner of any Web service, people must agree on the semantics, usage agreement and the service description that will govern the interaction with the web-server through web services.

Often this agreement is accomplished by the provider entity and offering both the semantics and the service description as accept it or reject it contracts that the requester entity must accept as mentioned by the legal entity, unmodified as conditions of use. In order to use the services provided by the owner the user must agree to the terms and conditions of the service provider. However, nothing in this architecture prevents them from reaching agreement by other sort of means.

2.User create the request and provider agents either directly or indirectly. Humans, the users must ensure that these agents implement the terms of the agreed-upon service description agreements and semantics.

Regardless of the approach or form used, from information point of view both the semantics and the service description must be somehow be input and both the service providing agent and the provider agent before the two agents can interact.

Conclusion

The functionalities that HTTP, Web Servers and Web Services provide now in the current scenario dramatically changed the way individuals, companies, and the people conduct business online. While it will be suitable to state that each technology was created for one specific purpose, the combination of these technologies that has greatly enhanced the transfer of information online. The example of users purchasing tickets online shows how critically important is a role of each technology, all these plays a very prominent role in one of the most common tasks users can accomplish on the Internet today. Without any one of these technologies, e-commerce industry all over the world would not have boomed as much as it is now and the convenience users may not have increased to this extent without these technologies.

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A Comparative Analysis of Iso-surface Generation Techniques for 3D Scalar Field Visualization

P.V.S.Srinivas[1] & Shubhashree Sahoo[2]

ABSTRACT

A simple and efficient method for the extraction of high-quality continuous isosurfaces from the volumetric datasets is implemented and tested. The present method proceeds in two steps. In the first step, a continuous interpolant of the dataset were determined and second step involves the extraction of isosurface geometry by sampling the points on Marching Cubes triangles and projecting them onto the isosurface defined by the interpolant. The algorithms are studied and implemented using Matlab. The results using a synthetic datasets and discussion of practical considerations are presented. The importance of present method is that the proposed implementation could be applied to any arbitrary data.

Keywords: Volumetric visualization, Iso-surface generation, Marching Cubes, MATLAB environment

1. Introduction

Recent preferment in computing hardware has eased the job of researchers and practitioners to model and simulate a variety of physical phenomena in a faster and efficient manner [1]. The output of such simulations and measurements is a dataset, which is massive in size and complex in nature. The eminent challenge is extraction of essential information from such a huge dataset. Scientific data visualization offers techniques and tools to gain information and insight from dataset by transforming them into visuals suitable for human comprehension [2].

Scalar visualization techniques furnish algorithms suitable to process and visualize the scalar data. Isosurfaces are the basic tools in data visualization that extracts absolute surfaces representing the features of a scalar field. Isosurfaces are commonly displayed using computer graphics. Isosurface generation is a technique to visualize the 3D volume data using intermediate polygonal based rendering [3]. It mainly contrives a surface made up of tiny triangles to narrate the areas having similar or constant properties. There are three cell based high-resolution 3D surface construction isosurface algorithms namely Marching Cubes, Dividing Cubes and Dual Contouring. Among these algorithms, the Marching Cubes algorithm is popular one. The Marching Cubes algorithms generate polygonal representation of surfaces having constant properties from 3D volume data [4].

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A facile method for the isosurface construction from 3D volume dataset has been adopted. The continuous interpolation scheme has been defined and isosurface generation process is addressed by first computing the triangles of a Marching Cubes surface. Inside the generated triangles, the points of interest are sampled and projected onto the necessary isosurface using continuous interpolant and surface rendering method principles. A software framework for Marching Cubes has also been designed and developed for isosurface construction in MATLAB environment. The present method requires only a moderated implementation effort and could be easily integrated into existing applications.

2. Related work

There are assorted approaches to the difficulty of 3D isosurface generation [5]. One of the elderly approaches involves construction of surface contours and its interconnection. However, presence of more than one contour in a slice causes ambiguity. The Mayo Clinic has used a different approach that displays the density volume rather than the surface and produced a conventional shadow graph that could be viewed from arbitrary angles. These surface construction techniques are discarded due to their inefficiency in extracting essential information from the original data.

Lorensen and Cline introduced the Marching Cubes algorithm for the isosurface visualization and the approach is greatly popularized [4]. Authors have used a case-driven approach that involved triangle generation to approximate the isosurface of interest. The relative simplicity and elegance of Marching Cubes algorithms make it a desirable technique for applying to multifarious datasets [6]. There are innumerable variations and improvements of the original Marching Cubes algorithms. Himish Carr has used Dividing Cubes algorithm that eliminates the scan conversion step used when rendering surfaces extracted by the Marching Cubes algorithms. The Dual Contouring method is proposed by Ju et. al. and provides a uniform approach for extracting isosurfaces. The major advantages include simplicity to implement and production of sharp features, which is not realized by other implicit surface meshing algorithms.

3. Isosurface generation

Isosurface generation is a technique that visualizes the 3D volume datasets using intermediate polygonal based representation. It principally constructs a surface made up of tiny triangles to narrate areas having similar or constant properties. Isosurfaces are rendered by a simple polygonal model that could be drawn on the screen very rapidly [7]. Isosurfaces are used to extract essential information from volumetric datasets obtained in the field of medical imaging, pharmacology chemistry, geophysics, computational geometry and meteorology. There are three well known cell based iso-surface generating algorithms such as Marching Cubes, Dividing Cubes and Dual Contouring [3].

3.1 Marching Cubes algorithm

Marching Cubes is a rudimentary algorithm in the field of isosurface polygonization and widely accepted by the visualization community for its simplicity and robustness. The results from Magnetic Resonance (MC), Computed Tomography (CT) and Single-Photon

Emission Computed Tomography (SPECT) had proven the quality and functionality of Marching Cubes [8]. These algorithms employ a divide and conquer approach that involves splitting of the volume into a grid of regular cells. Marching Cubes algorithm operates on two basic steps such as detection of active cells (cells intersected by the isosurface) and provoking the triangles inside each active cell. The algorithm determines the way that surface intersects the cube and subsequently moves or marches to the next cube [9].

To find the surface intersection in a cube succeeding steps has to be followed.

Step 1: Cube's vertex is assigned 1, when data value at the vertex exceeds the value of surface that is being constructed and such vertices are inside the surface.

Step 2: Cube's vertex is assigned 0, when data value falls behind the surface value and such vertices are outside the surface.

Step 3: When one vertex is inside the surface (one) and the other outside the surface (zero), then the surface intersects the cube edges.

Each cube contains eight vertices and two states such as inside and outside. Therefore, there are 28 = 256 ways that a surface could intersect the cube. The two essential symmetries of the cube reduce the problem from 256 cases to 14 unique patterns [4].

Step 4: The intersecting edge could be found by interpolating the surface intersection along the edge by using Linear Interpolation method.

Step 5: The gradient vector is the derivative of density function and is given by

$$\vec{g}(x, y, z) = \vec{\nabla} f(x, y, z)$$

Step 6: The gradient vectors at the surface of interest could be estimated by determining the gradient vectors at cube vertices and linearly interpolating the gradient at the point of intersection.

The gradient vector at cube vertex (i, j, k) could be estimated using central differences along the three coordinate axes by:

$$Gx(i,j,k) = \frac{[D(i+1,j,k) - D(i-1,j,k)]}{\Delta x}$$

$$Gy(i,j,k) = \frac{[D(i,j+1,k) - D(i,j-1,k)]}{\Delta y}$$

$$Gz(i,j,k) = \frac{[D(i,j,k+1) - D(i,j,k-1)]}{\Delta z}$$

Step 7: Finally the Marching Cubes algorithm calculates a unit normal for each triangle vertex that renders the image [10, 11].

$$\overrightarrow{n1} = u\overrightarrow{g2} + (1-u)\,\overrightarrow{g1}$$

3.2 Dividing Cubes algorithm

Dividing Cubes algorithm was developed to eliminate scan conversion step of conventional polygonal based display algorithm. The basic principle involves creation of surface points instead of triangles, association of surface normals with each surface and subdivision of cells as necessary. This algorithm subdivides the voxels into smaller cubes that lie on the object surfaces and projects the calculated intensity for each cube onto the viewing plane creating a gradient shaded representation of the 3D object [12]. The Dividing Cubes algorithm involves the following steps.

Step 1: The 3D volume data input.
Step 2: At first, four consecutive slices were read into the memory. Subsequently, the data are being processed by advancing one slice at a time.
Step 3: Creation of cube that is defined by eight data values from two consecutive slices.
Step 4: Calculation of gradient vector components by taking differences between forward and backward neighbors along each axis at eight-voxel vertices.
Step 5: Cube classification: Interior cube (intensities of each vertex are above surface value), exterior cube (intensities of the vertices falls behind surface value) and the surface intersect the cube.
Step 6: Division of each cube to subcubes followed by its scanning and testing for surface intersections.
Step 7: Gradient vector interpolation at each cube intersecting the surface.
Step 8: Intensity calculation at each surface point.

3.3 Dual Contouring algorithm

Dual Contouring algorithm is nearly similar to Marching Cubes algorithm. However, the meshing is performed on a dual mesh and needs the scalar functions to furnish gradients or surface normals in addition to function value. The major advantage of this algorithm is to procreate sharp features, which is not realized by the other implicit surface meshing algorithms. The Dual Contouring algorithm commonly works on Hermite data, i.e. the function value at any given point with all the partial derivatives of the function [13]. The Dual contouring algorithm involves the following steps.

Step 1: The region to be meshed is divided into convex overlapping cells.
Step 2: Evaluation of the meshed scalar function f(x, y, z) at the vertices of corresponding cells.
Step 3: Labeling of each vertex as being either inside or outside. In addition, the cells having a mixture of inside and outside vertices contain a portion of the surface.
Step 4: Generation of a single dual vertex per cell straddling the surface followed by their connection with neighboring dual vertices to produce final mesh.
Step 5: Location of the dual vertex that passes through the edge intersections is calculated by the equation,

Where, d-dual vertex position, pi- location of ith edge intersection and Ni- normal for ith intersection.

4. Implementation

A simple and efficient method for the extraction of continuous isosurfaces is implemented and tested on various datasets. It involves two crucial steps. In the first step, a continuous interpolant of the dataset was determined and second step includes the extraction of isosurface geometry by sampling the points on Marching Cubes triangles and projecting them onto the isosurface defined by the interpolant. The isosurface generation problem is addressed by computing the triangles of a Marching Cubes surface in each grid. Inside the triangles, the points are computed at which volume for function value and gradient are sampled using interpolation scheme.

and then projected onto the isosurface using continuous interpolant and surface rendering techniques. The resulting points are rendered by employing the surface rendering algorithm.

5.1 Coding

The Marching Cubes algorithm is implemented using MATLAB environment. The entire section of code is divided into three modules such as data module, algorithm module and rendering module. Figure 1 shows the block diagram of software design.

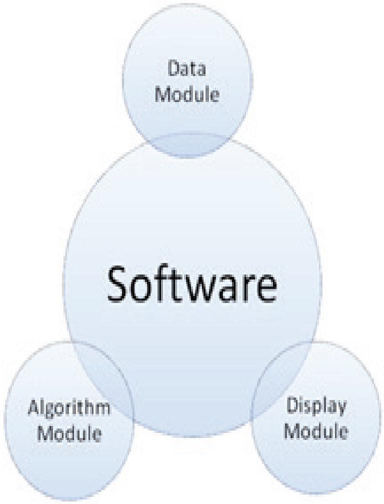

Figure 1: Block diagram of software design.

The data module takes care of input data and its processing suitable for algorithm module. However, the algorithm module contains the algorithm portion of the software and implements the Marching Cubes algorithm. The results are exhibited using graphical tools of MATLAB in the display module. The output from the algorithm module is in form of triangles, which are rendered using MATLAB's rendering system.

Two data sets have been taken for the present experiments. A raw data 'bucky.raw' has been downloaded from the publicly available domain. Subsequently, this raw data is implemented in MATLAB environment in order to find the pixel value at each part of the data. The information of raw data is provided in the Table 1 and its visual imagery is available in public domain.

Name of dataset	Grid Size	Resolution	File Size
Bucky.raw	32*32*32	32*32*32	32kb

Table 1: Information of the raw data.

MATLAB code:

```
fid = fopen ('bucky.raw' , 'rb')
v = fread (fid, 32768)
```

An equation based spherical data has been generated manually and implemented in MATLAB environment. It generates a mesh of size 50*50*50 (sphere data). Table 2 gives the information of sphere data and the visual imagery is shown in Figure 2.

Name of dataset	Grid Size	Resolution	File Size
Sphere data	50*50*50	50*50*50	2 kb

Table 2: Information of sphere data

MATLAB code:

```
x = linspace(0, 4, 50);
y = linspace(0, 4, 50);
z = linspace(0, 4, 50);
[ xx, yy, zz ] = meshgrid(x, y, z);
c = (xx-.5).^2 + (yy-.5).^2 + (zz-.5).^2;
view(-50, 50);
```

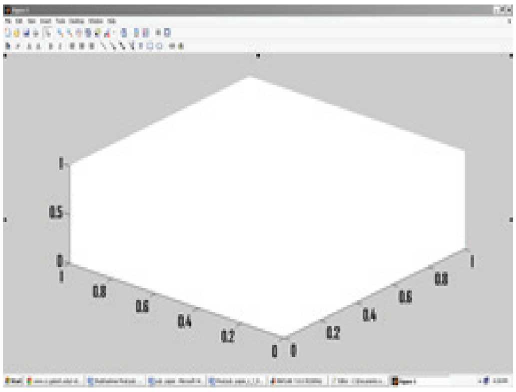

Figure 2: Visual imagery of sphere data

A surface tendering algorithm is exploited for visualizing the resulting point set representing the isosurface. A software framework for Marching Cubes has also been designed and developed for isosurface construction in MATLAB environment. The results using a synthetic datasets and discussion of practical considerations are presented. The importance of present method is that the proposed implementation could be applied to any arbitrary data.

5.2 Experimental setup

In the current research work, a software framework is designed using MATLAB that can be easily installed on Windows, UNIX and Mac OS X. There are minimum system requirements for each of the operating system. The platform used for implementing the algorithms is MATLAB with Windows operating system. MATLAB makes the task easier as it supports various image formats such as TIF, Bmp, JPEG, PNG, GIF etc. The MATLAB installer informs the hard disk space requirement for particular partition.

6. Conclusions

The simplicity and generality of the present method make it an attractive solution for acquiring high quality isosurfaces from any volumetric data. An efficient implementation of Marching Cubes algorithm is presented for the reconstruction of bucky data and equation based sphere data that have been downloaded from the publicly available domain. The computational aspects of Marching Cubes algorithms for faster and efficient implementation are highlighted. The practical aspects of the implementation of Marching Cubes algorithms and performance are studied. MATLAB is easy for prototyping and handling volume data.

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29th Indian Engineering Congress

Technical Session IV

TECHNOLOGY MANAGEMENT AND INCLUSIVE GROWTH

The Institution of Engineers (India)
Andhra Pradesh State Centre

INVITED TALK

Technology Management and Economic Growth

P.N. Murthy[1]

The Link

The link between Technology and Economy is integral, almost seamless. In this hyperspace of our World we live in – (Society x Science x Technology x Economy) – technology has become a major resource for creation and distribution of wealth and economy is a synthetic system comprising of many types of wealth like finance, academic, culture, administration, technological skills and various other tacit and explicit resources.

Technology

Technology is Science in action in and for society. Technology has the ability to democratize comfort, communication and information for a society. Technology is a productive instrument and is a great resource for creation and distribution of wealth. As a productive instrument it can be capitalized and commandeered by groups of people or nations and can be used as a powerful weapon of authority. It can be exchanged for power and money and also between the latter two.

Being a powerful instrument of productivity resource it has to be managed with consummate skill, care and concern. Technology, like economy, is very much influenced by the culture of society in which it is generated.

Technology generation is the story of innovation and invention while history of science is a story of discovery.

Technology has spread at an exponential pace during late 19th and 20th centuries. It has touched now every element and section of society. We have become practically 'slaves' of technology. Everyone is living on the crutches of technology.

Economy

As stated earlier, economy is a systemic configuration of the network of wealth creating institutions and the regulating institutions both for distribution and creation supported by knowledge repositories like educational and research bodies. Technology and economy operate in a feedback mode of mutual influence. Now economy has grown global due to the powerful influence of information technology. It is said that trillions of dollars move / transfer across the World thro' the internet, a tremendous 'disruptive innovation'. National boundaries have become thin and flimsy for operation over internet. So now all economies are influencing all. None can escape this global phenomenon. Simultaneously a powerful instrument of influence called 'social media' has emerged out of the IT inventions and innovations. We are all beneficiaries as well as victims of this communication phenomenon.

1. Formerly Professor IIT Kanpur

The World we live in

While comfort is democratized, the benefits are not that much spread over to all people due to the greedy graft and villainous crafts of people who are in charge of the wheels and chains of power. Inequity, nonviability have taken up firm roots causing needless trouble to large sections of people even in so called advanced nations. These tendencies have brought the World and its constituent societies and nations into a state which is called 'edge of chaos' - a state where stability and instability are in delicate balance.

Technology Management

Technology Management has several facets to it depending upon the context, content, and skills. One fact is to be constantly kept in mind that technologies are generated at many points in the globe. There is no country or nation which has no native technology. There is no nation or country in the World which is totally independent / self sufficient. Import and export of technologies is a natural phenomenon which all wealth creating, controlling, and distributing organizations among nations have to understand and factor in their strategies for war peace. So Technology Management has three variants.

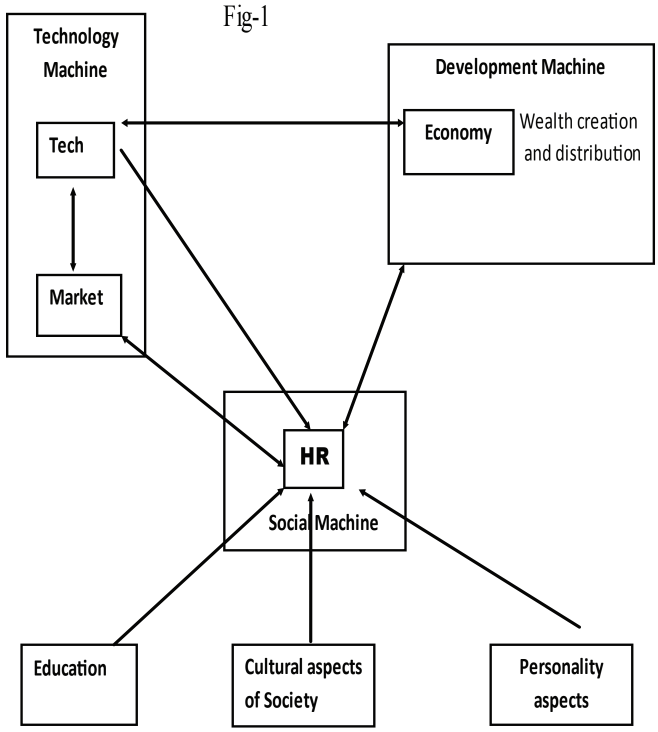
(i) Managing imported technologies

(ii) Managing technologies generated in the country

(iii) Managing technologies generated in-house.

In each of these, the Human Resource (HR) requirements vary. Without any fear of contradiction, one can say in all these cases Technology Management requires highly competent, intellectually and resourcefully competent – managers. We can represent this in the following figure:

Fig-1



This figure-1 essentially implies

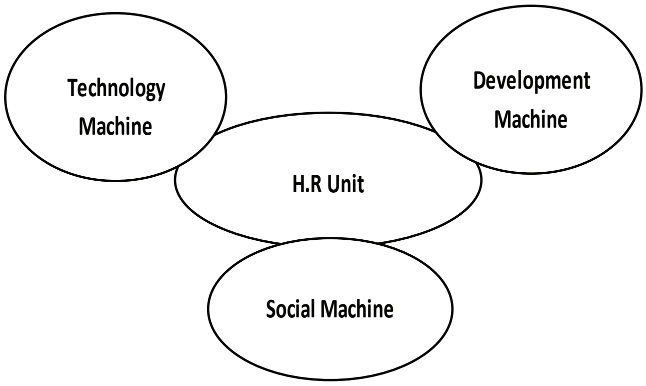


Figure - 2

This indicates the primary of Managers of Technology in making the Technology – economy loop effective, efficient instrument in social engineering for prosperous and happy society.

Technology Manager evidently requires courage, conviction, compassion, intuition and experience. Management of technology is an intuitive operation both in terms of evolution of the technique, strategy and process of management. Throughout history of Technology which is coeval with human existence, those who managed well had the upperhand even in the history of nations.

American experience

US is the most technologically developed country now. It has become a socio-technical system. It has taken nearly 100 years to irretrievably bind the three machines with a well trained HR unit holding it together. This rich profoundly strong relationship was built thro' increasing and continuous promotion of R & D in what is now called 'disruptive innovation' activity; with a full, animated interaction between academia and industry. Much of the R & D in academic institutions was funded by industry along with Government. The emphasis was on solving local, neighborhood and country's problems. The effort demcratised technology and people. USA has become a world power in technology with a democratic tradition supporting the entire effort. US has become a role model for industrialization and consequent prosperity.

Indian problem

India became free from colonial exploitation only 6 decades ago. None of the three essential interacting and networked machines were in a shape to provide needed HR. Everything was at the beginning. Only administrative apprentices designed for the dominance of the colonial power, was at the beginning. Only administrative apprentices designed for the dominance of the colonial power, was somewhat intact. Freedom struggle and the remnants of World War II left the country in a disarray in all other aspects. The link with technology was slender. The only area which perhaps did not feel this weakness was civil engineering.

To gear up the Technology machine and push the Economy Machine into self organizing mode considerable help was needed. Most of the technology was imported without any meaningful technology transfer. R & D was at its lowest level. Thus India, even now, is a large country with agricultural mindset with problems galore. Even now the situation is not really perfect for a surge in many areas except for a few areas like Civil Engineering, Space Technology, Nuclear Energy, Pharmaceutics. The character of Research is still at a stage of 'technology demonstrations'.

Even in IT, which stands at the top of export earnings, is almost 'body shopping' level. Academics are not still oriented to excellence in R&D. However efforts are in the right direction.

We need a step jump in all the three machines and it is possible.

1) We must quickly step and shape out of the noisy democracy and the industry political nexus mode.

2) Become a Knowledge society which was a characteristic of our culture.

3) Our well trained scientists must focus on local and neighborhood problems and solve them through R & D and innovation.

4) Technology Management must:

a) Generate indigenous technology

b)Use imported technology with efficiency and knowledge

These 'must' steps are not easy in a democracy that is noisy and interfering in all efforts, with clogged knowledge and wealth transfer channels. India is now a green market for the entire world with enormous benefits. This opportunity must be cleverly used for mutual benefit. In all this the help of IT should be used with fineness and alacrity, harnessing the mood of the people to live well.

We should not wait for things to happen through catastrophes. Seizing the initiative is not difficult. All sections of the society must develop a will to succeed through ethical means. Most important is this will to become part of the initiative for oneself and the country. Mere suggestions which can be easily made are not sufficient. The three machines should simultaneously thrive with the active intervention of intellectuals who received lot of benefits from the society in which they are living now. Now every nation has become inward looking. We too must develop a strong inward look embellished by outward attention. India is being targeted as a Greenfield market by all the developed countries. To tolerate this push and pressure and get benefitted India must become a real world power. This can happen, fortunately, by utilizing the most modern technologies available to us. Digital Technology can help this effort to develop at near lightering speeds. The idea of Digital India is a well conceived idea. The leaders of the present 'noisy' democracy will have to yield place to silent and speedy development, which otherwise will pass by. The leaders, who use democracy to achieve their undemocratic ends, have to fall in line. Once a critical stage is reached in the development status, the growth will be self propelling. One should not wait for ideal conditions. One can hope for a turn around to a sensible,technology driven, shared-wealth society with human face.

INVITED TALK

Synchronized Collaboration – industry & Academia

Er Ananth Subramanian[1]

Preamble

Until the 80's/90's, Indian engineering education was dominated by the IITs, Government institutions and a handful of non-government participants like BITS and a few others. Quality of engineers passing out was controlled and Indian engineers were very much sought after. This also contributed to the much debated "Brain Drain" as well.

As the population of the country exploded, the rapid proliferation in the number of engineering education institutions in the country followed. This created immense opportunity for aspiring children to realize their goal of becoming engineers and enhance the household income potential. While this situation enables access to education, hitherto restricted, this has also contributed in some element of problem as well.

There are very nice aspects of the Indian Engineering Institutions that need mention

• Over 3300 Engineering Institutions in India

• Largest English Speaking Population and 2nd most Scientist and Engineering work force

• Expect to have the largest work force in 6 years and English Speaking

• IT continue to be a large recruiter in campus but old economy industries making a comeback

Academic Institutions have been established to service the current and emerging needs of Industry and there is an onus on the Education Sector to align curriculum to address Pain points of Industry. Business centricity and Industry relevance in Engineering education are existent in some pockets and it's a situation where India churns out a record number of engineers every year and employability of many of these students is becoming increasingly getting difficult.

Current Challenges

While there will be arguments for and against the point of view expressed in this paper, one should holistically try and examine the causes of this problem and the real impact of this problem on industry. Some of the causative factors thereof could include:

Unplanned growth in Institutions

• Poor industry relevance in course content impairing placement of students

• Need for industry relevance in faculty

• Poor program content

• Inadequate or irrelevant involvement of Industry with only paper MOUs

• Poor communication skills of students

• Theory centric knowledge that necessitates significant training effort/ costs for businesses

One Quantified Impact

Let us take the example of the IT Industry which so far has been a huge recruiter from various campuses.

1. President & Managing Director, Hitachi Solutions India

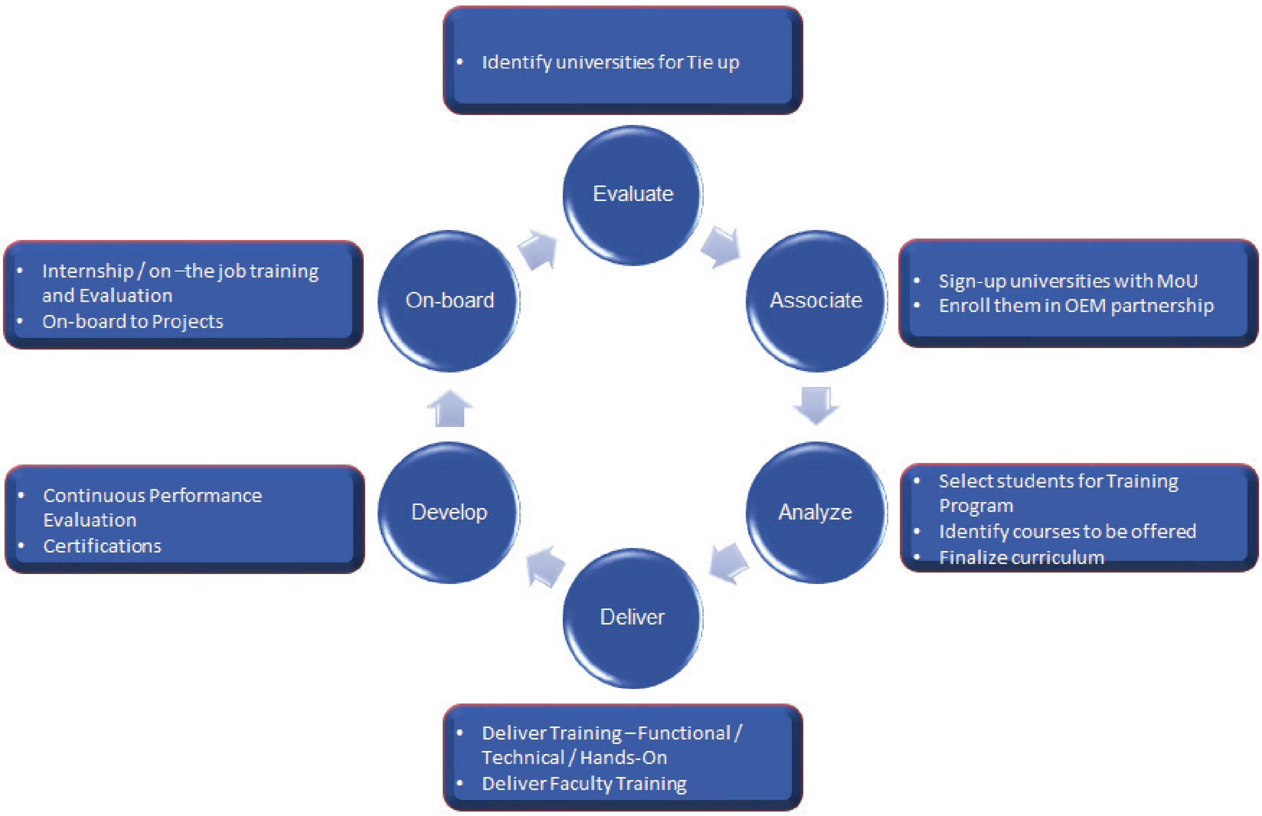
In the IT sector, where demand is high and needs for cost control is also very pronounced, there is considerable effort to be expended towards training thousands of engineers recruited from campuses. As a rough estimate, the effort for training 100 BE – Computer Science Graduates for a minimum period of 6 months will translate to:

- A direct cost of at least $ 300,000
- Revenue Opportunity loss of at least $ 1.9 MN if deployed on projects from 3rd month onwards

One can well imagine the quantum of this impact, given that IT sector alone recruits in several thousands.

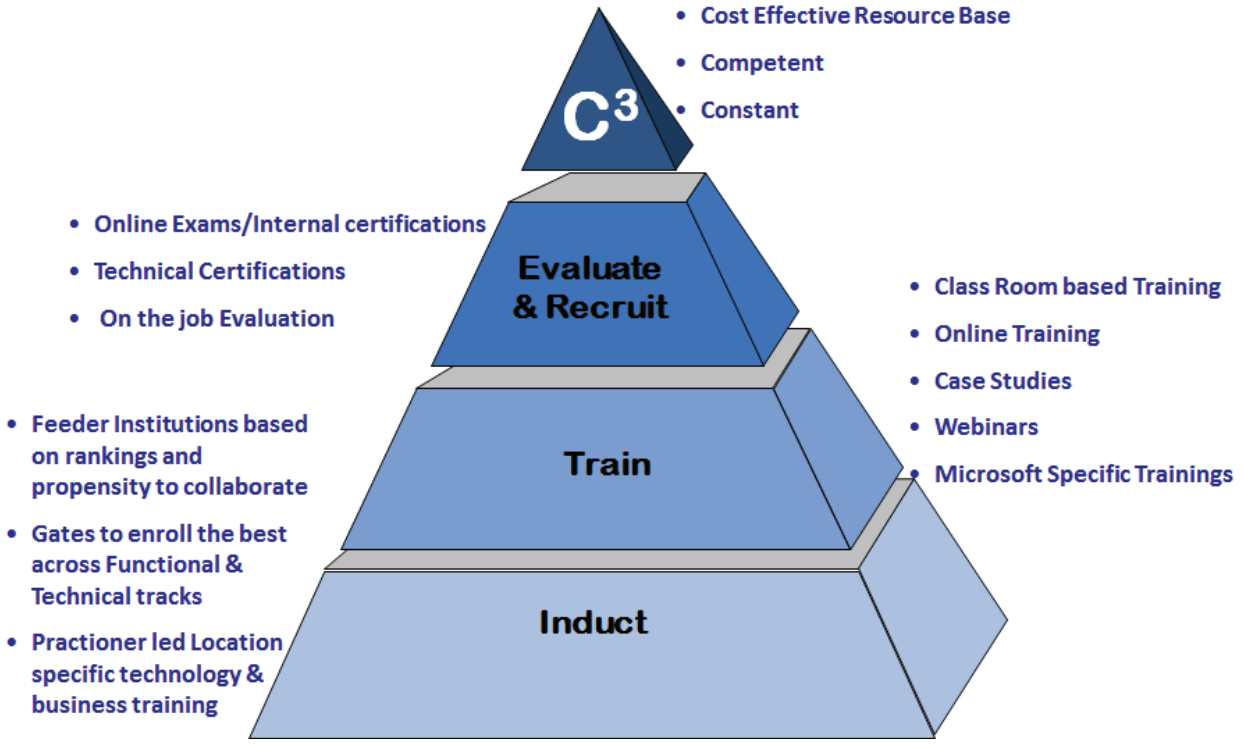
Need for Synchronized Collaboration

Given the above, there needs to be serious introspection in Academic and Industry circles on what needs to be done to mitigate the challenge on hand. One way forward, empirically tested, could be in terms of a tighter alignment between Industry and Academia that calls for investment from both sides. A model towards this end has been piloted in the Author's organization and is summarized below:



Academic – Industry Incubation Synchronized Collaboration Model

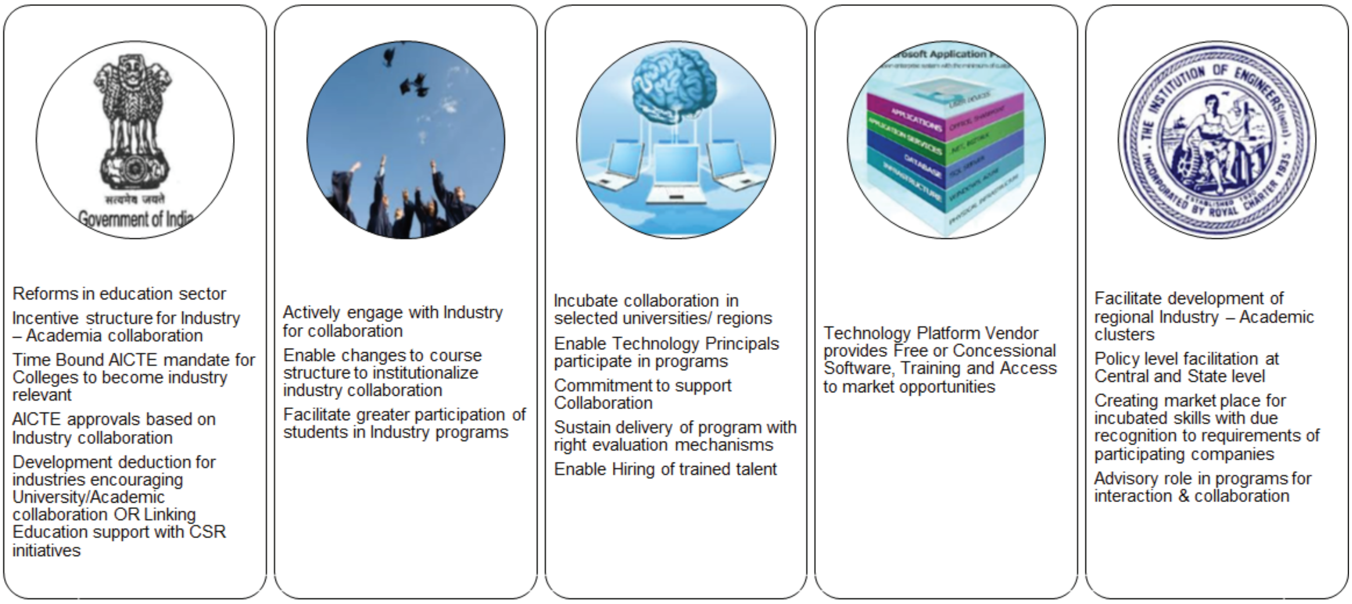
An ideal model for collaboration is articulated herein and can be adopted across industry segments to symbiotic advantage.



How can we achieve synchronized collaboration?

Any new initiative will required support from foundation pillars for the initiative. Key pillars for getting a collaboration initiative forward would necessarily include the following with some suggested areas for their contributions:

1) The Institution/ University
2) The Industry and its captains
3) Government
4) Technology Platform Company - OEM
5) Enabler – Institution of engineers / ESCI



Early Steps towards change

An analysis of the spread of institutions indicates a concentration in South India and a larger scale pilot with the synchronized collaboration model can be around the following:

- Pilot initiative in South Cluster in TN, AP, Telengana and Karnataka with 5 Industry collaborations per state
- Academic incubation tied to industry's ability to underwrite job placements

Ananth Subramanian, President & Managing Director, Hitachi Solutions India

- IT, Discrete manufacturing, Chemicals, Automotive and Pharma can be good segments to start with
- ESCI can help co evolve curriculum and governance
- Extend to other regions after pilot through 1 year in Southern region

In Summary

The Indian engineering Education system, though good, requires a rejig in its relevance to industry and a synchronized collaboration between industry and Academia will help realize a symbiotic ecosystem.

Enhancement of Efficiency of the Turbo Generator using Hydrogen Gas

K.Muthukumar[1] & M.Ravichandra Babu[2]

Abstract:

A.C Generator or Alternator is common equipment in any of the Power Plant. By increasing the efficiency of this common electrical equipment, efficiency of the Power Plant could be increased and intern conserving the fuel. The efficiency is increased by adopting enhancement of increasing cooling inside generator and thereby increasing current density in the conductors. More electrical loading of the stator and rotor is possible by adopting good effective cooling. Over the years, cooling of large Turbo Alternators have changed from conventional air Cooling to Hydrogen cooling and now to mixed Hydrogen and /water cooling for higher capacity generators. The effect of all the methods adopted helps to reduce the size of active volume needed per MVA capacity.

1. Introduction

Up to 100MW, Stator & Rotor is cooled by air. Up to 250 MW, Stator & Rotor is cooled Hydrogen Gas. In the above ratings, some of the water cooled machines are also available. In 500MW and above Generators, stator is cooled by De-Mineralized (DM) water and Rotor is cooled by Hydrogen gas. The

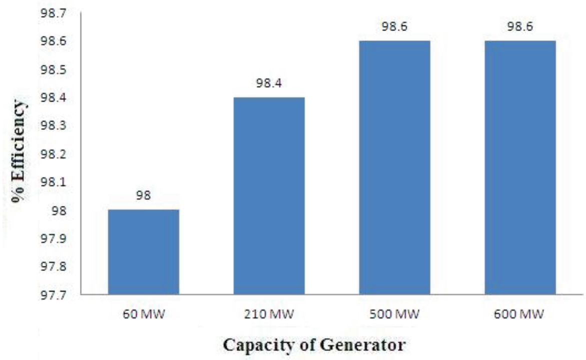


Figure 1: Capacity of Generator and Efficiency

efficiency and various capacities of generators are shown in figure 1.

With increase in cooling over the years, the weight of Generator per MVA rating is reduced effectively for the higher capacity generators. The figure 3 shows the year and development in increased capacity of Generators with reduced weight /rating of generators.

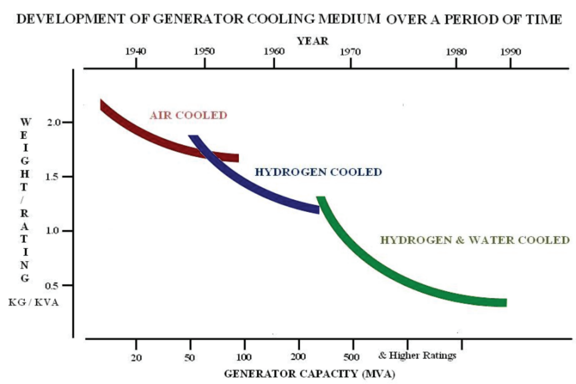


Figure 2: Generator Capacity and Weight / MVA

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Southern Region, Neyveli – 607 803, Tamilnadu.

2. Losses in the Generator

There are various losses occur in the Generator viz., Stator winding, Stator core, Casing & Structure, Bearings & Seals, Windage, Rotor winding etc., The losses in a generator of 500 MW Capacity with mixed cooling is about 1.4% , ie 7 MW and their distribution is shown in figure 3.

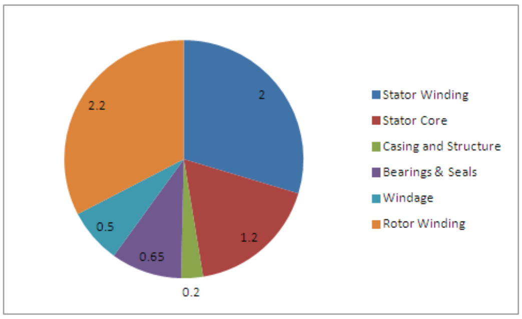

Figure 3: Distribution of various losses in a 500 MW Generator

The temperature gradient in stator is such that the highest temperature will be at stator copper, gradually falling upto core and then to cooling medium. In rotor, with ventilating slots, temperature drop will take place from copper and iron via insulating material to slots and from core teeth to rotor surface inturn to the air gap.

3. Cooling Medium

The research studies carried out expeditiously with minimum of coolant required and with minimum of operational hazards. The earlier cooling medium air was replaced by Hydrogen gas for higher capacity machines. Now water is also being used for stator cooling of machines for the capacity of 200 MW and above.

The choice of a coolant depends upon various properties like specific heat, density, thermal conductivity etc,. These properties decide the quality of the coolant used and fan capacity power required to dissipate a given amount of losses. The relative properties of various coolants are given in table 1.

Coolants	Specific Heat	Density	Practical Velocity	Thermal conductivity	Heat Transfer Coefficient
Air	1.0	1.0	1.0	1.0	1.0
Nitrogen	1.0	0.966	1.0	1.08	1.03
Carbon-di-Oxide	1.27	1.52	1.0	0.64	1.13
Methane	1.22	0.55	1.0	1.29	1.43
Helium	5.25	0.138	1.0	6.4	1.18
Hydrogen at a) 1 kg/cm^2	14.35	0.14	1.0	6.69	2.65
b) 2 Kg/cm^2	14.35	0.22	1.0	6.69	3.65
c) 3 Kg/cm^2	14.35	0.30	1.0	6.69	4.4
d) 4 Kg/cm^2	14.35	0.375	1.0	6.69	4.85
Oil	2.09	848.00	0.012	5.45	21.00
Water	4.16	1000.00	0.012	21.00	50.00

Table 1: Relative Properties of coolants taking Air as Base

The deployment of coolant to suit a particular method of carrying away heat also plays an important role to reduce the losses and intern to the improve the efficiency. In the machines below 200 MW, the heat is principally dissipated by convection to circulating media. The fans are provided at rotor ends to augment the circulating the cooling medium and baffles are provided to direct the same through pre-determined paths for effecting cooling. This is also known as conventional method of cooling.

In machines of higher ratings, now direct method is being used in which heat is carried away by conduction method. The conductors are hollow in construction and the coolant, whether gas or liquids, is passed through these passages.

This method also gives more MVA per ton of machine material and hence size of machine is reduced. The following table 2 shows the comparison of generator using different cooling system.

Generator rating MW	60	100	200	350	500
Generator rating MVA	75	125	222	412	588
Rotor Coolant	Air	H_2	H_2	Water	Water
Stator Coolant	Air	H_2	H_2	H_2	H_2
Method of Cooling					
Stator	Conventional	Conventional	Direct	Direct	Direct
Rotor	Conventional	Conventional	Conventional	Direct	Direct
Generator total Weight tons	200	230	240	290	385
MVA per Ton	0.375	0.54	0.92	1.42	1.53

Table 2: Wight Comparison of Generators with Different cooling System

The greatest advantage in direct cooled system is that it eliminates film barrier between cooled surfaces and coolants. In our country more than 500 MW Generator, rotor winding, made up of hollow conductors, through which hydrogen passes and hence, is called directly-Hydrogen cooled rotor.

4. Advantages of Hydrogen

Since 1930, greater use is being made of hydrogen as cooling medium in large capacity Turbo-generators due to the following main advantages.

i) Lesser windage and friction losses

The lesser the density of the cooling medium, the less will be the losses. Also due to low density, fan power will also be reduced. The density of the hydrogen at a given temperature and pressure is approximately 1/14 th of that of air, but in practice advantage is limited to 1/10 th. The use of hydrogen will result in 0.5 to 1.0 % increase in efficiency at full load.

ii) Reduction in size of the machine

Hydrogen has superior cooling properties as compared to air because of its high thermal conductivity, which is seven times that of air and ability to transfer heat from heated surfaces through forced convection which is 50% more than that of air. Because of these properties, hydrogen will extract more heat per unit volume/minute. Thus for a given rise of temperature, machine capacity can be increased. It has been estimated that by the use of hydrogen, 20% reduction in active construction materials can be achieved. At 0.035 kg/cm2 of hydrogen, machine rating is increased by 20 to 25% and at 2.109 kg/cm2 the rating increase is 35%.

iii) Increase in life of machine

Enclosed construction which keeps dirt and moisture out from windings and ventilations passages. There is no deterioration of armature insulation due to corona. During corona discharge, ozone, nitric acid and other chemical compounds are formed due to oxidation, which attack organic bounding materials of insulation.

iv) Increased output from the same machine

With increase in Hydrogen pressure used in Generator, the heat transfer co-efficient increases appreciably and also in the same space more hydrogen by weight can be employed. Thus the denser hydrogen will have improved capacity to absorb and remove the heat with resulting from the same machine, output may be increased.

5. Safe Operation of Hydrogen:

Hydrogen and air mixtures between 5/95% and 75/25% are explosive and hence, normally a 95/5 to 98/2 percent content is employed. In modern system, it is more general to restrict hydrogen/air mixture to 98/2.

The Hydrogen cooling system in general takes the gas supply from the gas manifolds into the generator housing through two headers; one at the top of the generator and other at the bottom. The gas manifolds are connected to the respective bottles or to the gas supply main if gas generation plant is available in the station. The gas stand also, is provided with necessary instrumentation for measuring gas pressure and purity and also a gas relief valve to safeguard the system against excessive pressure build ups

During purging out operation, Carbon-di-Oxide being heavier than hydrogen, is used as the displacer gas and charged through the bottom header, while hydrogen being forced out through the top header thus ensuring that hydrogen gas does not come in contact with air inside the generator to form any explosive mixture. Similarly, during filling in operation, hydrogen is charged through the top header and Carbon-di-Oxide is forced out from the bottom header. The figure 4 below shows the Hydrogen gas filling and scavenging operation.

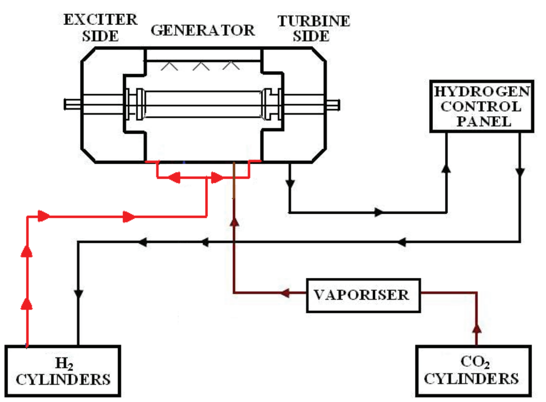

Figure 4: Hydrogen Gas filling and Scavenging Operation

Hydrogen while in circulation in the generator may absorb water vapour. Hydrogen dryers containing alumina powder are provided through which a certain percentage of hydrogen is in continuous circulation and getting dried up. The alumina powder is reactivated by heating when found necessary. An induction Level indicator is provided on the drain pipe connected to the generator bottom to detect the presence of water/oil inside the generator. The indicator has also the facility to initiate an alarm signal when it senses liquid.

6. Hydrogen Gas Coolers:

The hydrogen gas coolers consist of cooling tubes made out of brass with coil copper wire wound on them to increase the surface area of cooling water tubes. Cooling water flows through the tubes and the hydrogen flows across the cooling tubes and hence come in contact with external surface of the cooling water tubes and thus hydrogen is cooled. The tubes are arranged in a staggered form so as to expose maximum surface area to hot hydrogen. The ends of the tubes are expanded into end plates so as to provide water tight joints. Water chambers are bolted to the tube plates on either end through rubber gaskets. The outside flange of water chamber on slip rings side elastically fixed to the stator body with the help of moulded rubber gasket, whereas on turbine side it is fixed rigidly to the stator. End covers of water chambers are removable without purging the hydrogen from the generators. The detail of the cooler has been shown in figure 5.

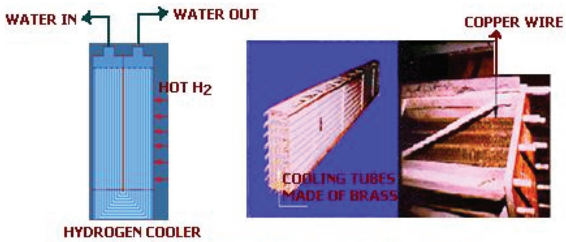

Figure 5: Hydrogen Gas Cooler arrangements

7. Conclusion:

In addition to the above, for stator conductor cooling using Stator Water System which uses de-mineralized high di-electric strength water is also employed to improve the efficiency. The only other gas which shows significant advantage over air in terms of reduced density or improved cooling properties is Helium but it is too costly. But hydrogen is easy to manufacture and lesser cost compared to Helium. Thus, by using Hydrogen gas as coolant in the Generator, the efficiency of the Generator is enhanced.

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Infrastructure built with Technological Innovations Hyderabad Water Infrastructure - Key component for economic growth of the City

M.Satyanarayana[1]

Objective:

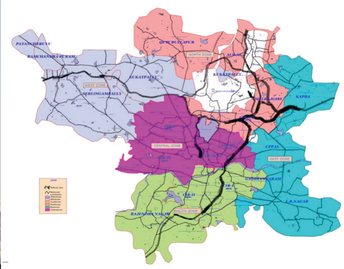
The main objective of building the water supply infrastructure using Innovative Technologies is to achieve sustainable growth as well to yield healthy and economic growth of the city.

Introduction:

The water supply infrastructure is one of the key components of the holistic economic development for any urban city. The water supply infrastructure at Hyderabad supports economic growth of the city from the aegis of Nizam period to the current days of newly formed State of Telangana by providing supplies to the various customers including revenue / economic generating units in the city apart from the domestic supplies. The economic aiding units of yester years like VST, DBR Mills, Praga Tools to the current revenue generating units of IT Hubs, International Airport, Pharmaceutical Industries etc are fully supported with the water supply facilities having good infrastructure.

Application of Technology:

It is seen that for the older systems for bringing raw water from Osmansagar reservoir to Hyderabad City for a distance of 15 Kms, one RR Masonry conduit was built with surki mortar. The bottom section of the conduit is in parabolic shape to generate uniform self cleaning velocity all along its gradient. The side walls in RR masonry were of most economic sections to retain the internal water pressure and external earth pressure and overburden. Being it is a gravity nature, at the summit points deep cuttings to the tune of 8 to 10 M were resorted and at valley portions, masonry pillars based aqueduct at a height of 10 to 15 M above was built at Kokapet & Manikonda for crossing the streams at low lying areas.

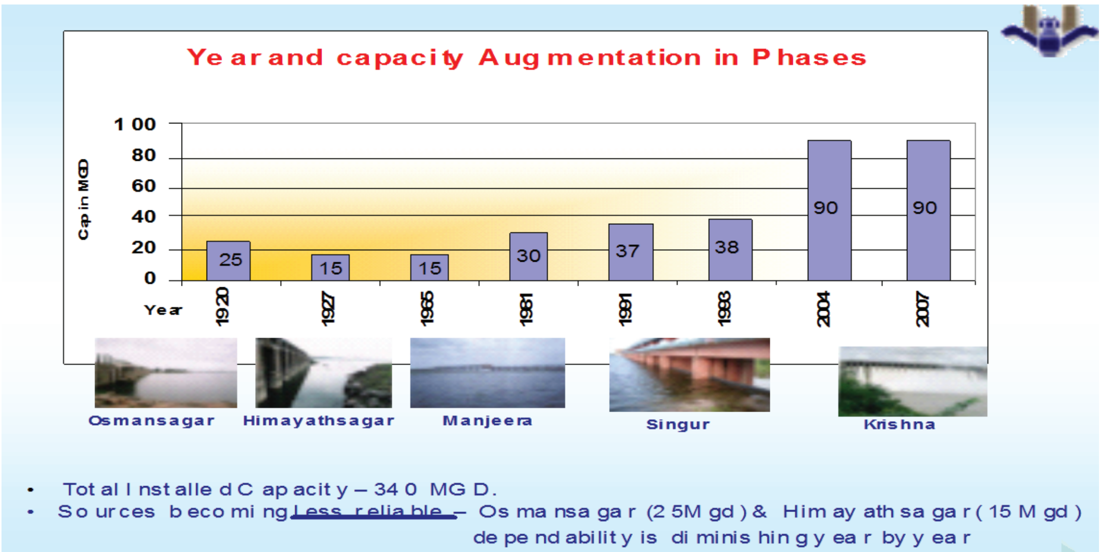


Wherein the technology part is seen that, uniform slope was maintained throughout the length with 1 : 5000 slope i.e. just 3 Mt fall in a 15 Km length and observed that no deposition of silt is taken place and also no scouring for the base or side walls with functioning of 94 years service. The simple application of technology is maintaining of uniform gradient which is one of the engineering feather adopted in the design of yester years.

1. Executive Director / Engineer-in-Chief, HMWSSB, Hyderabad.

Phase Wise Development of Sources – Yester Years to Current Period

Sl. No.	Sources	Year Commissioned	Capacity TMC	Normal Drawls in Mgd
1.	Osmansagar on Musi River	1920	3.90	25.00
2.	Himayatsagar on Esi River	1927	2.967	15.00
3.	Manjira – Phase-I (Manjira Barrage)	1965	1.509	15.00
4.	Manjira – Phase-II (Manjira Barrage)	1981		30.00
5.	Manjira – Phase-III (Singur Dam)	1991	30.00	37.00
6.	Manjira – Phase-IV (Singur Dam)	1993		38.00
7	Krishna – Phase- I (Akkampally)	2004	5.50	90.00
	Krishna – Phase –II	2008	5.50	90.00
	Total			**340**



The creation of infrastructure for the current periods, the modern technological applications are being adopted with the GPS tools, hydraulic network designs, STADD Programming and also certain simulation models. For the Godavari Phase-I Project which is under execution, for the 3000 mm dia pipeline, the protective coating was adopted with food grade epoxy paint to have higher frictional coefficient and being laid as per the natural topography of contour with the installation of air vessels at the beginning of the pump house and surge tanks on the hillocks of the alignment as part of surge protection systems which were being processed with the advanced technological

simulation programmes replicating the real time dynamics of pipe hydraulic systems. Further, the operation systems of Krishna Phase-I & Phase-II schemes is being witnessed of its rate of flows, pressures etc from the water treatment plant location till the service reservoir point for a distance of 160 Kms using the SCADA system with real time monitoring of various parameters in the Transmission system. Even in the distribution system, the water levels in the reservoirs, the rate of flows of inlet mains and outlet mains, presence of residual chlorine etc are being monitored through SCADA system.

The infrastructure coupled with application of modern technology during the current periods have become the tools for the engineers for execution of major projects and also for its effective operation & maintenance during its O&M period.

New Domains and Concepts:

With the advent of the modern technological gadgets for engineering applications, the new engineering domains are being expanded with the new concepts of installation of online boosters on the large transmission mains connecting to the different grid systems from one source to the other source system to make as an integrated network system, to maintain required residual and peak pressures at various demand supply nodes.

The new concepts of pressure mains along the Outer Ring Roads, extension of Radial Mains both inside and outside to connect to the internal trunk mains and with connectivity to the external Regional Ring Main Roads, Satellite Towns, Urban Centres, Urban Nodes and Growth Corridors etc are being conceptualized for preparation of Detailed Project Reports for implementation.

Sustainable Reorientation / Approach:

It was seen that earlier particular supply area was attached for one commanding source. And another area was connected to another commanding source system. With the reorientation and new approach, away from the conventional patterns, it is being conceptualized to have connectivity of different sources at the supply node areas.

Further, within the distribution ring fence areas, the bulk transmission connectivity is being extended to one ring fence zone to other ring fence zones which are proving to be a good model for transfer of supplies from surplus areas to critical areas effective system maintenance.

It was observed that, such supply node linkages has resulted the improved customer satisfaction for conveying the water from one supply zone to another supply zone in the critical times and also has become a standby arrangement for the operational engineers for its usage at complex periods.

Further this sort of reorientation / approach is being conceptualized to have connectivity among the sources. In this concept the variation in source drawls will be programmed to meet the overall demands of the supply area from whichever the source the water is available. In this concept, the individual source constraints will be addressed suitably and a new approach of multi-reservoir operation concept will supplement source deficit areas with optimization techniques.

The best engineering practices towards such reservoir operations are being viewed to conserve the water at the source, patrol and monitor the catchment for quality protection, monitoring inflows, outflows, spills, mandatory releases etc are being considered as variables for such reorientation / approach under this new concepts.

The regime tables of each source, governing levels of each reservoir, operating rule curves, operation guidelines, operational schedules for all the parameters of inflow, outflow regulations can be developed duly keeping the demand nodes requirement for the full design period.

The demand nodes can be segregated into high demand zones, medium demand zones and low demand zones. The below poverty areas can be considered as low demand zones and accordingly the required releases can be provided to such nodes to avoid the leakages and wastages and whereas for high demand zones where the affordable and potential customers becomes part of major revenues for sustenance of the system can be provided more releases to such nodes keeping in view of cross subsidy as well exploring the potentiality of the affordable customers for the commercial, industrial, water based units apart from domestic requirements.

By adopting such new engineering practices and concepts, the conventional embedded applications of UFW measures, intermittent supply approaches, two hours supply in a daily to 24 hours supply zones, the new reorientation is in consideration to have overall encompassing of development for sustenance of the developed infrastructure

and to yield the optimal and even the best outcomes from the system.

The infrastructure so created even can be considered as one of the key factor for the economic growth of the urban city as the potable water supply is one of the key health index factor as well as business potential indicator which can even be seen from the aegis of developing cities at the banks of river / water bodies or water locations. The Hyderabad Metropolitan Water Board, to the extent gives high priority for providing water supply in a balanced by way taking care of the social objectives of providing the minimum water supply to the below poverty people as well as to encourage the economic and overall development of Hyderabad city by providing water to the various commercial clusters, IT Hubs, water based units including Railways, Airports etc for their optimum usages with the sole objective for a sustainable and economic growth of Hyderabad City. In its anvil, already two major augmentation projects of highly embedded technical features of bringing water from river Godavari to Hyderabad City through pipeline for a traverse length of 250 Km for a lift of 500 M of 172 Mgd i.e. 10 TMC in a single scheme with 3000 mm dia (ID) of MS pipeline with associated water

transmission units and another project of Krishna Phase-III from river Krishna of Nagarjuansagar reservoir is of similar high technical featured to bring 90 Mgd (5.5 TMC) in a single scheme for a traverse length of pipeline of 170 Km for a lift of 450 M with associated transmission, ancillary units of MBRs, TBR, SRs etc.

The Board provides the water supply services for about 120 Lakh people in and around Hyderabad City through 8.5 Lakh customer connections. The individual service connection sizes are ranging from 15 mm to 600 mm diameter wherein higher size customers includes BHEL, Ordinance Factory, Railways, MES etc apart from other industrial and water based units.

The monthly revenue presently yields to the tune of 91 Crores from all the regular payable customers, and the expenditure is about 90 Crores wherein 50% is only the charges payable towards power consumption for bringing water from such long distance sources from 120 M lower contour to the higher contour areas of Hyderabad city situated at 600 M contour. The pipe network length is about 5500 Km includes transmission to the distribution with various types of pipes having RCC, PSC, CI, DI, MS material.

Conclusion:

HMWSSB water supply infrastructure serves the people with quality and quantity and paves the foundation for technological applications and usages to align itself to the good governance structures and realizes the targets and adopts the reforms of both optional & mandatory as suggested by the State and Central Governments to have a sustainability and to address the social objectives of political, institutional and the citizens in particular.

The infrastructure built with technological & innovative approaches will certainly aid for good economic growth of the city. By using the technological innovative SCADA based water supply infrastructure not only provides the real time monitoring of the system but also provides connected benefits like minimizing the operational costs, enhancing the revenues and encompasses to the inclusive development & economic growth of the city.

SLOPE STABILITY MONITORING USING ADVANCED RADIO COMMUNICATION - A PROPOSAL

S Jayanthu[1],G Karthik[2], and Chandra Mohan [3]

Abstract

Monitoring of slope movement using wireless communication systems can be an effective for pre-warning of slope failures like fall, topple, slide, spread, and flow, can occur in a variety of materials and degrees of slopes. This paper deals with elimination of manual monitoring and the need of the presence of technicians to collect the data from slope instruments at scheduled intervals with the help of Wireless Network Infrastructure which also replaces the need of physical cables. This paper also gives an insight into the recent and emerging technologies for pit slope monitoring. Computer softwares are available like DIMONS (Displacement Monitoring System) software which has been developed to support fully automated deformation monitoring schemes with automatic data acquisition for quickly plot the data and allowing immediate assessment of slope conditions. Wireless Data Transmission System uses advanced antennas at respective slope instruments in opencast mines or natural slopes. By installing the wireless sensor nodes at respective slope stability points in mines for acquiring the data from slope instruments and can be interpreted online. Wireless sensor networks (WSNs) are well suited to monitor the movement and it consist of sensor nodes which measure physical quantities and transmit the pre-processed measurement results to a base station wirelessly.

Key Words: Wireless sensor networks (WSNs), DIMONS, and Slope stability.

INTRODUCTION

Slope stability accidents are one of the leading causes in surface Mining operations .Unexpected movement of ground causes the potential to endanger lives, demolish equipment, or destroy property. The economic consequences and operational problems associated with slope instabilities dictate the need of appropriate slope monitoring and management measures. Slope management basically constitutes anticipation, pre detecting of likely changes and control of slope behaviour. An understanding of the causative factors of slope instability and the expected slope behaviour is a prerequisite to successful mining. Failure geometry, strength properties, and monitoring data are important guides in predicting slope behaviour. The practical approach to slope stability is guided by the basic geological data, geo-technical parameters, ground water characteristics and a good measure of engineering judgment. By deploying the wireless Data Transmission System using advanced antennas at respective slope instruments in underground or

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opencast mines we can collect data without any physical connections. Developments in information and communications technology (ICT) support the collection, connection and analysis of data through sensing and monitoring of slopes in mines. Sensors are parts of all machines that gather data and have an integral role in subsequent processing and transmission of data. Proper and reliable communication system not only saves machine break-down time but also helps in immediate passing of messages from the vicinity of underground working area to surface during day-to-day normal mining operations as well as during disaster situation. Therefore, wireless communication is the need of the hour for establishing effective communication and enhancing safety of miners in mines. Remote monitoring of slope movement using electronic instrumentation can be an effective approach for many unstable or potentially unstable slopes. Many options are available for monitoring unstable, and potentially unstable, slopes. These range from inexpensive, short-term solutions to more costly, long-term monitoring programs.

WIRELESS SENSOR NETWORK

A wireless sensor network (WSN) in its simplest form can be defined as a wireless network consisting of spatially distributed autonomous devices called sensor nodes to cooperatively monitor physical or environmental conditions at different locations, The Wireless Sensor Networks (WSN) technology is employed in the open-pit mine slope detection system. These are expected to be widely used monitoring of slopes When the open-pit mine slope is found abnormal. The WSN transmit data to the monitors timely in case of the unnecessary losses Wireless routers and gateway for creating a self-forming wireless mesh network with tags and sensors in their vicinity to transmit tag/ sensor data from field to a control station for remote real-time monitoring. Low power and low data rate short range wireless communications suitable for monitoring applications.

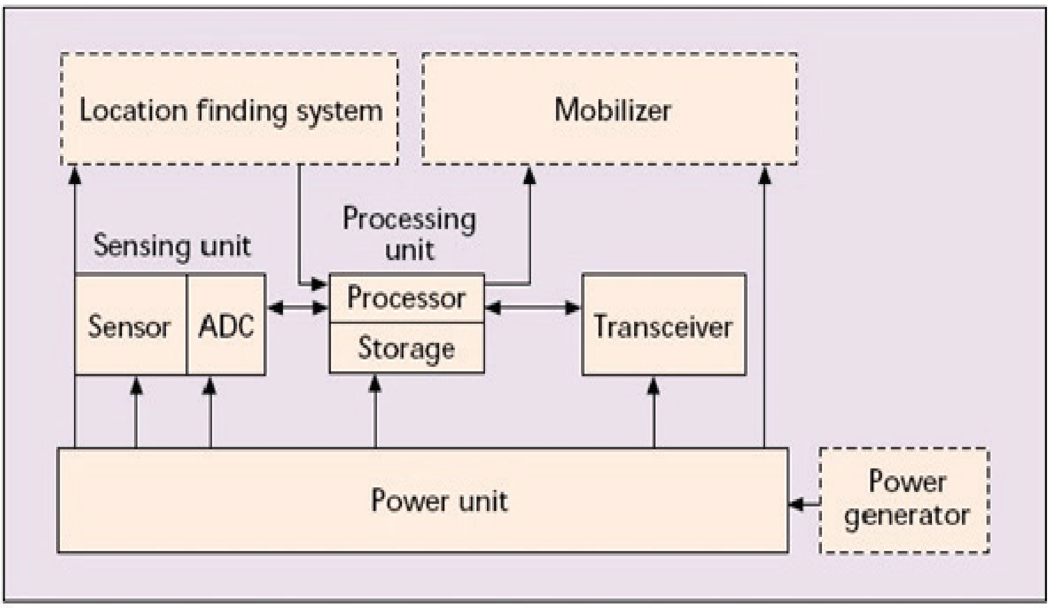

Fig.1. The general architecture of a sensor node

Sensor Node

A sensor node is made up of four basic components as shown in fig.1: a sensing unit usually composed of two subunits: sensors and analog to digital converters (ADCs).A processing unit, which is generally associated with a small storage unit, manages the procedures that make the sensor node collaborate with the other nodes to carry out the assigned sensing tasks a transceiver unit: it connects the node to the network. A power unit: might use solar cells AND other additional application-dependent components such as a location finding system: for sensing or routing purpose, Mobilizer is to move sensor nodes and Power generator.

The Sensing Unit

It consists of the sensor deployed at the node which collects data at the ground level. This data is the physical or the raw data which is sampled and converted to the analog domains and then into the digital form which is then converted into digital forms which is then sent to the processing unit. Sensing units are usually composed of two subunits: sensors and analog to digital converters. Sensor is a device which is used to translate physical phenomena to electrical signals. Sensors can be classified as either analog or digital devices. There exists a variety of sensors that measure environmental parameters such as temperature, light intensity, sound, magnetic fields, image, etc.

The Processing Unit

The processing unit mainly provides intelligence to the sensor node. The processing unit consists of a microprocessor, which is responsible for control of the sensors, execution of communication protocols and signal processing algorithms on the gathered sensor data. Commonly used microprocessors are Intel's Strong ARM microprocessor, Atmel's AVR microcontroller and Texas Instruments' MP430microprocessor. In general, four main processor states can be identified in a microprocessor: off, sleep, idle and active. In sleep mode, the CPU and most internal peripherals are turned on, and can only be activated by an external event (interrupt). In idle mode, the CPU is still inactive, but other peripherals are active. [6]

Transmission Unit

Similar to microcontrollers, transceivers can operate in Transmit, Receive, Idle and Sleep modes. An important observation in the case of most radios is that, operating in idle mode results in significantly high power consumption, almost equal to the power consumed in the Receive mode. Thus, it is important to completely shut down the radio rather than set it in the idle mode when it is not transmitting or receiving due to the high power consumed. Another influencing factor is that, as the radio's operating mode changes, the transient activity in the radio electronics causes a significant amount of power dissipation. The sleep mode is a very important energy saving feature in WSNs. [6]

PRESENT SYSTEM ARCHITECTURE AND DESIGN

The architecture comprises of three basic components, the wireless mesh network which consisting of RFID tags, sensors and/or actuators, the gateway and the central server and Internet. The mesh networks house local information which is communicated through a gateway to the central server. The gateway handles the messages to and from the mesh network. The gateway is expected to be mains powered while the individual nodes (sensors/actuators) are battery driven. Active RFID, Sensors combined with Wireless Mesh networking technology that can be used to detect slope moments. It sends out data via the communication components at the node. The communication among various nodes in the environment forms a small network, and the sensed data can be transferred on the optimum data transmission path in this network environment. The network system that is consisted of mobile base station can be used. The basic principle is to use the range covered with the dispersed sensor nodes in the network.

The slope monitoring instruments will be installed in a borehole in a typical mine to be drilled from surface and through RFID Tags as shown in Fig 2, and the data will be communicated to a central monitoring station/computer located in Managers room. The nodes form a network in Ad-Hoc mode, and the data link layer of each node is formed of star topology, as shown in Figure 3 phones or desktops represent the clients that communicate with the server. The medium through which the communication is accomplished is wireless local area network, e.g. the clients could be anywhere if they have connection to the Internet (Fig. 2). The base station serves as a link between the sensors and the clients. It can simultaneously communicate to both the sensor network and the clients.

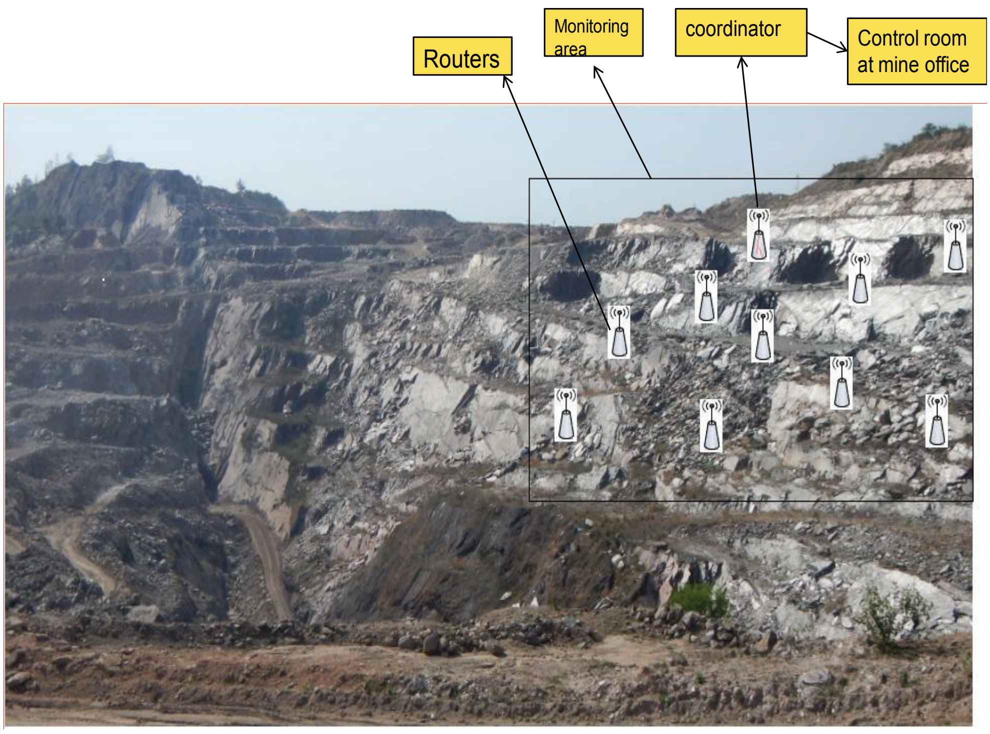

Fig 2: Location of monitoring stations in a typical opencast mine –Schematic layout along with WSN set up

Data Transmission Mode

The short distance, low power and low bandwidth wireless transmission protocol of Zigbee (IEEE 802.15.4) was used. The transmission distance of Zigbee is over 10m, and the operating frequency band is ISM frequency band of 868MHz, 915MHz and 2.45GHz respectively. The 2.45GHz is universal industrial and medical standard frequency band in the world, providing 16 channels and transmission speed of 250kbps. The Zigbee has high network extensibility, and there can be 65000 nodes in the network. In terms of Zigbee network architecture, Zigbee stack is similar to OSI network seven-layer architecture. Zigbee was used to construct a wireless sensor environment for monitoring the slope movement value. The measured data from various nodes were collected in local computer, and the data were transferred via mobile network card to the database in the remote server for storage [1].Data is stored in a database and can be analysed and processed on demand.

Power

Power requirements vary depending on the number of instruments and the communication device. Ideally, power is available at the site but that is often not the case. A small system with a phone line and one or two sensors requires only a small rechargeable gel-type battery. Sensor nodes are only equipped with limited power source (<0.5Ah, 1.2V). The battery is recharged by regulated solar panels. Node lifetime strongly dependent on battery lifetime. In some application, replenishment of power resources might be impossible. In a multichip ad hoc sensor network, each node plays the dual role of data originator and data router. The malfunctioning of a few nodes can cause significant topological changes and might require rerouting of packets and reorganization of the network. The main task of a sensor node in a sensor field is to detectevents, perform quick local data processing, and then transmit the data. Power consumption can hence be divided into three domains: sensing/actuating, communication, and data processing.

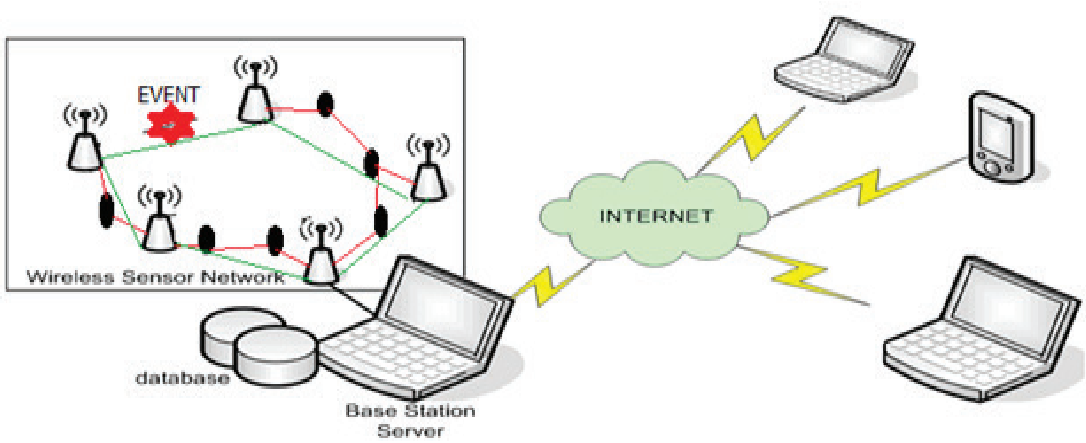

Fig.2.Overall system framework

RF MODULE

The Proposed Hardware Module is the DNT2400, WHICH includes a 2.4 GHz FHSS transceiver and a low current 32-bit microcontroller. It operates in the 2.4 GHz ISM band. The module includes nine frequency sub bands and 37 total frequency channels to support the various 2.4 GHz frequency allocations used throughout the world. This module has three selectable RF output power levels: 1, 10, and 63mW. Also, there are four selectable RF transmission rates:38.4, 115.2, 200 and 500 kb/s. It also includes a low-noise receiver preamplifier and a high efficiency transmitter amplifier, providing excellent range in outdoor applications and it provides a variety of hardware interfaces. There are two serial ports plus one SPI port. Either the primary serial port or the SPI port can be selected for data communications. The second serial port is dedicated to diagnostics. The primary and diagnostic serial ports support standard rates from 1.2 to 460.8 kb/s. The SPI port supports data rates from 6.35 to 80.64 kb/s. Also included are three 10-bit ADC inputs, two 8-bit PWM outputs, and six general-purpose digital I/O ports. Four of the digital I/O ports support an optional interrupt-from-sleep mode when configured as inputs. The radio is available in two mounting configurations. Fig.3 shows the DNT2400 RF module.

Module Firmware

Proposed module firmware can operate using either TDMA or CSMA channel access modes. TDMA supports up to 16remotes with rapid, deterministic channel latency. CSMA provides carrier-sense managed channel access for an unlimited number of low-traffic remotes. Its firm ware will operate “out of the box” using point-to-point transparent serial mode, with point-to-multipoint, peer-to-peer and tree-routing network topologies also supported.DNT2400 firmware provides the user with a rich set of configuration options including a choice of hopping patterns, hopping dwell times, RF data rates, serial or SPI data port operation, serial and SPI data rate selection, RF output power selection, plus configurable analog and digital I/O lines. Data integrity is protected by 24-bit error detection, with optional ACK and automatic transmission retries or redundant transmissions. 128-bit AES encryption provides a high level of data security for sensitive applications. Sensor networks can take advantage of timer or event-baseddata reporting and remote node sleep cycling for extended battery life [9].

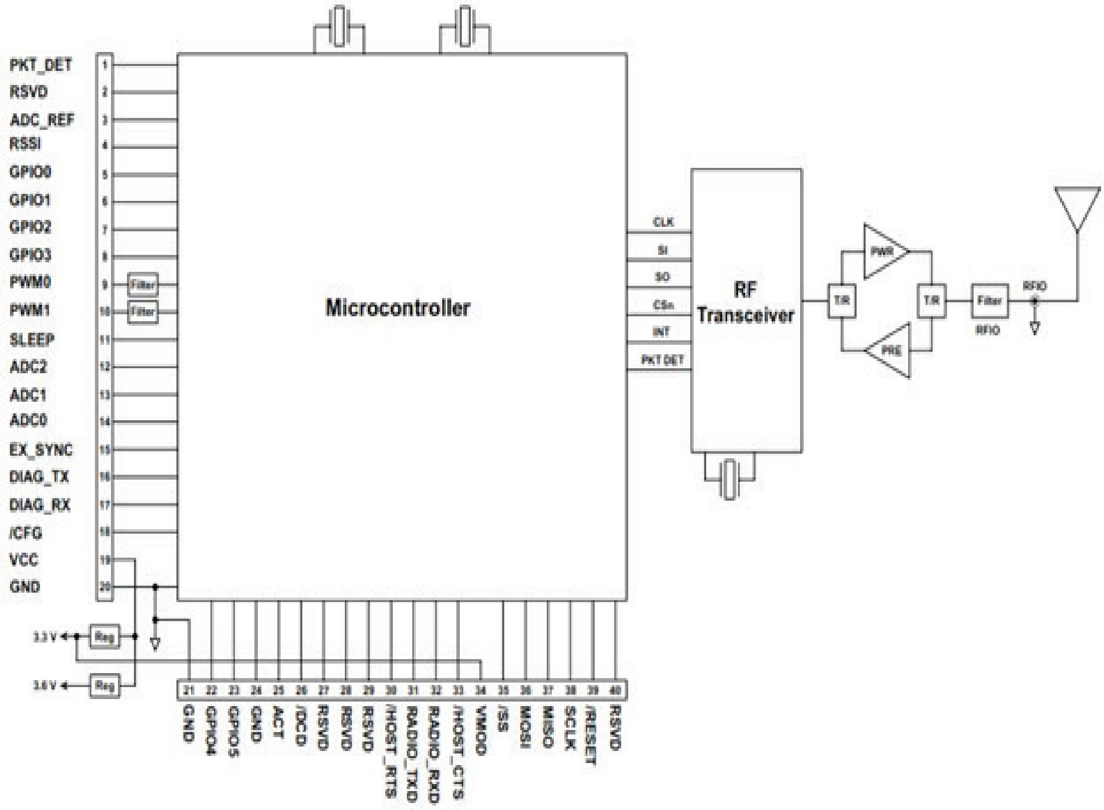

Fig.3.Proposed RF Module [9]

DATABASE AND VISUALIZATION

A visualization system has been developed to help monitor all data and analyze the landslide failure process. The recorded signals can be visualized online on a large screen located in the control room. This issue is really important, because allows the group of specialists and hazard managers in charge of the landslide monitoring to make concerted decisions. All data can be seen by any people in the control room. [5]

SENSOR NETWORK TOPOLOGY

The development and deployment of wireless sensor networks (WSN) have taken traditional network topologies in new directions [7]. Many of today's sensor applications require networking alternatives that reduce the cost and complexity while improving the overall reliability. Mesh networks allow data to "hop" from node to node; this allows the network to be self-healing. Each node is then able to communicate with each other as data is routed from node to node until it reaches the desired location. An example of a Mesh network is shown in figure 2. This type of network is one of the most complexes and can cost a significant amount of money to deploy properly

PREFERRED SOFTWARE DESIGN MODULES

At mine site office, software's are installed for analysing the received data from the RF modules. Software such as TDR100, ALERT, DEMONS etc. are most commonly used in filed application of TDR for soil slope movements, dam sites, embankments etc. Details of some of the software's are presented below:

ALERT

The ALERT software implements the methodology for deformation monitoring and analysis the system has continued to evolve, with features being added to improve accuracy, increase reliability, and address user needs as they are identified. The software allows for a remote control and pre-programming of observations and automatic determination and graphical presentation of displacements of monitored points with their variance-covariance Information. The system takes advantage of the core functionality of the Microsoft Windows NT systems (e.g., NT 4.0, Windows 2000, and Windows XP). There is full support for remote operation via LAN and Internet connections and provider-independent database access. In addition, the software's observation and processing tasks are automated according to any desired schedule and the system is able to recover from power outages with no user intervention. The result of data processing is a series of time-tagged coordinate values that are stored in the project database. Plotting utilities allow rapid visualization of displacement trends and advanced trend analysis, such as grouping observation cycles into mean values to smooth the effects of daily refraction. Because the database is in a readily accessible format, the end user can easily extract coordinate values using standard Structured Query Language (SQL) queries and build plotting and analysis tools to meet specialized needs. It can be helpful to examine the time series for a given point, to see the day-to-day repeatability of coordinate solutions and to determine if there is a systematic trend in the position differences. The storage of coordinate solutions in a relational database makes it very easy to selectively examine subsets of the data .SQL allows the user to specify virtually any criterion to choose the particular solution set desired. Several network configuration options are supported by this software [3].

DIMONS

The DIMONS (Displacement Monitoring System) software has been developed to support fully automated deformation monitoring schemes with automatic data acquisition. The software allows for a remote control and pre-programming of observations with robotic total stations and other sensors; fully automatic reduction and processing of positioning surveys; automatic identification of unstable reference stations using the Iterative Weighted Similarity Transformation; and automatic determination and graphical presentation of displacements of monitored points with their variance-covariance information. The specific capabilities and characteristics of DIMONS are: it Stores its data in a relational database, Supports operation in fully automatic, semi-automatic, or interactive measurement modes. Supports flexible, user-definable scheduling of data collection activities. Interfaces with digital temperature and pressure sensors for meteorological data storage and correction of measured distances. Is accessible remotely. Has the ability to transfer observation data between different computers. Performs an automatic restart of measurements following a power loss. [4]

CONCLUSIONS AND FUTURE WORK

The WSN systems can be widely implemented in opencast mines for reliable monitoring of stability of slopes in conjunction with audio-visual alarming systems for warning of impending slope failures in right time for taking proper control measures for stabilization of slopes, as per the requirement. There were many problems in the construction of the WSN monitoring system in the course of connecting nodes to power cord on site, short circuit, system off line, data transmission suspension and in-situ industrial computer leakage because of carelessness. The proposed research work in some of the opencast mines would provide another means of increasing the monitoring scheme's reliability. In addition, further research work is required to transfer technology used for the simulation Platform to the real environment through Ministry of Mines supported R&D projects in near future. NIT-Rourkela is in the quest of Research and development activities on proper implementation of the TDR and WSN systems in some of the Indian opencast mines.

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Smart Grid – Prepared for future

J N Karamchetti[1]

ABSTRACT:

India is one Nation, one Grid and one Frequency. All the five regional grids have been synchronized and now it is made into one National grid. Our demand for electricity is increasing and following the GDP growth of 8%, while the supply has not increased at that pace. We have plans for adding additional capacities at a cost. While improving Plant Load Factor (PLF), Reduction of transmission and distribution (ATC) losses, adding Renewable Energy (RE) and Demand management are some of the low cost strategies in meeting the demand.

The distribution segment assumes the critical importance in meeting the growing energy demand. Being sole interface between energy sector and the consumer, the constant efforts are being made by distribution utilities to plug infrastructural gap through the deployment of new technologies.

Introduction:

A key initiative, taken by Ministry of Power in this regard, is the implementation of SMART GRID pilot project at 14 locations across the country.

The main objective of undertaking these pilot projects is to evaluate the readiness of Network and to assess the Smart Grid technologies, and also to assess the benefits in implementation and acceptance the stake holders. These projects also provide an opportunity to indigenous development capability of Smart grid technologies and maintenance of the same

Definition:

1). A smart grid delivers electricity from suppliers to consumers using digital technology to save energy, reduce cost and increase reliability – says Wikipedia

2). Second definition: Smart Grid is an application of digital information technology to optimize electrical power generation, Transmission, distribution and use.

3). Third definition: A modern grid that enables bidirectional flows of energy and use of two-way communication and control capabilities that will lead to an array of new functionalities and applications.

Functions of Smart Grid:

Supply of quality power, Reduction of ATC losses, Improve Reliabilty of power, Integrate Renewable Energy with grid, reduction in meter reading costs, outage mangement, optimisation of Unscheduled Interchanges, and asset management.

At the end Cost benefit Analysis shall be done function wise to estimate the cost of (kWh) unit for a reliable and quality power.

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SMARTGRID Features:

Advanced Metering Infrastructure (AMI)

AMI allows utilities can move from merely reading meter automatically to actually managing and controlling key aspects of the grid. And with modern analytics and predictive science, a whole new world awaits when it comes to automating, predicting, monitoring and controlling the grid, enabling self-healing capabilities and creating new relationships between utilities and their customers.

Outage Management System (OMS)

Utilities receive last gasp outage notifications from smart meters. In order to quickly identifying most likely points of failures, these notifications are mapped against the distribution infrastructure.

Power Quality Management (PQM)

The important parameters like voltage, frequency, reactive power, and harmonics are monitored continuously and kept within limits as dictated by regulations.

Demand Response (DR)

Demand response is a strategy used by electric utility companies shift energy consumption from peak hours of the day, when the demand for electricity is the greatest leaner demand periods, It involves allowing customers to choose non-essential loads, which can shed by customer themselves or by the utility, at peak times. It is a prearranged agreement between the utility or intermediate agencies like aggregators with the consumer with specific conditions of load, price and time intervals. Since power plants and transmission systems are designed to respond to the highest potential demand, lowering peak demand during demand intensive times of the day helps utility reduce overall installation operating costs and mitigate potential grid failures.

Decentralised Distributed Generation and Micro Grid:

When energy is generated and distributed using small scale technologies closer to its end-users, it is termed as Decentralized Generation. These generations are based on the technologies, mainly renewable, including but not limited to, wind turbines, photovoltaic modules, and micro hydro power plants. Onsite power generation had many benefits over the centralized power generation systems, as it eliminates the costs associated with transmission and distribution of power over long distances. These small scale technologies can yield power from 1 kW to as much as 10 MW.

Smart Home Energy Management:

House hold appliances like washing machines, ACs and other appliances are remote controlled (called as intelligent appliances). These appliance can be switched ON or OFF by utility during peak hours thus differ in power-cuts.

Energy Storage:

Till about a few years ago, we thought that electricity be stored and needs to be consumed as and when it is generated. Times are changing, today electricity can be stored in megawatt scale thanks to developments made in storage technologies and solutions. These electrical energy storage (EES) applications are increasingly becoming viable around the world.

The smart grids are expected to be

achievement of 21st Century and energy storage technologies are going to be an important part of it.

The EES technologies around the world: Energy storage technologies encompass a large set of diverse technologies. They are broadly classified into mechanical, electrical, chemical electrical and thermal energy storage systems.

Electric Vehicles:

Flexibility and low initial costs mean that motorized transport based on internal-combustion engine (ICE), has come to dominate the markets for passengers and freight transportation across the globe. The recent rapid growth in the number of vehicles, together with the limited implementation of emission control technologies, have made ICEs the major source of urban pollution in the developing world.

The large-scale introduction of electric vehicles is seen as a critical part of the solution to this problem of emissions. Electric engines produce no tailpipe carbon emissions and the energy they consume is increasingly being produced from renewable energy sources. Electric engines are also more efficient than ICEs and can help decrease energy use. Both features help to reduce the emissions from energy production.

ONLINE AMI DATA ACCESS:

To manage and use this information to gain insight, utility companies must be capable of high-volume data management and advanced analytics designed to transform data into actionable insights. For example, designing effective demand response programs requires that utilities execute advanced analytics across a combination of data about customers, consumers, physical grid dynamics behavior, generation capacity, energy commodity markets and weather.

ONLINE OMS DATA ACCESS:

✓ How much excess energy will be available, when to sell and whether the grid can transmit it?

✓ When and where equipment down time and power failures are most likely to occur?

✓ Which customers are most likely to feed energy back to the grid, and under what circumstances?

✓ Which customers are most likely to respond to energy conservation and demand reduction incentives?

✓ How to manage the commitment of larger, traditional plants in a scenario where peaks from distributed generation are becoming relevant?

ATTIBUTES IMPLEMENTED:

India considers Smart grid as integrating the electrical and information communication technologies in the complete power system value chain enabling every point for generation and every point as controllable consumption (of consumers). Ministry of Power (MoP) decided to develop Smart Grid in India in stages by taking up pilot Smart Grid projects.

Need for Smart Grids:

▪ Sustainability of the electrical system requires the evolution towards new paradigms (Smart Grid), pursuing high efficiency and integration of renewable energy .

➢This is expected to cut down GHG emissions.

▪ Issues for the implementation of Smart Energy Grids:

➢ Load management, Distributed Generation, Microgrids, Energy Storage, Grid Management, Market operations, Electrical Vehicles, ...

▪ Much intelligence is needed to:

➢ retrieve, share, process, store and transmit information;

➢ make grid management automatic, reliable, resilient, safe and secure.

The role of Information and Communication Technology (ICT) in reducing GHG emissions:

The ICT sector can enable emission reductions in a number of ways:

▪ Standardizing: ICT can provide information in the form of standards on energy consumption and emissions, across the sectors;

▪ Monitoring: ICT can incorporate monitoring information into the design and control of energy use;

▪ Accounting: ICT can provide the capabilities and platforms to improve accountability of energy and carbon;

▪ Rethinking: ICT can offer innovations that capture energy efficiency opportunities across buildings/homes, transport, power, manufacturing and other infrastructures, and provide alternatives to current ways of operating, learning, living, working and travelling;

▪ Transforming: ICT can apply smart and integrated approaches to energy management of systems and processes, including benefits from both automation and behavioural change and develop alternatives to high carbon activities, across all sectors of the economy.

Smart Grid Pilots in India

The following functions have been proposed in the 14 Pilot projects		
S. No.	Functionality	Objective
1	Residential AMI	Demand Response, Reduced AT&C
2	Industrial AMI	Demand side Management, Reduced AT&C
3	Outage Management	Improving Availability and reliability, Proactive Maintenance
4	Peak Load Management	Optimal Resource utilization, Distribution capacity enhancement, load curtailment
5	Power Quality Management	Voltage control, Reduced losses and failures, Decreased in reactive power and harmonics
6	Micro grid	Improved power access in rural areas, Renewable Integration, Reduced carbon emissions
7	Distributed Generation	Improved Power Access in rural areas, sustained growth, New technology implementation

Smart grids in Indian economy:

- Smart Grids have the potential to fill the gap

➢ sustainable and low-cost production of electricity through large integration of renewables;

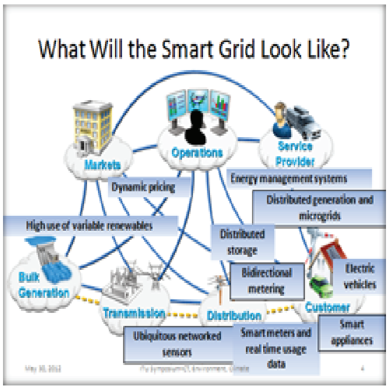
➢ microgrids and islanding mode of operation for rural areas;

➢ improvement of efficiency by grid monitoring;

➢ reliable and cheaper supply of electricity by demand-response mechanisms;

➢ new business models to address specific needs of low-income customers and reduce administrative costs related to meter readings and billing.

Benefits of the Smart Grid:	
Benefits to Utility	**Benefits to Consumer**
Reduction in AT&C Losses Increased Grid stability Peak load management Renewable integration Self-healing grid Reduced Capital & operational cost Increased employee safety Increased revenue Higher customer satisfaction Opportunities to leverage its resources and enter new markets Increased asset utilization	Prosumer (Producer & Consumer) enablement Improved quality of power supply User friendly & transparent interface with utilities Reduction in electricity bills by shifting loads from peak hours to non-peak hours Opportunity to interact with the electricity markets through home area network and smart meter connectivity Opportunity to purchase energy from clean resources, further creating a demand for the shift from a carbon-based to a "green economy"



Conclusion:

The current gaps in distribution infrastructure can be assessed by these pilot projects and showcasing the cost Benefits by implementing Smart Grid technology. India is known for development of Information Technolgy all over the world and now it will be showcased in India itself and fullfilling the dream of Make in India.

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Discrete Wavelet Transform Based Differential Protection for Power Transformers

Narri Yadaiah[1] & Nagireddy Ravi[2]

Abstract

This paper proposes wavelet transform based differential protection scheme for three phase power transformer. The potential of using discrete wavelet transform has been proved for characterization of transients in power transformers. The characterization of different transients will aid in the development of a novel differential protection scheme for power transformers. The simulation results illustrate distinguishing of normal and abnormal conditions such as magnetizing inrush current, internal fault and external fault.

Key words: Power transformers, Differential protection, Discrete Wavelets transforms, Fault Detection

1. Introduction

Transformer is most important element of power system. The proper functioning of power transformer is crucial to maintain uninterrupted power supply to the consumers. Hence proper detection and diagnosis of fault helps in isolation of the defective transformer thereby avoiding unnecessary outages and instability of the power system and ensures good power quality. To accomplish these objectives an efficient fault detection method will help the electric utilities to enhance the availblity of generation, transmission and distribution. Traditionally, differential protection is in use for the protection for power transformers. A complete differential protection scheme was used to discriminate internal faults from other transients such as magnnetising inrush current and sudden change in loads etc. [1].

To enhance the differential protection method a methods based on artificial neural networks has been proposed [2]. In the paper [3] and [4] fuzzy logic algorithm is applied and the test results shown significant gains in both sensitivity and selectivity for the differential protection relay compared with traditional approaches.

Wavelet Transform (WT) is introduced in place of Fourier analysis and received considerable interest in fields such as acoustics, voice communications and seismic etc. In past several decades several algorithms have been implemented for fault detection in power system equipment using wavelet transforms (WT) and the wavelet transform technique is very useful and efficient in fault detection of power system components [5]. The WT technique has been reported for fault detection in transformers [6] - [8].

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This paper proposed a new wavelet based differential protection for power transformers. Wavelet transforms has been proposed to identify the magnetizing inrush currents and to distinugusih other type of faults such as internal and external short circuit faults. The characteristics of wavelet transform are fast in response, ability to represent both time and scale simultaneously and its applications found in fault identification, image processing, denoising, multi resolution analysis, data compression etc.. Its characteristics are suitable for characterization of current and voltage signals and hence its analysis will aid an automatic detection of faults in the transformers and can be extended to other systems related to power systems.

2.0. Wavelet transforms

Wavelet transform is a mathematical tool for signal analysis. It is the representation of a signal in terms of finite length or fast decaying oscillating waveform known as wavelet prototype function and is known as an analyzing wavelet or mother wavelet. Applying scaling and translation to the mother wavelet, a family of wavelet functions are created with same shape as the mother wavelet, but of different sizes and location [9]. In this paper a discrete wavelet transforms is proposed to use for fault detection and is defined as follows:

$$DWT(f,m,n)=\frac{1}{\sqrt{a_0^m}}\sum_{k=-\infty}^{\infty} f(k)\overline{\Psi}[\left(k-na_0^m b_0\right)/a_0^m]$$

where a0 and b0 are fixed constants with a0 > 1, b0 > 1 and m, n are positive integer variables. The values of a0 and b0 are selected such that mother wavelets form an orthonormal basis. The orthonormal basis satisfies if a0 = 2 and b0 =1. This choice leads to Multi-resolution signal decomposition technique [10].

The implementation of the DWT with a filte bank is effective for analyzing the information of the signals. The DWT is computed by analyzing the signal at different frequency band with different resolutions by decomposing the signal into coarse approximation and detail information, using this technique any wavelet such as Haar, Daubechies, Symlets Coiflets and Bior 4.4 etc can be implemented.

3.0 Choice of Wavelet

The selection of mother wavelet is an important role as it enhances the performance of fault detection scheme. The choice of the wavelet also depends on the nature and kind of the signal which has to be detected and to extract the useful information rapidly. This process leads to an accurate fault classification thereby protecting the transformer from faults. In order to select the most capable mother wavelet, different mother wavelets such as Haar, Daubechies, Symlets, Coiflets and Bior 4.4 wavelet have been considered and compared. Bior 4.4 is simply chosen since it gives a more accurate in detecting low amplitude, short duration, fast decaying transients and minimum error during the magnetizing inrush condition.

The DWT technique has been proposed for differential protection of power transformers. The wavelet decomposition technique analyzes the transient signal which characterizes the condition of the component. The primary current and secondary currents of power transformer are measured through cureent transformers (CTs) and are used for signal analysis such as normal operation, magnetizing inrush and short circuit faults. Wavelet technique, a time-scale domain approach is applied to detect the magnetizing inrush and short circuit faults by comparing with normal operation of power transformer. The signal obtained from the CTs of power transformer is passed through a low pass and a high pass filters to obtain approximate coefficients and detail coefficients respectively.

The structure of the proposed DWT based differential protection scheme used for detecting faults and classifying different transients is shown in Figure 1. The fault detection is summarized as below step by step

Step 1: Obtain the primary current and secondary current signals from the terminals of current transformers (CTs).

Step 2: Apply DWT for the signals obtained in step 1 for analysis

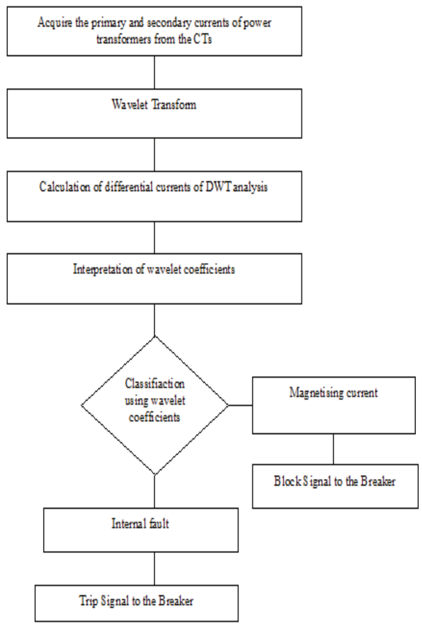

Figure 2 Structure of Proposed Differential Protection Scheme

Step 3: Analyze the detail coefficients of DWT with respect to time by plotting sample – coefficient Graph.

Step 4: Identify the fault through interpretation of wavelet coefficients.

Step 5: Distinguish between an magnetizing current, internal short circuit current, external short circuit current and normal operation current.

5.0 Simulation, Results and Discussions

A power system network with a three phase transformer and a load, as shown in Figure 2 is simulated using MATLAB software. Table 1 presents the parameters associated with the power transformer.

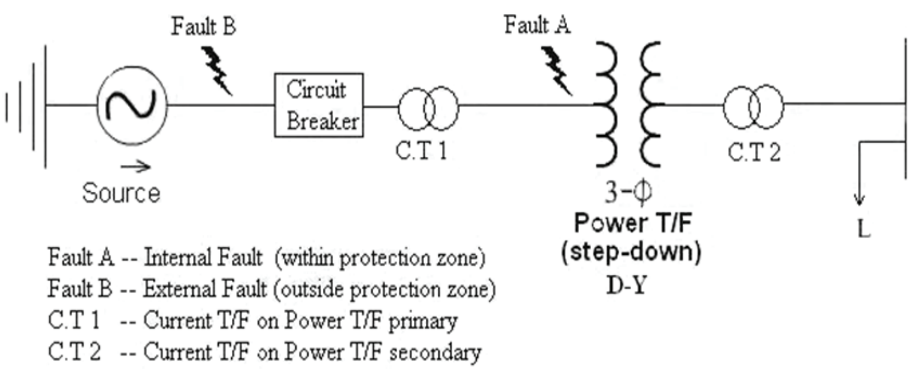

Figure 2 Single line diagram for the simulation model

The power transformer is simulated for various types of transients. The primary and secondary currents are measured and the discrete wavelet analysis is performed on signal. The simulation is carried out for 0.2 sec and the data is captured for 10-cycles.

Table 1 Transformer Parameters

S.No.	Parameter	Rated Value
1	Rated Power	250MVA
2	Primary Voltage	735KV
3	Secondary Voltage	315KV
4	Rated Frequency	50Hz
5	Magnetization Resistance (R_m)	500pu
6	Magnetization Reactance (L_m)	500pu

5.1 Normal Operation

The output currents from both primary and secondary side CT's are analyzed for comparison with other conditions like internal and external faults in the system. During normal operation there is no malfunctioning of the transformer and hence the wavelet decomposed output signal is a straight line. The current signal obtained from the CTs of power transformer and DWT analysis for normal operating condtion are as shown in Fig 3 (a) to 3 (e).

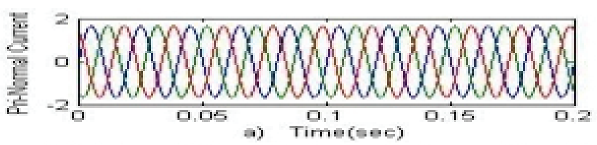

Figure 3 (a) Normal Current entering at primary side

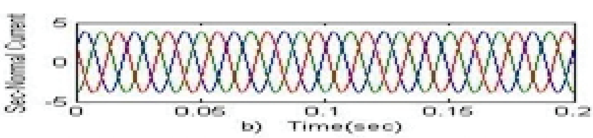

Figure 3 (b) Normal Current leaving the secondary side

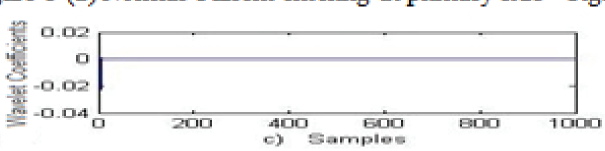

Figure 3 (c) DWT of normal curmet at primary side

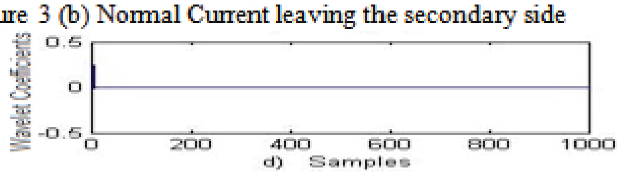

Figure 3 (d) DWT of normal current at secondary side

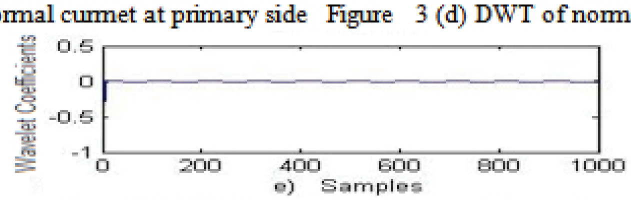

Figure 3 (e) DWT of differential normal current

5.2 Magnetizing Inrush

When a power transformer is energized it generates inrush current, the magnitude of this currenr wil be 1-2 % of rated current. This type of transient may cause innecessary tripping of transformer. In time domain it can be observed spikes during the entire in rush transient period whereas in DWT localization acne be observed in 600th sample which corresponds to 0.12 sec, which is the time of enerziation of power transformer. The current signal obtained from the CTs of power transformer and DWT analysis for magnetizing inrush condtion are as shown in Fig 4 (a) to 4 (e)

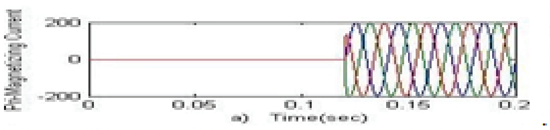

Figure 4 (a) Inrush Current entering at primary side

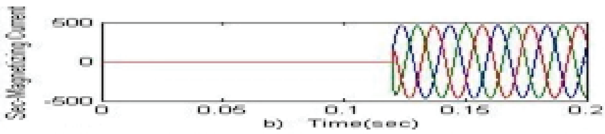

Figure 4 (b) Inrush Current leaving the secondary side

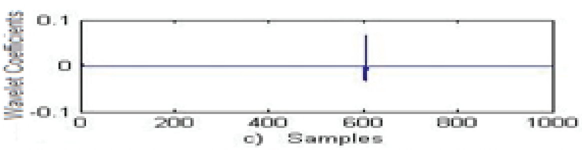

Figure 4 (c) DWT of Inrush current at primary side

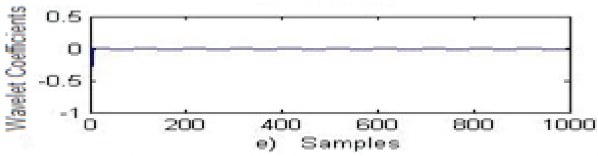

Figure 4 (d) DWT of Inrush current at secondary side

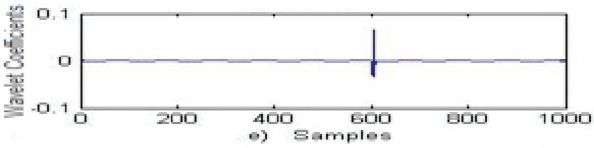

Figure 4 (e) DWT of Differential inrush currents

5.3 Internal fault

Short circuits in transformers results in currents of high magnitude. The detection of short circuit fault is essential and requires fast action by protective relay to de-energize transformer, otherwise this leads to extreme mechanical stress of core and coil assembly.

The simulation was carried out for 0.2 sec. The short circuit fault is set to occur at instants 0.12 sec and cleared at 0.14 sec that is the total fault time is 0.12 sec. The peak primary current is measured for an internal short circuit fault is 1000 A. The spikes can be observed at the short circuit time and there is a differential current and DWT coefficients are high compared to othet transients which enables the realy to operate. The current signal obtained from the CTs of power transformer and DWT analysis for internal fault are as shown in Fig 5 (a) to 5 (e).

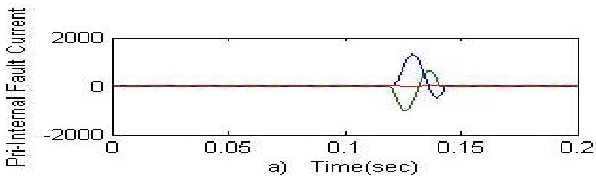

Figure 5 (a) Intternal fault current entering at primary side

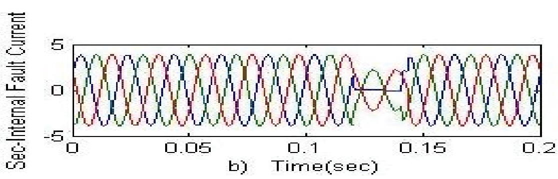

Figure 5 (b) Internal fault current leaving the secondary side.

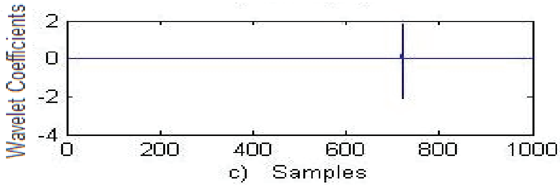

Figure 5 (c) DWT of Internal fault current at Primary side

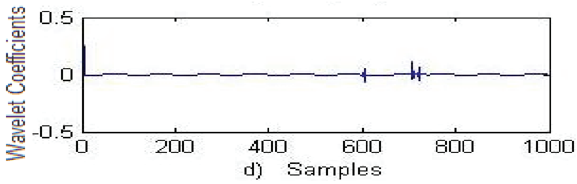

Figure 5 (d) DWT of Internal fault current at secondary side

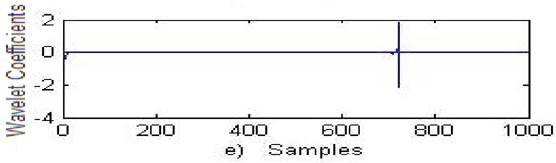

Figure 5 (e) DWT of differential internal fault current.

5 4 External Fault

External faults are system faults that occur outside the transformer differential protection zone. The external fault event is also appears to be localized and DWT coefficients are higher at fault time The fault existence timing is 0.12 sec to 0.14 sec. The fault selected for analysis is LL-G fault. The current signal obtained from the CTs of power transformer and DWT analysis for external fault are as shown in Fig 6 (a) to 6 (e).

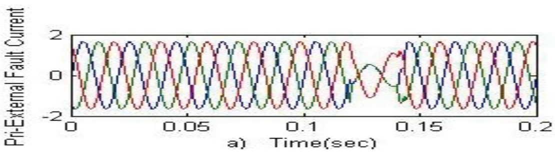

Figure 6 (a) Entternal fault current entering at primary side

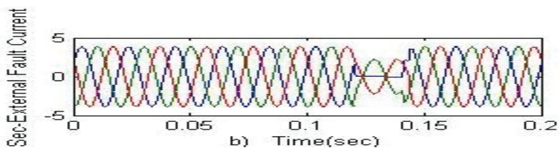

Figure 6 (b) Enternal fault current leaving the secondary side.

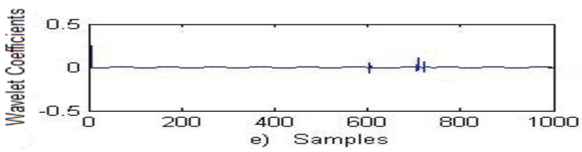

Figure 6 (c) DWT of externall fault current at Primary side

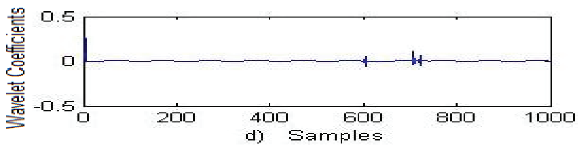

Figure 6 (d) DWT of external fault current at secondary side

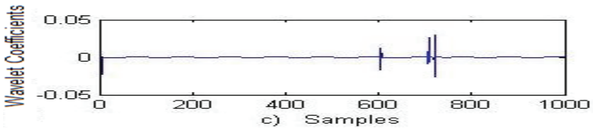

Figure 6 (e) DWT of differential external fault current

6.0 Conclusions

The Wavelet decomposition breaks up signal into both time and frequency, allowing for a complete and efficient description of signal. This information is very important in detecting the fault. It is observed from the coefficients that fault is seen to be localized. The wavelet transform is applied to normal operation, magnetizing inrush currents, internal fault condition and external fault condition. It is also concluded from the obtained results that this technique is better in characterization and discrimination of faults. Application of wavelet transforms for differential protection scheme of transformer protection overcomes the drawbacks arising in conventional differential protection method as fault localization and characterization is very precise.

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THE ROLE OF INFORMATION TECHNOLOGY IN APPAREL INDUSTRY

Jyothirmai S[1] & Sasmita Panda[2]

ABSTRACT:

Today information technology plays an important role in the field of Apparel industry. Any industry employs five "M"s Men, Material, Machine, Market and of course Money. Success of the industry depends on the effective utilization all the five "M". The position of Information technology plays a key role in managing five "M" in an effective way.

Use of Information Technology can create greater difference in organizational growth which starts from employees clocking in to supply chain management, design, production, packing, distribution e -commerce e –retailing etc.

The article gives the brief picture of managing five "M"s effectively by placing the Information Technology in right manner and new trends of online retailing.

KEY WORDS:

IT : Information technology

ERP : Enterprise Resource Planning

MIS : Management information System

PDM: Product development & management

PLM : Product lifecycle management

GPS : Global Positioning System

CRM: Customer relationship management

INTRODUCTION:

Globalization of industries is a defining trend of our time. The textile and apparel industry, in particular, is one of the most globalized industries in today's world. To maintain its prosperity and to deploy new computing and communication technology is important.

Information technology (IT) is the resource to electronically input process, store, review, output, transmit, receive data and information. Today information technology became an important part in the Apparel Industry as the industries goal is to make information processing, order processing, product distribution, E-commerce and e – retailing more efficiently. Use of IT starts from resourcing the raw material, processing till the presentation of balance sheet. There are various IT tools which ensure the process of five "M" s is adapted in an effective manner. Managers can synchronize and synergize information with in and out of the organization using the IT.

IT is not only important tool but essential for the doing the business. Where we need real time data/ information we can't imagine anything without IT application. To name some uses of IT in Apparel industry are Designing software, ERP, Mailing, Voice chatting, Semi-automatic and fully automatic sewing machines and other machineries etc.

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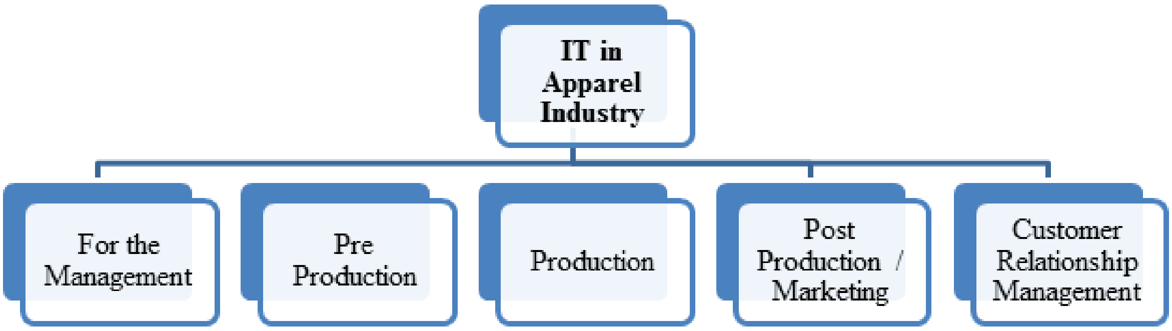
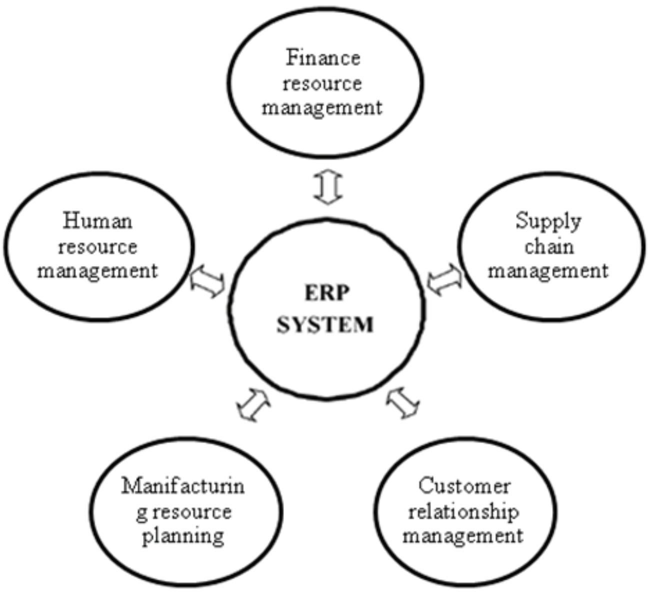


1.1 Uses of IT in Apparel Industry

2. IT FOR MANAGEMENT:

It plays vital role in effective flow of information through different departments. All this can be achieved by using Enterprise Resource Planning (ERP).The objective of the ERP solutions in an organization is to drive the flow of information between all internal business functions while managing connections, or "touchpoints", to outside stakeholders. The ERP system integrates both internal and external information flows used by the organization within a single, comprehensive solution. An ERP solution incorporates the practical systems used by organizations to manage the basic commercial functions of their business, such as planning, inventory/materials management, purchasing, manufacturing, finance, accounting, human resources, marketing and sales, services etc. ERP can greatly improve the quality and efficiency of a business. By keeping a company's internal business process running smoothly, ERP can lead to better outputs that benefit the company such as customer service, and manufacturing ERP provides support to upper level management to provide them with critical decision making information. This decision support allows the upper level management to make managerial choices that enhance the business down the road.



2.1 ERP System

Employee management like attendance, managing shifts, over time, payroll etc can be done with ease by using IT .Generation of MIS reports purely depends on IT. Flow of information assigning and reviewing the work etc became fast, easy and cost effective by using email, voice call like skype, goto meeting etc.

In industry, product lifecycle management (PLM) is the important process which helps in managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal. PLM integrates people, data, processes and business systems and provides a product information backbone for companies and their extended enterprise.

Organizations become successful not only when they earn profits but also when the extra expenses are better checked. Controlling the expenses or in other words using the funds in right manner in right place by minimizing the unnecessary expenses directly related to the profits of the organizations this can best achieved by using costing software.

3. IT FOR PRE PRODUCTION:

Software with multiple features will be used to design a garment. Product development & management tool (PDM) of IT is important to decide on type of the product need to be developed. Computer aided design (CAD), Lectra are pattern making softwares to make patterns with minimum mistakes or making the patterns with no mistakes. Textile design software is to design the product.

One of the most stimulating advancement is 3D technology is quickly gaining popularity. 3D body scanning will measure the circumferences and view cross sections in different areas hence accurate measurements can be taken for custom made clothing. Trained designers can now make or change patterns in no time. The 3D body scanner is the biggest boon to the textile industry. It can create a virtual figure matching a real person.

3D digital printing. It gives the designers numerous options to work and endless chances for modifications. The usefulness of 3D technology is not limited to a few sectors. From textile designers to garment manufacturers and pattern creators, all are to gain.

4. IT FOR PRODUCTION:

Along with designing IT also has a major role to play in manufacturing or production .Computer aided manufacturing (CAM) is important for plotting. Embroidery software, 5D embroidery machines are the new invention to create a design automatically from a picture, then adjust it with beautiful special effects such as multi-color gradient fill, to Draw or load raster or vector images and convert them to embroidery automatically, and amazing fill types include Crosshatch, Contour, Radial, Spiral, Shape and Quilt Stipple. We Can also Embellish designs with our own machine stitch motifs or design our own motifs using 5D embroidery machines.

Software used by automated printing like Tuka Studio will give Separate and clean colors quickly, easily, and accurately. Convert existing images into repeats, jacquards, and color ways, or build our own from scratch. Knitting machines, like Shima seiki will help to get final product as per the predefined pattern and design with almost no errors. Computerized cutting machines and use of semi automatic and fully automatic sewing machines in the production house will help to decrease the wastage of raw material and to increase the production.

5. IT FOR POST PRODUCTION / MARKETING:

The apparel industry is a buyer-driven commodity chain led by a coalition of retailers, contractors, subcontractors, merchandisers, buyers, and suppliers. Each participating entity plays a role in a network of supply chains which span from fibers, to yarn, to fabrics, to apparel, to trading and marketing. Geographically, they span multi-continents and cut across regional and national boundaries. With the shrinking profit margin and advent of modern computing communication networks, it is imperative that textile and apparel industry seriously consider establishing a cost effective IT infrastructure to maintain their supply chain on world - wide basis and also to maintain their competitive edge. And the competition made all the industries use the IT efficiently.

Mail order software is a tool which acts as an intermediary between the buyer and seller, calculates tax, shipping discount inventory lookup. This software will be linked with credit cards software for payment and parcel services for delivery

Fashion GPS will allow to track down the fashion shows through e-mail invites and digital seating confirmations. This Fashion GPS also used as a tracking process to make showroom appointments to extend the business.

Placing the fabrics in a retail show room is traditional way of marketing the appeal. The new trend of e retailing, e commerce or digital marketing is nothing but of selling goods directly to the customers. Some designer goods, the goods which have less inventory, or to sell the new trends, online marketing is the best method.

6. E-COMMERCE

E-commerce can be B2B (Business To Business) and B2C (Business To Customer). B2C commerce is the direct selling to consumers through Internet. While B2B marketplace can be defined as neutral Internet-based intermediaries that focus on specific business processes, host electronic marketplaces, and use various market-making mechanisms to mediate transactions among businesses. B2B appears to be more prospective than B2C.

7. E-RETAILING

With more than 100 million internet users, India has registered a phenomenal 100 percent annual growth in online shopping, reveals the Associated Chambers of Commerce and Industry of India (ASSOCHAM) latest survey.

The study by Google India says that online shopping in India saw 128% growth in the period between 2011-12, compared to only 40% growth the previous year. Apparels and accessories (30%) emerged as the second biggest product category after consumer electronics (34%)

Festive season, there is a 65 percent more traffic on online retail websites and shopping on ground has taken a back seat. Apart from convenience, rising fuel price, security reasons, online discounts and availability with abundance of choice keeping them indoors.
Keeping the tremendous of online retailing in mind, the textile-retail giants are adding an Internet shopping-component to their offering. It has affected their distribution and warehousing infrastructure. As a result of going online, retailers have changed their supply chain strategy. High volume products with stable demand are stocked in local stores, while low-volume products are stocked centrally for online purchasing.
Companies prefer a direct route to consumers by closely scrutinizing individual customer's tastes, preferences, habits, and buying patterns. Instead of waiting for consumers to visit their stores, retailers simply send them e-mails with offers. Internet has facilitated quick response system. With the use of web-enabled technology it is possible to have automatic customer replenishment system.

7.1 New trends of E-retailing:

The present generation is a Tech – savvy generaton as people gain access to new technologies such as Smart phones, tablets etc., this tech-savvy generation that is heavily dependent on online retailing. Hence as a seller it is important to stay on top of the latest social media trends in order to promote the brand. Many fashion labels are turning to Facebook, Twitter, etc. and also sending emails with new products and offers to have special promotion and online only discounts. This can drive traffic to the website and has been proven to be enormously successful.
The fit of a garment online is one of the biggest challenge and that is where virtual fitting rooms made E retailing to move ahead by interfusing the new technology virtual trial rooms . It is an attempt to bring online shopping a step closer to consumers and it's a route to add customers and credibility alike.
Virtual trial rooms offer mannequins in their virtual trial rooms. This lets people choose a mannequin that best suits their color and size. Also, there are stores that give one an online tailor. It means just as a tailor would take different measurements of one's body, one needs to provide this information and a matching figure will come up on which they can try out the dresses. Whereas some retailers use live video to synchronize how the customer would look in 3D, others just overlap the product image on the customer with lesser details. All this is with the new technologies such as bio-metrics, neuroscience and facial recognition.

8. CUSTOMER RELATIONSHIP MANAGEMENT:

Identifying and knowing the customer and the customer satisfaction are very important to make an organization to do successful business. The IT is important to maintain the customer and prospective customer data and also to analyze and understand the customer satisfaction. Customer relationship management (CRM) it is integrated component of ERP system. CRM is a model for managing a company's interactions with current and future customers. It involves using technology to organize, automate, and synchronize sales, marketing, & customer service. The CRM will be helping an enterprise to enable its marketing departments to identify and target their best customers, manage marketing campaigns and generate quality leads for the sales team. CRM also helps in providing employees with the information and processes necessary to know their customers, understand and identify customer needs and effectively build relationships between the company, its customer base, and distribution partners.

9. CONCLUSION:

The use of Information Technology in maximum possible ways can enhance the performance of the companies as the managers use the Men at work efficiently by assigning the work on time, use the Material and technology which will help them to save time and resources. Usage of high end machines for the better production performance was possible due to the use of IT. IT is incredibly important to formulate the perfect marketing strategy and effective e-retailing, which makes the managers to use the Money in an efficient way. Hence, the success of the Apparel Industry depends on the effective utilization of all the five "M" i.e.; Men, Material, Machine, Market, and Money.

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TECHNOLOGICAL INNOVATIONS IN COAL MINING INDUSTRY

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ABSTRACT

This paper presents latest technological innovations applicable in mining industries with emphasis on mechanisation in coal mining industry. Latest Exploration and Survey techniques utilising GIS, light weight laser scanning systems etc including RADAR applications, are discussed. Automation in underground mining machinery and innovations in heavy earth moving machinery for large scale open cast mining are also presented with impetus on wide utilisation of the latest Information and Communication Technology (ICT) for mining and attempts required for MAKE IN INDIA CONCEPT a reality.

The recent Information and Communication systems (ICT) along with WSN systems for all aspects of mining industry can be widely implemented in opencast and underground mines for reliable monitoring of stability of workings and location of men and machnary in conjunction with audio-visual alarming systems for warning of impending ground failures in right time for taking proper control measures as per the requirement. coal mining sector will need heavy mechanization; giant size shovel dumpers, draglines, in pit crushers surface miners and High wall miners for different situations and along with ancillary equipments like spreaders, reclaimers etc .

There is need for the mining industry to come out of the cell, invite engineers and technologists of different allied streams for the joint effort to cope up to the demand. But before that, the mining engineers have to have clear perception, dedication and commitment to customize the options and inculcate confidence in the manufacturing units to come forward for the investment and resources to make in India mission a success. For the underground mining, modern high capacity power support, panzer conveyor and shearer suitable for high to moderately thick and thin seam will be required in large number in days to come. The Industry on date is depending upon the foreign sources for most these machines/ equipments while the nation has capability to develop them at own. Underground coal gasification should be widely practiced with due regard to identification of proper blocks unsuitable for mining but most suitable for UCG.

1.0 INTRODUCTION

The mining industry is confronted with a number of well-known systematic challenges, including limited availability of qualified labour (both local and export), remote and difficult work environments and the unending need to improve yields and reduce costs to meet competitive challenges in an industry

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where there is limited pricing differentiation. Mining companies has to understand their perspective on future industrial trends and their expectations for autonomous equipment. Three areas in which autonomy could provide the most value inputs are in improving overall mine performance, increasing safety and reducing the aggregate labour requirements.

The mining industry typically operates in a cyclic fashion with periods of strong growth followed by inevitable downturns. The industry is currently under heavy stress and in throe of downturn. in the throes of a downturn. In India, coal is the most important energy resource as also the main contributor to the basket of commercial energy of the country. India is the third largest coal producer in the world after China and USA. The biggest reserves of coal are in the USA, Russia, China and India. The details of state –wise representation of 301.56 Billion tones of geological resources of Indian coal are presented in Table 1 [1].

Table 1:State-wise Geological Resources of Coal in India as on 1.4.2014 (in Million Tonnes)

State	Proven	Indicated	Inferred	Total
West Bengal	13403	13022	4893	31318
Jharkhand	41377	32780	6559	80716
Bihar	0	0	160	160
Madhya Pradesh	10411	12382	2879	25673
Chhattisgarh	16052	33253	3228	52533
Uttar Pradesh	884	178	0	1062
Maharashtra	5667	3186	2110	10964
Odisha	27791	37873	9408	75073
Andhra Pradesh	9729	9670	3068	22468
Assam	465	47	3	515
Sikkim	0	58	43	101
Arunachal Pradesh	31	40	19	90
Meghalaya	89	17	471	576
Nagaland	9	0	307	315
Total	125909	142506	33149	301564

Associated with production of coal, mining industry also is a part of indirectly producing about 20 % of Coal as by-product of Thermal Power stations (about 0.67 Kg of coal for generating one unit –KWh of electric power). However, its utilization is nearly 50% of the production (2009-10), which is very less in comparison to the major fly ash producing countries like China, U.S.A. and Germany. Future generation of about 1000 MT of fly ash need to be properly utilised as a resource rather than waste material under the guidance of Centre for Fly Ash and research management –CFARM –Scheme of Government of India [2] (Table 2). Fig 1 shows backfilling with Fly ash in a typical opencast mine where scientific investigations were done for the first time in India on filed experimental trial of admixture of 25% of the fly ash with Overburden material.

Table 2: Generation and Utilisation of Fly Ash in India

Year	FA Generation (Million Tonne)	FA Utilization (Million Tonne)
1994	40	1
2008	160	80
2011-2012	220	110
2031-2032	1000	--

Timely application of INNOVATIVE PRACTICES in various aspects of mining; EXPLORATION, SURVEYING, OPENCAST AND UNDERGROUND TECHNOLOGIES are urgently required to improve productivity, getting more out of existing people, equipment and infrastructure. As owner-operators continue to slash Crores of Rupees of spending, shed jobs, divest underperforming mines, cut back on capital projects, and attempt to reign in wages, many have begun to focus on long-term optimisation of operating costs and capital allocation as sustainable measures for mining industry with the recent set back of DE-ALLOCATION OF COAL BLOCKS.

2.0 EXPLORATION TECHNOLOGY

Recent innovations include GEOSCIENTIFIC DATABASE FOR MINERAL PROGNOSTICATION IN INDIA. The Geological Survey of India has built up a national geoscience database in the form of 1:50,000/1:63,360 scale geological maps covering the entire country, using ground survey, aerial photographs and satellite imageries. In addition to the existing facility of aero geophysical survey by fixed wing aircraft for a faster coverage, procuring new set of equipment's and helicopter will strengthen the continuing program of multi-sensor aerial survey.[3] As more and more exploration data is collected, digitized, and stored, explorers are establishing a stronger focus on understanding the information for making it more easily accessible and preserving AS DIGITAL DATA BASE it for future exploration.

Deep and large opencast coal mines of 400 m to 450 m depth are considered important to increase the coal production of India. Planning and managing such large open pits depends upon a thorough understanding of geological and geotechnical aspects of the rock strata comprising the overburden column. The experiences of Singareni Collieries Company Limited (SCCL) located in Telangana, India document borehole geophysical logging as an effective means to generate a continuous description of geological and geotechnical strata features from the surface to total drilled depth. Conventional geophysical logs are used to identify the basic lithologies and construct geological maps of overburden strata. The uniaxial compressive strength (UCS) of sandstones is empirically estimated by correlating P wave velocities (Vp) obtained from sonic logs with the laboratory determined UCS value. Acoustic images help determine the location and trend of fractures and minimum horizontal stress directions.

Together, these data provide the basis for characterisation of the rock mass and form the foundation for the effective design of stable pit walls in deep sedimentary strata [4]. A typical iron-ore mining, transport, and shipping activities are already generating 2.4 terabytes of data per minute [5]. The terminology that has gained mindshare is 'big data'. Big data is the raw material that can be 'mined' for insights, and to which algorithms and expert systems can be applied to produce predictive analytics. In an attempt to drive productivity enhancements, the mining industry's attention has turned towards INNOVATION. INNOVATION is quickly turning tip-of-the-spear technologies into disruptive new capabilities that present opportunities for strong differentiation and massive leaps in efficiency.

INNOVATION comes in many forms. One such innovation embraced by industry is the adoption of digital data, including data-enabled equipment, operating/safety/ environmental sensors, and the growing acceptance of the use of laser scanning or point-cloud data. Digital data will increasingly be used to support real-time tracking, surveillance, traffic management, environmental monitoring, various automated routines (e.g. driverless trucks), improved maintenance and asset management, and production monitoring and reporting.

As data from these various sources becomes readily available to the broader enterprise, the mining industry needs to better leverage this digital data to target specific productivity challenges. This ability to successfully leverage digital data across an enterprise is often described as "information mobility."Information mobility is a key to unlocking value across the entire lifecycle and without it, data languishes in 'islands' where it becomes stale and obsolete. As the mining industry transitions into this era of digital data and information mobility, there is growing recognition of the scale of digital data being created and the need to better manage, maintain, and disseminate this information across the entire enterprise to ensure the right information reaches the right people at the right time

2. MINE SURVEYING TECHNOLOGY

A mining operation needs to design and develop the necessary infrastructure prior to its operation. However, unlike many other infrastructure projects, once a mine site becomes operational the process of design, develop, and extract becomes an integrated and continuous loop, with this cycle remaining for the life of mine (LOM) which is often measured in years, if not decades. This continual cycle becomes the focal point of a mine's operation, with particular emphasis directed towards the results achieved throughout the extract phase.

In order to test the execution, effectiveness, and accuracy of mine planning methods it is necessary to measure production against this plan. This tests both the accuracy of the geological and evaluation models on which the targets are based and the efficiency of the ore and metal recovery departments. Key to this is the accurate positioning of the excavations mined and the geological and evaluation features encountered. Unless this is achieved, it is impossible to gauge the progress made with any accuracy. Additionally, there can be no improvement in the base data used for evaluating the next planning cycle.

Timing is a fundamental part of the control issues on a mine. Operations are in effect, continuous, so snapshots have to be taken to measure planned production against actual outputs. Monitoring the actual extraction volumes versus production target rates has traditionally been measured by surveyors at month's end. However, there is a growing desire by industry to measure the volume of extracted material at much shorter intervals, allowing management to better monitor and define the progress of the mine's production rate. The ability to accurately monitor this phase is therefore seen as mission critical; and therefore the role of mine surveying is central to the success of this cyclic phase. A mine's operation is typically governed by a significant number of stringent and rigorous regulatory requirements. These vary from region to region with many requirements directly impacting a raft of mine surveying practices, processes, and workflows.

In many instances, it is imperative that the mining operation maintains and manages its survey data, including legacy data, in a secure environment throughout the list of mine. Traditionally this information has been maintained in hard-copy formats; however, as the industry transitions to digital, mechanisms and solutions which manage and maintain this mixed information environment will need to be established. Solutions and systems offering opportunities of secure data management capabilities, including an ability to store all survey data (i.e. raw observations/measurements, calculated information), survey control, survey notes, survey reports, plans of surveys, mine accurate plans, and more will be required.

Due to the INNOVATIONS IN survey technologies, traditional and historical surveying workflows are continuously being challenged. However, unlike other surveying disciplines, some aspects of mine surveying deal with unique circumstances. This is especially evident for underground operations, where surveying methods and techniques need to overcome the challenges of this environment. For this reason, traditional and historical survey workflows (i.e. tape and offset surveys) are still evident within industry today, however, there is an industry desire and need to promote innovative techniques to survey the underground environment. Over the past 50 years, the survey industry has undergone massive changes due to technology advancements, including the introduction of electronic distance meters (EDMs), total stations, global navigation satellite systems (GNSS), and robotic total stations [6]. Today, point-cloud creation technologies are challenging those traditional mine surveying workflows, with surveyors now looking at solutions capable of quickly

producing accurate point-cloud data of the mine's in-progress state. Technologies such as unmanned aerial vehicles (UAV) combined with photogrammetric processes are now used to create point-cloud data quickly, effectively, and safely. In many regions, laser scanning workflows
have been slow to make an impression within the mining industry. However, the past few years have seen a very different trend with terrestrial laser scanning (TLS), airborne laser scanning (ALS), and mobile laser scanning (MLS) systems becoming ever present within the industry. The increase use of this technology can be traced back to a combination of factors, including reduced size and costs of units, coupled with better performing and durable hardware suitable for the mining environment. In addition, software vendors are now catching up with the hardware, providing innovative solutions capable of efficiently working with, managing, and maintaining voluminous amounts of point-cloud data. Today laser scanners are used on a broad range of survey related workflows, including end-of-month reconciliation surveys, overburden and/or stockpile volume surveys, mine subsidence surveys, general 3D topographical surveys (surface and underground), and many other surveys where cost-effective data collection is required.

With the introduction of lightweight laser scanners to the market,(LLS) the combined benefits of UAVs and laser scanning offers surveyors another option to create point clouds. These combined technologies provide a relatively low cost, safe, quick, and accurate option to map a mine's in-progress state leveraging the point-cloud data to create 3D information models.

Within a mining environment various laser scanning techniques have been used to collect and map a mine's in-progress state. More recently, advanced MLS techniques have been adopted for underground mining environments. Leveraging a simultaneous localisation and mapping (SLAM) technique that consists of a spinning 2D LiDAR unit and an industrial-grade mounted inertial measurement unit (IMU), the acquired scan data is processed through a series of steps to produce a dense and accurate geo-referenced 3D point cloud that can be collected quickly and efficiently, without disrupting mining operations. An extension of this SLAM technique has recently been successfully completed in South Africa using a handheld version of the vehicle-mounted SLAM technology. Regardless of the survey technology adopted, mine surveying still remains the technique and science of accurately determining the 3D spatial location of points and or features on or below the Earth's surface.

3. OPENCAST MINING TECHNOLOGY

Surface mining is the main pillar for meeting the rising demand of metals and minerals as the total production of limestone, dolomite, bauxite, and iron ore and lignite is to come from these mines for ever while nearly 90% of total coal production. With rising demand of the coal, estimated to cross 1000 million tons by 2024, this share is going to cross

95% limit and the working depth is going to cross 300 m and the mine size for the mission will cross on average 5 million tons per mine. Heavy mechanization of the surface mining is therefore going to be the panacea of the mining sector [7].

There is need to amalgamate the latest IT modules in these machines, improve their efficiency, safety and economy in operation and maintenance. The conveyor system is found to be most economical in material transport in coal mines and needs perfection in fabrication, operational and energy efficiency. In addition, the machinery/ package demand will rise in coal mining sector during and be sustained over the next 50 years are In pit crusher conveyor package, Surface miner. conveyor package, Dragline and auxiliary machines, High wall miner /conveyor package etc. Biggest causality with the surface mining is the land, environment, hydraulic regime and green cover, the basic need of the life to survive. The land of interim use for mining is the lifeline for the posterity, and the society realizing this fact has started resisting the mining so necessary for their own development. All effort should be made to make the surface mining eco-friendly , ensuring restoration of the land to the stake holders after it is of no use to the industry – forest land for forestation, agricultural land to the farmers for cultivation, dwelling land for the settlement of the displaced persons rather than making it water land for ever. These are possible only by clubbing these objectives to the mining practice, and undertake concurrent backfilling, reclamation and restoration to its prime stage. The in pit crusher – conveyor transport system should be hooked with the spreader like the one adopted with the bucket wheel excavator to reclaim the land for common use. Remote Control of equipment, Fleet management, Process management, and Proximity Detection are some of the areas requiring more research in application to the field conditions in opencast mines.

- Opencast mining has witnessed a sea change in India during the last 30 years
- Opencast mining in the country has relied heavily on the following indigenously available equipment

1. Rope shovels – upto 9.5 cum bucket capacity
2. Rear shovels – upto 120T capacity
3. Hydraulic excavators – upto 9.5 cum bucket capacity
4. Draglines – upto 24/96 size
5. Blast Hole Drills – upto 250 mm dia. Capacity
6. Bulldozers – upto 770 hp capacity
7. Front End Loaders – upto 7 cum capacity
8. Motor Grades – upto 280 hp capacity
9.Vibratory compactors – upto 25T capacity

4. UNDERGROUND MINING TECHNOLOGY

Current world practices in underground coal mining technology mainly involve the following mass production technology:

i) Mechanized Longwall

ii) Continuous Miner technology in board / room and pillar method with continuous miner, shuttle cars, roof bolters, feeder – breaker, and intergrated belt conveyor system for outbye coal transport.

Continued strong growth in the global demand for energy, driven by both developed and developing markets, has lead to the coal sector playing a major role in meeting current demand and in raising production to meet annual planned increases. The most important of these markets for coal is the Asian Pacific area with consumption at over 3.3 billion tonnes last year, or over half the world's consumption. China is the most important coal-consuming country by far with its energy sector growing at between 7 to 9% per year. With this booming growth, underground coal owners and operators are looking at ever more productive and powerful equipment. Man riding systems for underground mines are very much required to cut down the time for reaching to work place and efficiently utilise the equipment. Fig 2 shows the man riding facility at a typical underground mine.

Fig 1 : Backfilling with Fly ash in a opencast mine

Fig 2: Man riding facility in a typical mine

Particular emphasis is made on the high capacity Chinese, Australian and the US markets where high productivity is coupled with maximising the extraction of coal reserves in both very thick seams and in thin high quality seams where premium prices can be commanded. As a result of this demand for increased production, manufacturers have made significant advances in thin seam and ultra-high seam extraction equipment.

Roof Support Electronics using the FACEBOSS electronic control system Integrating the long wall and mine-wide system to enable automatic control of the long wall operation, including fully automatic shearer and roof support gate turn rounds appears to be a better choice for futre long wall equipment for better performance. ComPak Valve System for controlling modern automatically operated longwall roof supports and facility for online and continuous monitoring of health of equipment, and stability of workings with appropriate sensors may be explored using Wire Less sensor networks, wherever feasible. Fig 3 and 4 shows Remote LHD used in BG method along with OC hydraulic props and

Longwall equipment with Chock Shield supports, respectively in typical UG coal mines.

Major portion of this reserve will come from underground mines, to be worked by Long wall method of mining. First requirement for this will be the sinking of deep shafts, may be through backfilled loose burden. The mining will be possible only by fully mechanized long wall package, with high capacity double telescopic power support (600-800 tons) and high shearers. The fast advancing long wall faces will need advanced preparation of the panels that will need 3 heading drayage pattern , possible only by continuous miner conveyor combination with self advancing bolting machines. It is therefore, necessary that instead of multisource shopping of package of different specifications, the country should select, fabricate and modify the most trusted package with the latest IT modules by the time this stage comes, The present long walling in different pockets may be used to derive conclusive guideline for such in house development . **As per the mining condition of India and the past experiences, some of the machine/ equipment which will be the most befitting mechanization for deep working which should be developed at home to meet the future requirement include Sophisticated shield support of 600-1000t capacity for thin to thick seams, Shearer for seams of different thickness and compatible panzer conveyor, Continuous miner shuttle car/ conveyor package, Self advancing bolter etc.**

This is possible by joint effort of the engineers and the technologists who should

Fig 3: Remote LHD used in a typical mine (Blasting typical Gallery method)

Fig 4: Longwall equipment in a typical Mechanised mine of SCCL

put in their expertise in deciding the package characteristic most likely suitable for deep seated coal seams under hard roof formation, Once, the decision is finalized, the MAKE IN INDIA exercise should start with the cooperation of different R&D agencies and the manufacturing units in translating the technology.

5. UNDERGROUND COAL GASIFICATION (UCG) TECHNOLOGY

India has total resources of 301.56 billion tonnes of coal and about 43.22 billion tonnes of lignite resources. The coals in Kaitha and Thesgoda 'C' blocks are at greater than

300m depth with more than 150 MT coal resource. Conventional mining is not suitable for these blocks. To utilize this unmined coal reserve underground coal gasification is one of the most suitable technologies which is economically viable and environmental friendly.

UCG is similar to surface gasification, occurs in a manufactured reactor whereas the reactor for a UCG system is a natural geological formation containing unmined coal.UCG typically consists of two adjacent bore holes drilled into a coal seam and pressurized oxidant such as air or oxygen/steam is used for ignition of coal seam. The oxidant and the gasifying agent are fed through the injection borehole and the combustion and gasification products are recovered from the production bore hole. Injecting oxygen and steam instead of air produces the most useful product gas. The main constituents of the product gas are H2, CO2, CO, CH4 and steam. The proportion of these gases varies with the type of coal and the efficiency of the gasification process (Fig 5).

6. CONCLUSIONS

The recent Information and Communication systems (ICT) along with WSN systems for all aspects of mining industry can be widely implemented in opencast and underground mines for reliable monitoring of stability of workings and location of men and machnary in conjunction with audio-visual alarming systems for warning of impending ground failures in right time for taking proper control measures as per the requirement. coal mining sector will need heavy mechanization; giant size shovel dumpers, draglines, in pit crushers surface miners and High wall miners for different situations and along with ancillary equipments like spreaders, reclaimers etc . There is need for the mining industry to come out of the cell, invite engineers and technologists of different allied streams for the joint effort to cope up to the demand. But before that, the mining engineers have to have clear perception, dedication and commitment to customize the options and inculcate confidence in the manufacturing units to come forward for the investment and resources to make in India mission a success. For the underground mining, modern high capacity power support, panzer conveyor and shearer suitable for high to moderately thick and thin seam will be required in large number in days to come. The Industry on date is depending upon the foreign sources for most these machines/ equipments while the nation has capability to develop them at own. Underground coal gasification should be widely practiced with due regard to identification of proper blocks unsuitable for mining but most suitable for UCG.

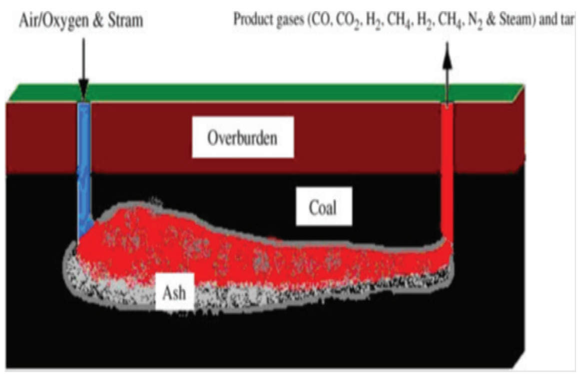

Figure 5: Schematic Plan UCG process [12]

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TECHNO-ECONOMIC FEASIBILITY OF ROOFTOP RAINWATER HARVESTING SYSTEM FOR GREENHOUSE

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ABSTRACT:

Aiming at water security in agriculture and higher returns, a study was conducted for techno economic evaluation of rooftop rainwater harvesting system with polyhouse (greenhouse). The rainfall data were analysed or weeks, months and seasons. The water supply for the crop (capsicum annum and anthurium) was monitored regularly. The total water requirement of capsicum annum was completely monitored and for anthurium 19 weeks were monitored, combination of these two crops gave water requirement of 48753 litres. Rainwater harvested with a runoff coefficient of 0.90 was 202273 litres from an area of 176 m2. The depth of water required for the sweet pepper was 202.4 mm at 100 percent application. The rooftop rainwater harvesting would provide an additional income by taking up a crop in off season and totaling at least 3 crops with the harvested water only if it is stored for long period. As expenditure on borewell drilling is very high and many times it is not sure to get the good quality groundwater. The study considered three scenarios to analyze the benefit cost ratio of the same. Scenario, a) greenhouse with groundwater pumping system, b) greenhouse with rooftop rainwater harvesting and pumping the water from the storage tank and c) greenhouse with rooftop rainwater harvesting with gravity/low head irrigation for crops. Among these combinations the B:C ratio was 0.996, 1.63 and 2.238 respectively. This study proved that the rooftop rainwater harvesting system is one of the best methods which are technically feasible and economically viable option for the hitech agriculture.

Keywords: Design of rooftop rainwater harvesting system, polyhouse, benefit cost ratio.

1. INTRODUCTION:

Water is indispensable for the welfare of human beings and their natural environment. But scarcity and misuse of this resource poses seriously growing threat to food availability, human health, industrial development and the ecosystem. The management of water in agriculture has a vital role to play as it accounts for 70 per cent of the potential harnessed which will improve the quality of life of rural population by enhancing its availability and use for food production. Only about 40 per cent of the water used for irrigation reaches the intended crops. The remaining part is either lost through runoff or

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recharges the ground water or is recycled within the irrigation system. In many instances, irrigation systems are poorly maintained or constructed with no water control systems.

Rainfall is the first form of water that we know in the hydrological cycle, hence is a primary source of fresh water for us. Rivers, lakes and ground water are all secondary sources of water in present times; we depend mainly on such secondary sources of water. In the process, it is forgotten that rain is the ultimate source that feeds all the secondary sources and remained ignorant of its value. Hence, conservation of water at every front is the need of the hour. It is a matter of serious concern that adequate attention was not paid to handy water management techniques available.

There is an urgent need for propagating water harvesting, conservation and recharging on a large scale (Gopinath, 2000).

Indian agriculture has always remained a gamble with monsoon, and the situation is assuming precarious levels due to non-adherence to implementing of water harvesting strategies. The term "water harvesting" is the art and science of improving water yield efficiency of a catchment and utilization of the surface runoff in a smaller collection or spreading area by direct cultivation of plants or through storage and recycling (Bali, 1988). However, this concept is a new methodology for an old principle. It is very much needed in the recent years, to narrow down the supply demand gaps of water. There are different ways in which rainwater can be harvested, one such way is collection of rainwater from rooftops. The rooftop rainwater harvesting means the collection of water through top of the house or any structure. This system consists of three basic components such as catchment area, conveyance system and storage facilities. The catchment area is the roof of a house or any other structure; a conveyance system consists of gutters and pipes that convey rainwater received on the rooftop to storage tanks or cisterns. This method has advantage over others in which water is harvested from ground catchments, in the sense that water free from contaminants and is suitable for meeting most of the water need. The runoff from rooftops is collected in different kinds of storage tanks, which can be above or below the ground (Satishchandra and Singh, 1992). Greenhouse is a framed structure covered with transparent Low Density Polyethylene (LDPE) film, large enough to grow crops under partial or full controlled environmental conditions to obtain optimum growth and production. The main advantage of cover cultivation is that crops can be cultivated successfully throughout the year, with very high productivity and excellent quality. Further, it is easy to protect the crops against extreme climatic conditions and incidence of pests and diseases, thus the genetic potential of the crops can be exploited to the maximum extent. Apart from this, the roof of the greenhouse is a good catchment for rainwater harvesting (Jayaprakasha, 1998). The present study was carried out with the objective to find techno-economic feasibility of rooftop rainwater harvesting from greenhouse structure.

2. REVIEW OF LITERATURE

Veeraputhiran et al. (2003) gave the methods used for the analysis of weekly, monthly and seasonal rainfall for crop planning based on initial probability levels and conditional probability levels. He also suggested the optimum value of Coefficient of Variation (CV %). Ben-Asher (1979) reported that trickle irrigation timing and its effect on plant and soil water status on tomato plants in sinai and dunes were irrigated daily by drip irrigation. Results showed that day irrigation of soil with low water holding capacity increased the yield significantly and improved plant water potential as well as water use efficiency. Greenhouses are used so that flowers and vegetables can be produced continuously throughout the year. Plant requirements are the same in a greenhouse as they are outdoors, but the greenhouse, with its gradually evolving automatic means of supplying conditions artificially, is becoming better and better equipped for plant growth. Tiwari and Goyal (2000) explained about the design and construction of greenhouse, the irrigation methodology inside the polyhouse for crops and the technical viability of the project. Qiang (2003) compared rainfall collection efficiency of various materials and he reported that the rainfall collection efficiency obtained for an annual rainfall of 500-1000 mm was 75-90 per cent. For cement soil the collection efficiency was 45-60 per cent and for plastic film the rainfall collection efficiency was 85-92 per cent.

Dewan (1988) carried out water harvesting study and he reported that source of water may be from roofs, from sheet flow or from intermittent and even perennial streams. Productive use includes domestic water, stock water, and water for irrigation and use for fish farming. The techniques used resulted in soil and water conservation, together with more efficient water use. Das (1988) gave the classification of water harvesting systems depending upon the source of water supply as a) In-situ rainwater harvesting, b) Rainwater or direct surface runoff harvesting, c) Stream flow or runoff harvesting and d) Subsurface flow harvesting. Wentworth (2001 a) gave the theoretical method for estimating the amount of roofwater that can be harvested. A square foot of horizontal surface receives approximately 0.625 gallons of water with each inch of rainwater.

Surfaces of roof that have slopes, catch less water per square foot of surface area. So it is not the area of roof surface that need to be measured, but the roofs “foot print”, the area of the ground under it. To get the effective square footage of roof for catchment purposes, measure the sides of building from eave to eave, multiply the length times the width to get the square footage of the catchment surface. Multiply that amount times 0.625 to find the total gallons the roof can catch per inch of rain. If only a part of the roof is used for catchment, calculate only for that area.

Neelakantaiah (1991) evaluated the investment in groundwater irrigation and resource use efficiency in Bangalore rural districts. The results have shown that average investments on wells per farm were to the tune of Rs.46,593. The excavation cost accounted for 34 per cent followed by the cost of pumpsets (19 %) and pipes for water conveyance (11 %). The cost of irrigation for one hectare of land was Rs. 3409 of which the share of overheads was more than 84 per cent. In hard rock areas of Karnataka, declining water tables combined with increasing probability of not striking water led to increase in capital cost and consequently the annual fixed cost. The cost of a successful well was Rs.50, 000. Considering the cost of failed (initial) borewell, the estimated cost of successful well was about Rs. 62,500. Such colossal investment requirements restrict the resource poor farmers from venturing into borewell irrigation (Kolavalli and Atheeq, 1993). Wentworth (2001b) reported that for most of the rainwater harvesting systems, the storage tank represents the single greatest cost, especially for roof tanks where an existing roof structure in effect provides a free catchment area. The choice of suitable tank design to match an existing catchment and local conditions is important and careful consideration should be given in selecting the right one. Rajkumar and Natarajan (2003) conducted a study to evaluate the technical feasibility and economic viability of rooftop rainwater harvesting system in individual hostel buildings of Tamil Nadu Agricultural University (TNAU) campus. The cost analysis revealed that benefit cost ratio of 2.82 and payback period of 1.32 years. For individual residential blocks combination was found to be more feasible for installation of rooftop rainwater harvesting structure with a benefit cost ration of 2.27 and payback period of 1.78 years

3. MATERIAL AND METHODS.

3.1 Experimental site

The experimental site was located at the Division of Horticulture, Precision Farming and Development Centre (PFDC), Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bangalore, Karnataka State, India. Geographically the site is located at 12°58' latitude N, 77°35' longitude E and at an altitude of 930 metres above the mean sea level (MSL). The experimental site comes under eastern dry zone of state agro climatic zones.

3.2 Weather conditions

Past 30 years rainfall shows that the annual rainfall amount ranges from 528 mm minimum in 1990 to 1328.4 mm maximum in 1991, with an average annual rainfall of 916.5 mm. The highest rainfall intensity recorded in Bangalore over a period of 30 years was 45 mm/30 min on 27th May 1993. Bangalore receives rainfall in four seasons of which the south-west monsoon contributes to 56.4 per cent of the total amount, whereas the north-east monsoon contributes around 25.8 per cent of the total, the rest is pre-monsoon rainfall of 16.4 per cent and cold season rainfall 1.4 per cent. The number of rainy days varies from 71 the highest in 1975 and 36 the minimum in 2002 and the mean number of rainy days for the site was 56. The highest temperature was recorded in the month of April-May and lowest in the month of December-January.

3.3 Description of the experimental setup

To study the rooftop rainwater harvesting system, the already existing greenhouse (polyhouse) of naturally ventilated type was chosen which was located 300 metres away from the meteorological observation station. The framework of polyhouse structure was constructed with the arch shape of double span by using mild steel angles and GI pipes. The cladding material used as roof cover was a 200-micron polyethylene sheet. The temperature inside the polyhouse was controlled by rolling or unrolling the polyethylene film side curtains provided at the two sides of the polyhouse. The ventilated side was protected against the entry of pests by providing a 40-size netlon Ultra-Violet radiation stabilised mesh. The dimensions of the polyhouse are 16 m in length, 11 m in width and 3.35 m in height from the middle of the arch to the ground surface. The total greenhouse area is 176 m2. The greenhouse was constructed on a level ground surface.

3.4 Rooftop rainwater harvesting system

Plate: 1 General view of the greenhouse with rooftop rainwater harvesting system

3.5 Rainfall Analysis

Weekly, monthly and seasonal rainfall analysis was carried out to analyze the weekly rainwater harvesting potential and also dry and wet weeks over 30 years. The conditional probability for the rainfall levels of 0, 10, 30, 50, 60, 80, 100 and 120 mm were worked out. The daily rainfall amounts were added from first to seven days and for 52 standard weeks in a year for all the 30 years.

Conditional probability indicates the probability at which a particular amount of rainfall is anticipated for a particular place over a specified time series data.

For analyzing the weekly, monthly and seasonal conditional probability the following formula which was given by Veeraputhiran et al. (2003) was used:

$$\text{Standard Normal Variate (SNV)} = \frac{\bar{X} - X}{SD} \qquad (1.0)$$

where,

$\bar{X}$ = Mean rainfall for a particular period (mm)

X = Required quantity of rainfall (mm)

SD = Standard Deviation for the data set

3.6 Runoff co-efficient or rainfall collection efficiency

Rainfall Collection Efficiency (RCE) from the polyethylene sheet was found out by collecting the runoff water over a period of five months. The formula used for the calculation was given by Qiang (2003) as below:

$$\text{Runoff coefficient} = \frac{\text{Runoff collected}}{\text{Rainfall received}} \qquad (2.0)$$

3.7 Irrigation system

The water supplied to the crops by using water saving methods such as drip and micro sprinkler irrigation was monitored regularly. For the irrigation purpose, the basic source of water was borewell, and the water from borewell was pumped to a height of 110 m to the surface of the ground and this water was stored in underground storage tank, form where it was pumped for irrigation. The water supplied for two crops such as Anthurium and capsicum annuum (sweet pepper) was measured on regular basis. Water supplied per irrigation for the crop (litres) = Total number of micro sprinklers or emitters x average discharge (litres) x time of operation (h) (3.0)

3.8 Groundwater pumped for irrigation

As the main source for irrigation was groundwater, the water pumped for the irrigation was also monitored. It was calculated by collecting the discharges of two borewells Pump-1 (surface pump) and Pump-2 (submersible pump) in a container of known volume and the water pumped per second was calculated:

$$\text{Discharge (Q)} = \frac{\text{Volume of the container (litres)}}{\text{Time taken to fill the container (sec)}}$$

3.9 Water budgeting studies

For the water budgeting analysis, the polyhouse rooftop area (176 m2) and the area of gutters (6.5 m^2) was considered as the runoff contributing area and the weekly, monthly and seasonal demand and supplies were calculated using rainfall data and field observations for sweet pepper and Anthurium crops.

3.10 Layout and design

3.10.1 Rooftop Surface Area

To get the effective catchment area that contributed the runoff the surface area of the polyhouse and the gutter area were taken into account. For the measurement of catchment area the length and width of the polyhouse at the floor was recorded and the two gutters at the two sides were also added because the gutter was open to receive rainwater directly. The areas of polyhouse and gutter were calculated using the basic rectangular formula given by Wentworth (2001a).

Area of rectangular polyhouse = length x breadth

Area of the gutter = (length x breadth) X number of gutters installed

The area of central gutter was considered in the polyhouse measurements.

Total roof catchment area = area of polyhouse + area of gutter

3.10.2 Gutters to collect and convey the runoff

Gutters receive the runoff from the roof and also intercept a small quantity of rainfall directly adding to total runoff generated from the roof. The harvested runoff was conveyed to down pipe.For this purpose a slope of 1.8 per cent was given for smooth discharge of water from front of the greenhouse to its end. Two new gutters were installed at the two sides of the polyhouse. For designing the gutters' dimensions, the highest intensity of rainfall in 30 min from past 30 years from automatic raingauge rainfall charts was used. Various types of materials can be used for making a gutter. However, in this study galvanized iron (GI) sheets of 22 gauges were used to fabricate the square shape gutters.

Formula used for the design was as below, given by Rajkumar and Natarajan (2003):

Volume of water harvested (Q) = Rooftop area (m2) x rainfall intensity (m/s) x runoff coefficient (5.0)

Gutter discharge Q_g = A x V , (6.0)

where, Qg – gutter discharge, m^3/s

A – cross sectional area of square gutter section, m2

V – maximum velocity, m/s

Area (A) = side2 (7.0)

Velocity of flow through the gutter was calculated by using Manning's formula

$V = 1/n (R^{2/3} S^{½})$, (8.0)

where, V – velocity of flow, m/s

n – Manning's roughness coefficient for impermeable layers

R – hydraulic radius, m

S – Per cent slope

3.10.3 Down Pipes

Down pipes made of PVC were fixed to the gutters outlet and as an inlet to storage tanks. Three down pipes were provided for three gutters and fed individually to three separate surface storage tanks. The design of down pipes was done using the formula given by Rajkumar and Natarajan (2003) and Qiang (2003).

Volume of water harvested (Qd) = Roof catchment area (m2) x rainfall intensity (m/s) x runoff coefficient (9.0)

Discharge supply to down pipe

$Q_d = A \times V$, (10.0)

where, Qd – supply discharge/ flow rate, m^3/s

A – cross sectional area of pipe, m^2

$A = \pi/4 (d^2)$ (11.0)

d- diameter of the pipe, m

V – velocity of flow of water through the pipe, m/s

$V= \sqrt{\frac{Hdg}{2fl}}$ (12.0)

Where, H – Total head, m

d- diameter of the pipe, m

g- acceleration due to gravity, m/s^2

f - Darcy's roughness coefficient

l - distance between the outlet of the gutter to inlet of the surface storage tank, m

3.10.4 Filtration

The rainwater harvested is being conveyed through the 40-size netlon mesh to arrest the organic matter entering the storage tanks. The mesh was regularly cleaned.

3.11 Storage tanks

At the study site brick masonry underground storage tank was used. The total capacity of the tank was 25,000 litres measuring 5.8 m x 2.8 m x 1.5 m in dimensions. The top of the tank was covered with asbestos cement sheets as covering material so as to avoid the entry of sunlight, otherwise it may lead to growth of microorganisms. Using the 30 years daily rainfall data at a conditional rainfall probability level of 60 per cent was used to design the dimensions required to store one-day highest rooftop rainwater. The highest one day rainfall intensity recorded was 88.1 mm/day on the 7th September 1997.

Volume of storage tank required (Q) = Total depth of rainfall (m) x roof catchment area (m2) x runoff coefficient (13.0)

For purpose the present study, the methodology adopted was to store some quantity of water at the site by using surface storage tank and measure the collected water to find the runoff coefficient of the polyethylene sheet. The excess storage was conveyed to the underground storage tank for the measurement of total rooftop rainwater harvested.

3.11.1 Surface storage tanks

The plastic surface storage tanks of 5000 litres total capacity were installed at the backside of the polyhouse, and kept on a level platform.

The three tanks of 2000, 2000 and 1000 litres capacity each were installed. These tanks ere inter-connected at the bottom to distribute the collected runoff water equally in all the tanks. The water was first collected in the surface storage tanks and the excess of this storage was conveyed to the underground storage tank. The surface storage tanks were designed at conditional probability levels of 50 per cent for the rainfall of 30 mm over a period of 30 years. The excess of 30 mm rainfall was conveyed to the underground storage tank of 25,000 litres capacity.

The volume of surface storage tanks (Q) = Roof catchment area (m2) x highest rainfall intensity (m/s) x runoff coefficient (14.0)

Volume of tanks (m3) = $\pi r^2 h$, (15.0)

where, r – radius of the tank, m

h – height of the tank, m

These tanks were emptied after receiving and accounting of the rainwater collected either by giving irrigation to crops inside the polyhouse or leaving the water to

Plate: 2 Recording the rooftop rainwater harvested

underground storage tank to be ready for successive rainwater collection.

3.12 Excess Runoff Conveying System

The rainwater which was harvested during the rainfall in the surface storage tanks and the runoff produced during continuous raining after filling of all the three tanks, the excess runoff was conveyed to underground storage tank which was located at a distance of 60 m from the surface storage tank. This was done by taking out the outlets from individual tanks at the top at equal height and connected to a common excess flow PVC pipe, and further excess flow pipe was connected to underground storage tank. For the design of pipe size, 30 years highest rainfall intensity was considered. The highest rainfall intensity received over a period of 30 years as per the campus automatic recording rain gauge was 45 mm/30 min on 27th of May, 1993. Design was carriedout as stted in section 3.10.3 above.

3.13 Cost analysis

The cost of this rainwater harvesting technology varied considerably depending upon the location, type of materials used and the level of implementation. The components that need for cost analysis included polyhouse construction, roofing materials, gutters, conveyance pipes, energy consumption costs, storage tank, operation and maintenance cost. The expected life of the construction material for storage tank, PVC pipes, gutters and steel framework of polyhouse is considered as 25 years and that for polyethylene roofing material as 4 years.)

The initial investment was estimated for all the components such as greenhouse, irrigation system, the borewell drilling, the rainwater harvesting system and the storage tanks. The annual cash inflow was calculated by the crop output. Three scenarios were analysed for this purpose. Scenarios a) the cost of the greenhouse system with groundwater irrigation system, b) greenhouse with the existing surface storage tank with surface pumping with rooftop rainwater harvesting system and c) greenhouse with rooftop rainwater harvesting with gravity irrigation system and were annualized by amortizing the capital cost on greenhouse, pumping system, borewell, rooftop rainwater harvesting components, and for storage tanks. The maintenance and repair cost was added to the amortized cost to get the total cost of the system (Nagaraj, 1987).

$$\text{Amortized cost (Rs)} = \frac{i(1+i)^{n}}{(1+i)^{n-1}} \times P \qquad (16.0)$$

where, i - interest rate at 8 per cent
n – life of the component, years
P – cost of the system, Rs

a) Amortized cost for greenhouse with groundwater irrigation system = (Amortized cost of greenhouse without the cladding material + Amortized cost of the cladding material + Amortized cost of the drilling the borewell + Amortized cost of water lifting + Amortized cost of underground storage tank + Amortized cost of drip irrigation system) + annual maintenance cost

b) Amortized cost for greenhouse with the surface pump and underground storage tank irrigation for the present study condition = (Amortized cost of greenhouse without the cladding material + Amortized cost of the cladding material + Amortized cost of water lifting + Amortized cost of underground storage tank + Amortized cost of drip irrigation system + Amortized cost of rooftop rainwater harvesting) + annual maintenance cost

c) Amortized cost for greenhouse with rooftop rainwater harvesting system with gravity irrigation system = (Amortized cost of greenhouse without the cladding material + Amortized cost of the cladding material + Amortized cost of underground storage tank + Amortized cost of drip irrigation system + Amortized cost of rooftop rainwater harvesting + amortized cost of surface storage tank (2000 litres) + Amortized cost of hand pump) + annual maintenance cost

To examine the economic feasibility of investments and benefits in rooftop rainwater harvesting, the discounted cost analysis were done assuming that after the life of the components the reuse is not possible, The formula used for this calculation was as given by Nagaraj (1987)

$$\text{Discounted rate} = \frac{1}{(1+i)^{n}} \qquad (17.0)$$

Where, i = interest rate (8 %)
n = the year which is under consideration

Payback period

The payback period is the length of time required to recover the initial capital investments of the project and it was calculated by using the formula by Rajkumar and Natarajan (2003).

$$\text{Payback period} = \frac{\text{Initial cash outlay or investment}}{\text{constant annual cash inflow}}$$

According to this pay back criteria, the shorter the payback period, the more desirable the project would be.

Benefit cost ratio

This ratio was calculated by dividing the present worth of the discounted benefit to the present worth of the discounted cost. The formula used was as given by Tiwari and Goyal (2000).

$$\text{BC Ratio} = \frac{\sum_{t=1}^{n} Bt(1+i)^{-t}}{\sum_{t=1}^{n} Ct(1+i)^{-t}} \qquad (18.0)$$

Where, Bt - benefit in tth year

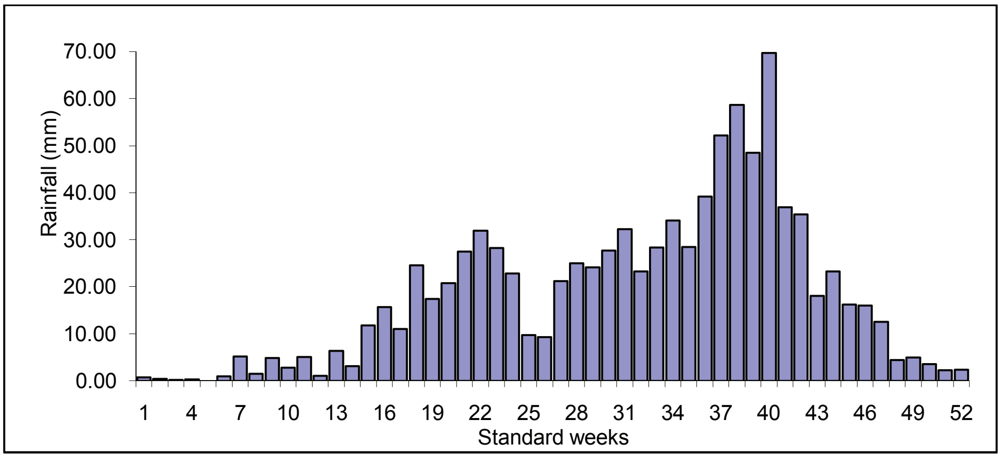
Ct – cost in tth year

i – discounted rate

4. RESULTS AND DISCUSSION

The analysis was carried out to know the rainwater harvesting potential of the area for weekly, monthly and seasonal, based on the past 30 years (1974-2004) rainfall data recorded at Gandhi Krishi Vigyan Kendra (GKVK), Bangalore Campus. The highest mean is 69.66 mm for the 40th week, the next highest was 58.67 for the 38th week. The least mean rainfall of 0.23 mm was noticed for the 3rd week. However, there was no rainfall for the 5th week for all the 30 years

Rainfall Standard Deviation for all the 52 weeks over 30 years period shows that the maximum deviation is 66.32 per cent for 37th week and 61.90 per cent for the 38th week, the least deviation is for the 3rd week which is 0.69 per cent. There is no deviation for the 5th week. Coefficient of variation (Cv %) varied from 497.06 per cent for the 9th week as the highest and 84.05 per cent for the 40th week as the least. There was no variation for the 5th week. The weeks, which were having Cv % less than 150 per cent, were the 18th to 43rd and 45th. From Fig. 4.1 it can be seen that rainfall events of higher order were concentrated from the 15th to 25th week and 27th to 47th weeks. The mean rainfall among 12 months for 30 years was maximum for September month, which was 210.019 mm, and minimum was 1.67 mm for January month. The second highest mean rainfall receiving month was October as 162 mm. The standard deviation in rainfall is maximum for September month as 103.25 per cent and minimum of 3.73 per cent for January month. The next highest deviation was for October month as 97.75 per cent (Fig 4.2)..



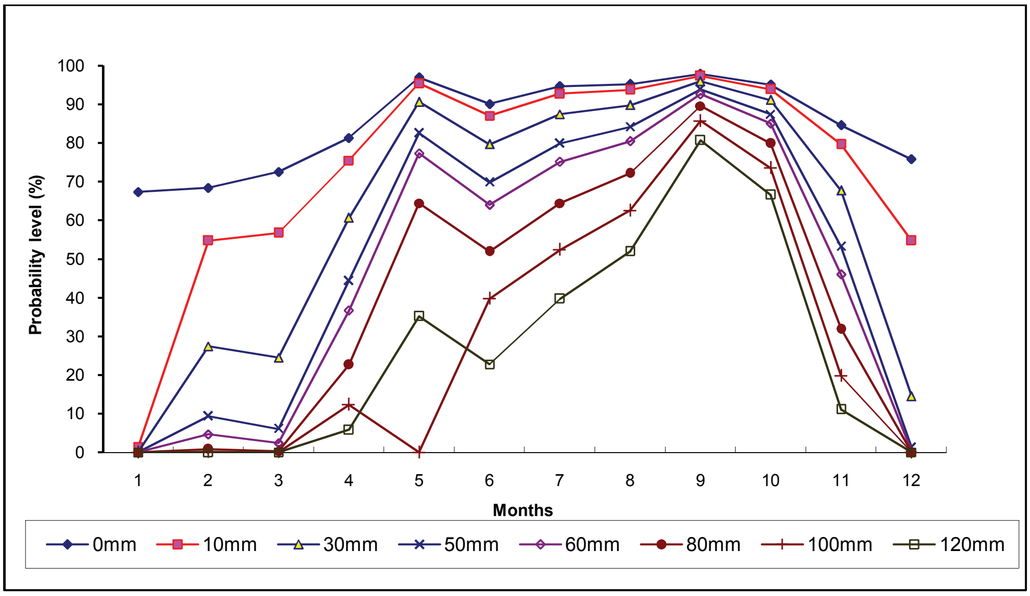


Fig. 4.2 Monthly conditional probability levels of rainfall (1974-2004)

Rainfall for the present study period

From Figure 4.3 the maximum rainfall for the present study period was 233.4 mm on 43rd week and minimum of 1.8 mm for the 5th week. Eleven weeks recorded a rainfall of more than 30 mm and twelve days recorded rainfall more than 30 mm. The weeks, which received no rainfall, were first 3 weeks, 6th to 10th, 12th, 13th and 20th weeks. The total rainfall received from 01 January to 3rd November, 2005 was 1330 mm and during the study period it was 1210.6 mm. The 23rd October, 2005 recorded the highest ever one day rainfall of 143.8 mm and the minimum one day rainfall was 0.4 mm over 92 rainfall events. Rajegowda et al. (2005) analyzed the rainfall data for 35 years for the GKVK Campus and gave the result. The results obtained were in line with the study in respect of wettest week and the coefficient of variation. They reported that the annual average rainfall for 35 years was 916.5 mm. They also reported that the 40th week was the wettest week in a year and weeks that fall from 1st to 15th weeks having CV % more than 150 per cent and similar was for 47th to 52nd weeks.

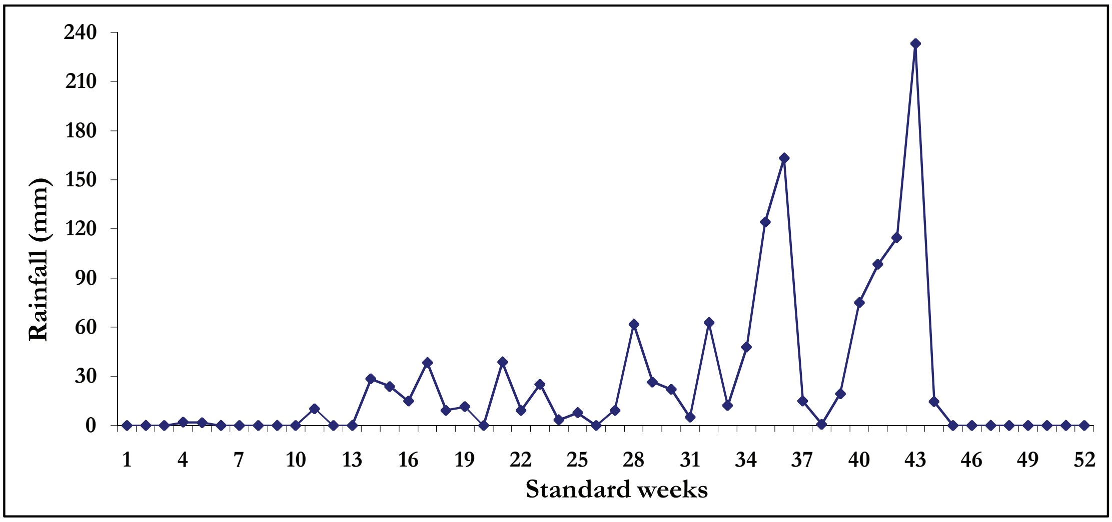


Fig. 4.3 Weekly rainfall for the study period

4.8.1 Rooftop area

Area of the rectangular polyhouse = length x breadth = 16 m x 11 m = 176 m^2

Area of the rectangular section gutter = (Length x breadth) x number of gutters = (16.45 m x 0.2 m) x 2 = 6.5 m^2

Total catchment area = 176 m^2+ 6.5 m^2

= 182.5 m2

4.5 Runoff coefficient or rainfall collection efficiency (RCE)

Runoff coefficient (C) or Rainfall Collection Efficiency (RCE) of polyethylene sheet was found out by collecting the daily rooftop runoff in a 5000 litres and 25,000 litres surface and underground storage tanks. Daily highest rainfall collection was obtained as 0.93 or 93 per cent for 9 rainfall events of 23.6, 4.8, 60.4, 59.8, 73.4, 14.6, 18.4, 33.4 and 10 mm of rainfall events. The minimum RCE is 0.85 for 1.6 mm depth of rainfalls. The daily rainfall events of higher depths, which are received in successive days, show highest RCE. The runoff coefficient variation is between 0.85 to 0.95 or 85 to 95 per cent minimum to maximum respectively and this trend continued for all the rainfall events. The average runoff coefficient for the study period was 90 per cent. The observation made in the present study is in line with the observation made by Qiang (2003).

4.6 Water budgeting

Water budgeting for crop water requirement, water supplied by rooftop rainwater harvested and the water pumped from the borewell were worked out and given in Fig 4.4. The total water demand for crop production for both sweet pepper for 21 weeks and Anthurium for 19 weeks were 48753 litres at 100 per cent conveyance. To supply this quantity of water, groundwater pumped was 5,68,232 litres. The rooftop rainwater harvested for the rainfall of 1198.6 mm at 90 per cent collection efficiency was 2,02,279 litres. If we take the water harvested and water requirement there was 1,53,526 litres were surplus after irrigating two crops. Rooftop rainwater harvesting from 182.5 square metres roof area saves the groundwater of 5,68,232 litres.

The cumulative water requirement of both the crops remained less than 50 cubic metres for all the weeks and the highest cumulative water requirement was 47548 litres for the 22nd week upto the completion of crop period. Cumulative rainwater harvested for the entire study period was more than 202 cubic metres; cumulative groundwater pumped was more than 550 cubic metres for entire crop period and the cumulative water deficit continued up to 36th week. From 37th week the rainwater harvested showed surplus of the water requirement. The rainwater harvested showed surplus trend over water supplied to crop from 29th week onwards and the critical period was noticed from 1st to 28th week, where the water requirement is higher than the water harvested.

Therefore, there is a need to store the water for these periods. The water, which was excess of storage tank capacity, is allowed to recharge the groundwater table. The study conducted is in line with the study conducted by Remy et al. (1989) and Pandey (2004) in respect of groundwater exploitation and conservation.

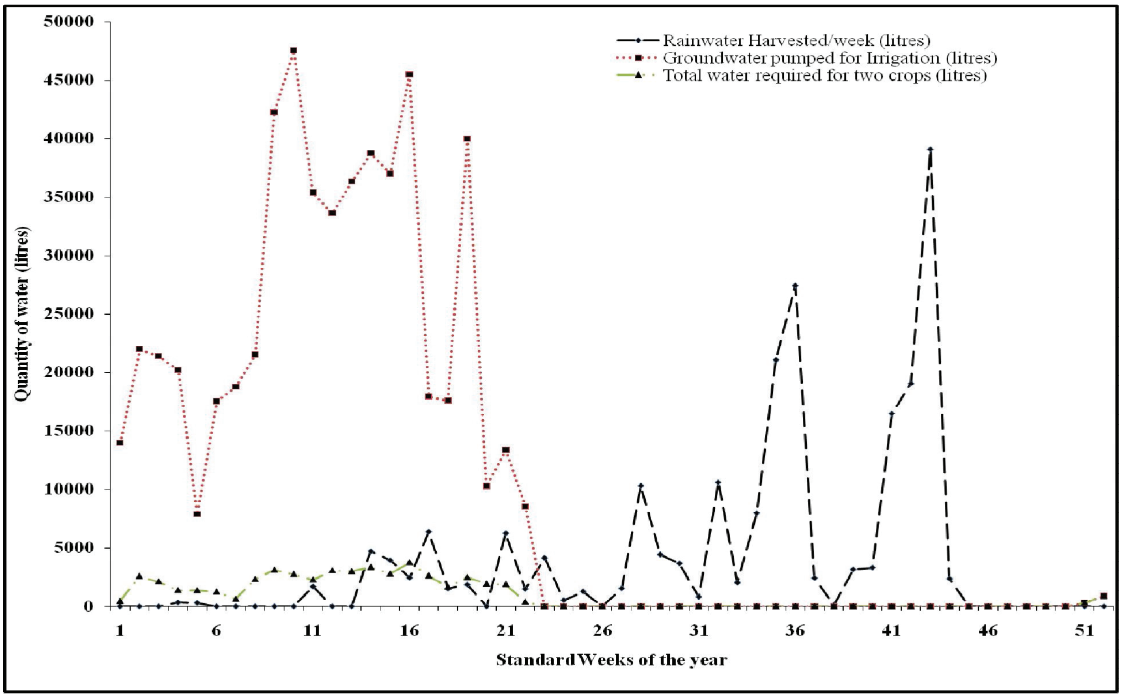


Fig.4.4. Water budgeting of the study period

4.11 Cost analysis

Cost analysis includes the greenhouse construction, rainwater harvesting components costs, water storage tanks cost, irrigation system costs, pumpsets and borewell drilling costs, labour costs and maintenance cost of greenhouse. The total cost of greenhouse was Rs.64305. The total cost for drilling one borewell having a diameter of 6.5 inches and a depth of 137.16 m is Rs 38202.59. The cost of the 7.5 Hp, 3-phase electric motor and 12 stage pump and also the cost of 2HP, 3-phase electric motor, including installation and necessary arrangement with drip irrigation (excluding sand and screen filters) is Rs 52310. The life of the borewell is taken as 20 years and that of pump and its assembly as 16 years. Total estimate for greenhouse rooftop rainwater harvesting system is Rs 11181.86. The life of the surface storage tank is taken as 15 years and for other components it is taken as 20 years, for drip irrigation the life is taken as 10 years.. The lifespan of the underground storage tank is taken as 25 years; it is constructed with brick masonry. The total cost of the tank is Rs 30674.44. The total cost of the storage tank including gravity irrigation system such as hand pump for pumping the water and the 2000 litres storage tank is Rs 69631.56. This tank stores the excess runoff water, which can be used for crop cultivation for two crops of sweet pepper using rainwater harvested from rooftop only through gravity irrigation. The abstract of cost analysis is given in Table 4.1.

The whole systems is divided into three headings such as:

a) Greenhouse with groundwater irrigation system,

b) Greenhouse with rooftop rainwater harvesting system for the present study condition and

c) Greenhouse with rooftop rainwater harvesting with gravity irrigation system.

Benefit cost ratio analysis for system (a) gives a benefit cost ratio of 0.996, which is less than 1, therefore this system is not feasible and viable one as the investment cannot be regained. Cost rate analysis for system (b) shows the benefit cost ratio as 1.630, which is more than 1; hence the project can be considered. The payback period for this system is 4.36 years. Cost analysis for system (c) shows the benefit cost ratio as 2.338, which is more than 1. The payback period for this system is 3.27 years. This system gives a benefit of taking additional two crops from excess stored water of 85,000 litres amounting to a net income of Rs 40500 from three crop, one crop by using rooftop rainwater in the rainy season and the remaining two using stored water.

Table 4.1 Abstract of the cost analysis of the systems

Sl No.	Criteria	Weightage
1	Teaching – the learning environment	30%
2	Research – volume, income and reputation	30%
3	Citations – research influence	32.5 %
4	Industry income – innovation	2.5 %
5	International mix – staff and students	5 %

5. CONCLUSION

Now a days, agriculture and urban areas are facing scarcity of water, which require an alternative source to bridge the gap between demand and supply. This scarcity is mainly due to uneven distribution of rainfall, increased water demands, vagaries of monsoon and depleted water resources. To balance the above factors, the alternative solution is the rooftop rainwater-harvesting module. Greenhouse is one of the structures that provided favourable condition for plant growth, also provided higher yield, which makes it possible to take different crops in off-season with the harvested rainwater only. If we take the water harvested and water requirement there was 1,53,526 litres were surplus after irrigating two crops. Rooftop rainwater harvesting from 182.5 square metres roof area saves the groundwater of 5,68,232 litres. It gives good runoff coefficient and higher collection efficiency with better cost benefit ratio apart from saving in natural resources like groundwater.

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ENVISIONING ENGINEERING STRATEGIES TOWARDS NATION'S TECHNOLOGY PROWESS

A K SINHA[1]

ABSTRACT

Phenomenal Scientific and Technological developments have taken place during the Nineteenth and Twentieth centuries respectively, thanks to a plethora of ground-breaking Discoveries and Inventions. The 21st century is reaping the benefits of 'Practical Real Applications' which has subsequently manifested in multi-faceted societal transformation.

The quest for Research, Development and Innovation amongst the global Scientific and Engineering community (including India) has catapulted the concept of Technologies via Science through the conduit of Engineering.

An attempt is made here to review broad aspects encompassing Science, Engineering and Technology with background and developments towards mankind progress.

A few shining examples that have recently evolved include Frontier/Strategic sectors like Space, Defense and Nuclear programs which have prospered tremendously enabling India's entry into global power hub. This has been significantly highlighted relating to Space Technology in particular with specific accomplishments/milestones; also defining future vision and mission program. This indigenous growth is phenomenal for Nation's overall strength and sustainability.

Technologies emerged during the last century and emerging Engineering Frontiers in the present century with a host of cutting-edge Research topics are enumerated, indicating positive future predictions.

There is a need to have an introspective approach for innovative strategies with a high level of professionalism leading to Quality Education and Research matching the global scales, thus ensuring sustained and inclusive growth with self reliance towards Nation's Technology prowess.

Crucial specific areas are touched upon and in order to attain this goal, there are many factors and dimensions that need nuanced deliberations. To that end a techno-visionary approach and the inculcation of a conducive Research and Industrial environment is the need of the hour.

In today's globally competitive scenario, the Nation desires to look forward towards a progressive road-map in the coming decades. Breaking all barriers in Engineering and allied disciplines and focusing on a multipronged strategy is the only solution to steer the future with a competent technical manpower and tapping proper resources with optimal utilization, following the concept of Frugal Engineering.

1. Former Senior Scientist, Indian Space Research Organization, Department Of Space [Government Of India]; Ex-director[R&d], Bharati Vidyapeeth Deemed University College Of Engineering, Pune; And Fellow, The Institution Of Engineers, India

Governmental Authorities, The Institution Of Engineers forum and Private Stakeholders would do well to join hands in this direction.

This is an attempt to dwell on aforementioned Topic of prime significance. This might help in preparing an Engineering vision document for overall progress.

After all, Engineers are the shadow of the Society and builders of Humanity; we are truly living in an explosive Knowledge Century as envisioned by Sir Ray Kurzwell, noted American author.

BACKGROUND AND SIGNIFICANCE

It is well known that phenomenal scientific and technological developments have occurred during nineteenth and twentieth centuries with a slurry of discoveries and inventions. Twenty first century is reaping the applications benefits, transforming society in all facets.

The quest for research, development and innovation amongst scientific and engineering community globally as well as nationally, has resulted in technologies propelling science through the conduit of engineering.

An attempt is made here to have a comprehensive look at broad aspects encompassing science, engineering and technology with its historical background, accomplishments, scientific and technological developments for societal gains and mankind progress.

Specially, emphasis is laid on frontier/strategic technological data, realization and milestones, future vision and missions in the coming decades in Nuclear, Defence and Space sectors to ensure strategic goals inclusive of sustained growth and national security. This indigenous growth is phenomenal for nation's overall strength.

There is a need to have an introspective approach for future vision and innovative strategies with a high level of professionalism in engineering and technology cross-disciplines, leading to quality education and research, thus ensuring sustained and inclusive growth with self-reliance towards nation's technology prowess. Crucial bottlenecks in specific areas are touched upon.

LEGACY

When we look back at the world scenario and Indian legacy, it is heart warming to note the pioneering role of global visionaries responsible for inventions and discoveries leading to Industrial, Aviation , Communication, Automobile , strategic sectors namely Space, Nuclear, Defence and all round scientific and technological revolutions.

We remember towering personalities like Edison, Newton, Bell, Galileo, Feynmann, Einstein and Boson and Indian illuminaries as Raman, Bose, Saha, and Visvesvarya, to name a few benefitting Mankind.

The fusion of Nuclear Sciences and

Technologies was evident in the form of Atomic bombs which were deployed during August, 1945 over Japan, but for destructive purposes.

STRATEGIC DEVELOPMENTS AND MILESTONES

Post independence , from 1948 onwards, India ventured and prepared a road map// blueprint in the strategic sectors of Industrial growth, Defence, Atomic Energy and Space.
Dr S S Bhatnagar established Council of Scientific and Industrial Research [[CSIR]]. Further, Defence Research and Development Organization [[DRDO]] was created.

More importantly, Dr Homi Bhabha pioneered the Department of Atomic Energy [[DAE]] and finally, Dr Vikram Sarabhai conceptualized the formation of Indian Space Research Organization [[ISRO]].

LANDMARKS

The nation has definitely accomplished credible milestones leading to it's strategic strength and independence. A few of them are narrated below.

I]ATOMIC ENERGY // NUCLEAR TECHNOLOGY=
In this sector, intensive research led to successful nuclear explosions=== Pokharan I during 1974, was India's first attempt and capability was proven to the world at large. Subsequently, Pokharan II blasted phenomenally in 1998, India's second Operation - Shakti, this being the most important high technology event during 1998, at the close of the Twentieth century, establishing nation's credence as a Nuclear power.
Concentrated efforts in Nuclear and Reactor developments led to Atomic Power generation in the Country creating Energy revolution with commissioning of successful Nuclear Power Plants across the country, presently accounting to a total generation of 5800mw approx. It is immensely satisfying to note that the latest Kundamkulam Power plant has started producing 1000 megawatts [100% capacity] of clean and safe energy. Jaitapur plant to be established in future shall be a gigantic one in the coming decade. Thus, the total nuclear power capacity must target about 20,000 mw by 2024. The nation's safety standards and accident free regime during the past five decades is well testified.
Substantial progress is achieved in the advanced Fast Breeder Reactor Technology [FBRT] at Kalpakkam. Further, DAE is envisioning the essential Research inputs in the frontier Nuclear Fusion, the Technology of Tomorrow.

Further Nuclear Fuel research led to substantial gains; Uranium, Thorium and Plutonium enrichment technology indigenization has been accomplished.

In addition, diverse Atomic Scientific and Engineering inter-disciplinary feats are being realized based on cutting edge research and innovations.

LANDMARK

II] DEFENCE RESEARCH AND DEVELOPMENT

Similarly in the Defence activity, the objectives were to develop Surface to Surface and Surface to Air missiles for induction into the armed forces.

The focussed vision led to the successful implementation of Integrated Guided Missiles Development Program [IGMDP] envisioned in 1980's, fructifying and consisting of Akash, Nag, Prithvi, Trishul and Agni missiles series upto Agni IV during the past three decades. Powerful Agni V is on the anvil, marching towards Inter Continental Ballistic Missiles [[ICBM] arena in a few years time.

Another success story is about landmark Brahmos supersonic missiles [a joint collaborative venture between India and Russia.]

Nuclear submarines and INS Arihant are other classic frontiers.

Yet another remarkable feat lies in the fruition of the recent Tejas project==Light Combat Aircraft [[LCA]], though schedulewise, it is delayed.

Recently, DRDO conduced the First Interceptor Missile Test at supersonic speeds sufficient to destroy incoming missiles at high altitudes of 120—140 kms.

Apart from above, numerous Military related weapons, devices and systems are in place.

However, a self reliant defence production base with a dedicated industrial corridor is overdue and immediately required.

LANDMARKS

III] SPACE SCIENCES, TECHNOLOGY AND APPLICATIONS=

Indian Space Program is a saga of a stupendous success story testifying fifty years of excellence and surging ahead. It is a story of focussed Vision and Mission. The initiation is with 'dream, imagine, ideate, design, develop, qualify, perform and fly from 'Laboratory to Orbit'.

The world Space activity commenced in 1957 with Russia sending Sputnik satellite into orbit. America joined the race resulting in spectacular events involving Launch Vehicles, Satellites, International Space Stations, Inter-Planetary explorations and so on.

India' historic Space journey commenced on November 21, 1963 when a small pencil nike-apache rocket took off from Thumba Equatorial Rocket Launching Station, Trivandrum. This gave birth to exhaustive Space technological activities in Launchers, Spacecrafts and Applications, establishing ISRO network all over the nation and overseas; now the Country is a leading Space Power hub, globally.

Accomplishments in Launch Vehicles over the period include Satellite Launch Vehicle [SLV], Augmented Satellite Launch Vehicle [ASLV], Polar Satellite Launch Vehicle [PSLV] and Geosynchrous Satellite Launch Vehicles [GSLV] and GSLV MARK III, presently in test mode.

Accomplishments in Satellites consisted of Aryabhata, Bhaskara, Indian Remote Sensing [IRS], Indian National Satellites [INSAT], Geostationary Satellites [GSAT], Indian Regional Navigation Satellites System [IRNSS], presently under progress.

Steadily, Space Applications have benefitted Mankind tremendously, transforming the country in all dimensions of Societal progress.

From 1963 till 2010, ISRO matured in Communications, Broadcasting, Meteorology, Remote Sensing, Satellite Imageries, Disaster Management etc towards National prosperity.

State of art achievements during the start of twenty first century took a new leaf in Interplanetary Missions.

Chandrayaan I Moon mission during November, 2008 was a landmark in Lunar exploration from global standards.

The unique Mars Orbiter Mission [MOM], launched on November 05, 2013 and after cruising a distance of about 680 million kms for 300 days in helio-centric orbit, was precisely inserted in specified Mars Orbit on September 24, 2014, a truly historic event in the annals of Indian Science and Technology. The same is in good health and functioning meticulously as per desired objectives and in liaison with Deep Space Communication Network, proving to be a world class exercise-another landmark in its quest for Inter-Planetary Martian exploration via PSLV's 25th silver jubilee launch.

GSLV D5 with indigenous Cryogenic stage [[complex hi-tech saga]] during January 2014 is another Technological milestone, marching towards self reliance in the embago scenario. The most recent launch of PSLV C-24 with Indian Regional Navigation Satellite [IRNSS-II] is aimed towards developing India's Global Positioning System [GPS].

India's vision 2025 document comprises of IRNSS operationalization, Astrosat, Aditya [for Solar studies], Chandrayaan II, Mars Orbiter II, enhanced Imaging capability, Reusable Vehicles, GSLV MK III operationalization, Manned missions amongst others.

ISRO is a classic example of indigenization and self reliance displaying excellence in collaboration with Academia-- R&D Organizations---Industrial alliance fructifying in state of art Space Technologies of global standards---a unique feat of Technology prowess .

CRUCIAL AND VARIED CHALLENGES CONFRONTING THE NATION

This is to concede that the country is striving to be a developed one in twenty years time frame.

Yet its technical menifesto requires attention from competent authorities and policy makers.

- `India's technology in Defence with heavy dependancy on foreign sources of Military Equipments supply is a hindrance to self reliance=== need of the hour is for rapid Indigenization and Productionization of relevant Products and Systems, developed by DRDO.

- Enhancement of production and delivery of high purity Electronic and Semi-conductor grade metals and materials [99.999% purity], despite abundant ores storage in the country.

- Medical Instrumentation===this is a very heavy imports based industry with heavy F.E. drain. Enormous potential exists indigenously in Bio-Medical Engineering sector. Here the inhouse talent is untapped due to paucity of encouragement from stake holders and inspirational support between the Engineering and Medical professionals, arguably the best force in the world.

TECHNOLOGIES EMERGED DURING THE LAST CENTURY

We are well aware of stupendous progress in these disciplines, transforming humanity at large.

✓ Telecommunications
✓ Instrumentation
✓ Automobiles
✓ Civil, Infrastructure and Transportation
✓ Power and Energy
✓ Chemicals and Polymers
✓ Thermal Engineering
✓ Micro-crystalline, Amorphous materials and Metallic glasses
✓ Smart functional Electronic and Structural materials and Composites
✓ Agriculture and Fertilizers
✓ Pharmacy and Drugs
✓ Geology and Biodiversity
✓ Biology, Zoology and Botany
✓ Healthcare and Medical Engineering
✓ Information technology
✓ Bio technology
✓ Oceanography and Earth sciences
✓ Petrochemicals, Oil and Gas exploration
✓ Greenhouse effect, Climatology and Environment
✓ Astronomy
✓ Modern Particle Physics

EMERGING MODERN TECHNOLOGIES IN THE PRESENT CENTURY

Engineering disciplines are breaking all barriers resulting in novel subjects; it is vital for the nation to catch up in the following visionary approach, if we are to attain global technical standards.

✓ Aerospace and Aeronautics
✓ Nucear and Atomic Energy
✓ Defence [R&D]
✓ Visual and Simulation engineering
✓ Robotics
✓ Artificial Intelligence
✓ Genomics
✓ Genetics
✓ Nano Technology
✓ Nano materials, devices, tools and products
✓ Micro and Nano electro mechanical systems
✓ Pollution and carbon emission control
✓ Internet, mobile, i pad, tab, apps evolution
✓ Advanced computing and IT enabled services
✓ Green revolution
✓ Internet technology enabled vehicles
✓ Stem Cell technology and Therapy
✓ Fuels –Helium, Methane, Shale gas, Hydrogen, Deutrium
✓ Super Critical and Ultra Super Critical Clean Thermal Power Generation
✓ Neural Engineering
✓ Tissue Engineering

A number of cutting-edge Research topics include:

>Electric Aircraft with Lithium batteries

>Wireless electronic implantable sensors and devices as pace makers etc

>Anti bacterial fabric bandages for infection free human bodies

>Microchip circuits with minimal power to drive prosthetic limbs

>Silicon based lenses for cellphone camera with cost effective microscope

>Mechatronics==Design plus Electronics shaping the future

>Particle physics and Neutrino=towards Large Haldron Collider==study of Universe

>Indian Neutrino Observatory planning and implementation-located underground in Theni district off Madurai, Tamilnadu

>Thirty Metre Telescope [TMT] , [Hawaai, USA]-a global project-India, a co-partner in the group of Nations

>Science to create new form of Matter from Light

>International Thermo-Electric Experimental Research Project [ITER]in USA, India, a co-partner in the group of Nations

TWENTY FIRST CENTURY DIVIDENDS===FUTURISTIC PREDICTIONS

=By 2029, Computers will match Human Intelligence===Ray Kurzwell

=Materials===Graphene, Carbon Nano tubes and Tin are wonder materials of tomorrow for Energy, Electronics and Computing applications with a mission approach.

=Energy===Exponential growth from Solar, Moon, Nuclear, Biofuels and renewables is in the offing.

=Energy from Moon-a gigantic [Japanese innovative project] will be a reality.

=Defence---

Inter-Continental Ballistic Missiles, Space war [[Military Satellites]], Nuclear sub marines as modern warfare are probables.

=Space age---

>Earth—Moon---Mars travel and Human resettlement // rehabilitation may be a reality post 2023 and by 2050.

>Electric Propulsion with Nanotechnology base might be a reality for Space Launches

>Nuclear Propulsion Launches also might be a reality.

>Space Elevator project [[NASA]] by 2100 is an ambitious one.

A VISIONARY THOUGHT-PROGRESSIVE PHILOSOPHY

''Because of the explosive nature of exponential growth, the 21st century is equivalent to 20,000 years of progress at today's rate, about a thousand times higher than the 20th century'===RAY KURZWELL, AMERICAN AUTHOR

TRANSFORMING INDIA

A VISION IN INNOVATIVE ENGINEERING RESEACH TO MATCH GLOBAL SCALES

It is of dire necessity that the nation builds up an Intellectual Think Tank of qualified Engineering and Technological professionals from institutions excelling in innovations.

A sustained national growth with Public Private Partnership model is required in all spheres.

QUALITY ENGINEERING EDUCATION AND RESEARCH

This is to follow a future blue print.

Engineering disciplines must be a blend of conventional and modern knowledge era.

The regular stream constitutes of Computer Sciences, Information Technology, Civil, Mechanical, Production, Electrical, Electronics and Communication, Architecture, Chemical and Materials.

In a bid to provide interdisciplinary knowledge, the last decade has witnessed a novel addition of engineering programmes added by major Engineering institutions across the nation.

This includes Aeronautics, Aerospace, Nanotechnology, Nuclear, Biomedical, Petroleum, Energy, VLSI, Instrumentation, Environmental Sciences, Structural, Marine, Naval Architecture, Systems, Robotics, Mechatronics, Modelling, Simulation, Construction and a host of others. This is vital to address challenges in Heathcare, Energy, Environment, Infrastructural growth, Advanced Manufacturing, modernization of Railways, Airports and Ports, modern cities concept, modern Industrial corridors and so on. Innumerable opportunities exists for all Engineers of all branches in this century- the traditional mindset must change for a better tomorrow.

This requires Educational growth coupled with cross-disciplinary Research ,Innovation, Technology Management, Academia=R&D Organizations=Industry Fora.

Bridging the gap between the end Products of the Institution and vital requirements of the Industry related sector is a priority subject.

Accreditation and recognition of authentic universities and Engineering/Technology institutions at National and International arena amongst fierce competitiveness is significant. Equally important are Patenting and Intellectual Property Rights awareness. Additionally, the main yardstick to promote the growth of Research culture constitutes of Faculty development and Core competence, Research publications in International and National Journals//Conferences, Master Indices copy with innovative coding for ready referral, evaluation of Scopus Factor, Citation Index and Impact Factor to match global standards.

Further, sponsorship of novel research proposals by competent authorities, primarily, Department of Science and Technology [DST], Technology Information, Forecasting and Assessment Council [TIFAC] and other Governmental/ Ministerial sponsoring bodies is another determining factor.

In our quest towards quality, Doctors and Masters Research programs must match International standards.

As already stressed, continuing innovative research forms an integral component of academia. Unrelenting technological developments are the key, bridging the gap between the products of the institutions and the end requirements of Industries and R&D organizations.

A FINAL WORD ON INNOVATION

Innovation may be defined as exploring new ideas leading to the creation of a new product , process or system or an improvement in the existing one leading to Frugal engineering advancements.

Innovation is invention or discovery plus new additional value contributing to better efficient output.

Innovation also means venturing into an exploratory journey towards new and untested technologies and employing out of the box thinking

Invention, development, implementation, diffusion and recognition are five important pillars of innovation.

SUMMARY:

In today's gobally competetive scenario, the Nation looks forward towards a new revolutionary road map in Engineering and Technological Research and Innovations for creating a Knowledge Society in this century. Digital India is proving to be a reality.

It is heartwarming to note that Space, Nuclear and Defence sectors are focussed with clear vision and missions orientation, playing a substantial role in the near future nation's status as a global power hub.

Breaking all barriers in engineering and allied disciplines and focussing on a multipronged strategy is the only solution to steer the future. Competent technical manpower and proper resources are to be tapped and built.

Engineers are the shadow of the society and the builders of the nation; this profession shall always be evergreen so long humanity exists; let us pledge ourselves to work towards developing a prosperous and a truly developed nation in the coming decades, the world can witness.

After all, Knowledge Engineering can rejuvenate the country's Technology prowess and all of us. Truly we are living in an explosive Knowledge Century, as envisioned by the American author.

Modeling Energy-Economic System for Strategizing Energy- The Conceptual Model XYZ - 3T with A Global Perspective

S P Chary[1] and S Bhaskar Ram[2]

Abstract:

Design patterns describe the higher level of abstraction and organization of solution to common problems. Design Space refers to the frame-work of Design Patterns in which various interrelated Design Patterns tend to describe the problem, its context along with the envisaged solution as well as its application in more general terms. The conceptual model, for Strategizing Energy, consists of the sub-systems –Ideology, Methodology, Technology and Resources. Ideology is to decide the type of power supply to be selected- whether to go for isolated or grid connected power. Methodology decides the source of power- whether it is Nuclear or fossil fuel based, Wind or Hydro-electric, Solar- thermal or solar photo-voltaic or OTEC power plant .The conceptual model XYZ-3T covers both the hydro-sphere and the atmosphere with its global co-ordinates of latitude X, longitude Y, and altitude Z, along with the temporal dimensions (3T), spanning past, Present and future times altogether. To meet the ever increasing demand for energy, there is a need for strategizing energy for ensuring sustainable development. Modeling Energy-Economic Systems is an integral part of the popular Model -View-Control Design pattern which converts a Threat into an Opportunity in the SWOT analysis creating the 'MODI'FIED SWOT analysis. With the deregulation of Diesel price,

Two major fuels-petrol and diesel are now shifted to market pricing mode at present in India.

Keywords: Design Patterns, Design Space, Strategizing Energy, Conceptual Model XYZ-3T

1. INTRODUCTION:

Design Patterns, classified into Creational, Structural and Behavioral Patterns, can be used in modeling the energy-economic systems with a global perspective easily[1,2,3,4,5,6,7,8].

1.1 METHOD OF CO_ORDINATES:-Ancient astronomers made use of a special system of co-ordinates on an imaginary celestial sphere to determine the position of brightest stars and made the maps of the stellar sky. Latter on the system of geographical co-ordinates found wide application for making maps of the earth's surface to determine the position of ships on high seas. Until 17th century, the method of co-ordinates found little practical utility only for indicating location of specific objects-immovable (a hill or a cape) or the movable ship or a planet. In his book on Geometry, published in 1637, RENE DESCARTES observed that the co-ordinates of a point moving along a given curve are associated with a particular equation which

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completely characterizes that curve. The turning point in mathematics was due to DESCARTES' variable magnitude concept of co-ordinates x and y is the mathematical basis of the Analytical Geometry and its peculiar method of describing geometrical figures- a figure given by an equation. An equation may be seen as a means of selecting points constituting the figure defined by the equation. A curve defined by an equation is treated as a function. Closer to this concept is the method of describing figures by inequalities. This concept is a simpler idea and easy to understand that can be explained easily by the Graph theory. When the co-ordinate axes are perpendicular to one another they are called as the Cartesian co-ordinates. The geographical co-ordinate system chosen for the Conceptual Model XYZ-3T are depicted as latitude, longitude and altitude indicated by the Cartesian co-ordinates XYZ coupled with 3T, the temporal co-ordinates of the past, present and future times all taken together.

2. COGENERATION: Cogeneration or the combined heat and power is defined as the sequential generation of two different forms of useful energy from a single primary energy source.

2.1Factors influencing cogeneration choice-

*Base electrical load matching:-In this configuration, the cogeneration plant is sized to meet the minimum electricity demand of the site based on the historical demand curve. The rest of the needed power purchased from the utility grid. The thermal energy requirement of the site could be met by the cogeneration system alone or by additional boilers.

*Base thermal load matching: The cogeneration system is sized to supply the minimum thermal energy requirement of the site. Stand –by boilers or burners are operated during the periods of increased demand.

*Electrical load matching:-All the power needs of the site at any time, including the reserves needed during scheduled and unscheduled maintenance are to be taken into account while sizing the system. This is also referred to as a stand- alone system.

*Thermal load matching:-The cogeneration system is designed to meet the thermal energy requirement of the site at any time. The prime movers are operated following the thermal demand.

*Heat- to- power ratio:-It is defined as the ratio of thermal energy electricity required by the energy facility The heat –to-power ratio of a facility should match with the characteristics of the co-generation system to be installed. The ratio of heat -to-power required by a site may vary during different times of the day and seasons of the year. Importing power from the grid can make up the shortfall in electrical output from the cogeneration unit and firing stand by boilers can satisfy additional heat demand.

*Load Patterns:-The heat and power demand patterns of the user affect the size and type of the co-generation system and Fuels available.A rice mill needs mechanical power for milling and heat for paddy drying. If a co-generation system were considered, steam turbine system would be the first priority because it can use the rice husk as the fuel which is available as a waste product from the mill.

*Quality of thermal energy needed:-For a sugar mill needing thermal energy at about 120 degrees centigrade, a topping cycle co-generation system can meet the heat demand. For a cement plant, requiring thermal energy at about 1450 degrees centigrade, a bottoming cycle cogeneration system can meet the requirements of both high quality thermal energy and electricity demands of the plant.

*System reliability:-A pulp and paper industry Cannot operate with prolonged unavailability of process steam. In such cases, the cogeneration system to be installed must be modular.

*Grid dependent system vs stand alone system: A grid dependent system has access to the grid to buy or sell electricity. The grid -independent system is also known as a stand-alone system that meets all the energy demands of the site.

* Retrofit versus New installation:-If the co-generation system is installed as a retrofit, the System must be designed so that the existing energy conversion system such as the boilers, can still be used. In such a circumstance, the option for co-generation system would depend on whether the system is a retrofit. .

*Back pressure turbine:-Depending on the pressure (or temperature) levels at which process steam is required, the back pressure steam turbines can have different configurations like simple back pressure, extraction back pressure,double extraction backpressure types.

3. COMBINED HEAT AND POWER:-.

The case study of a project being undertaken by Dubai-based company which has begun a two year test on a new wind turbine that is designed to produce up to 100 litres of drinkable water in an hour reveals that it could play a big part in helping solve water problems in desert areas across the Middle-East, [8] which, despite of the very high humidity in the air during the summer months, rely heavily on desalinated water. The turbine (24meters high, with a 13 meter dia.) works by driving in air, which is heated to become steam and then condensed .The condensate is accumulated and filtered in the Main-stem of the turbine. This eventually becomes the drinking water. The aim of the trial is to show that the turbine can work under the hottest conditions, with temperatures reaching close to 50 degrees centigrade during the UAE summer.The project is called as WIND TO WATER.

3.1 Solar photovoltaic & solar- thermal systems: The International Energy Agency (IEA) reports said that the Solar Photovoltaic (PV) systems could generate upto16% of the world's electricity by 2050 .The solar thermal electricity (STE) from concentrating solar power plants could provide further 11%.

3.2 Decreasing cost of photovoltaic modules and systems: The rapid cost decrease of photovoltaic modules and systems in the last few years has opened new perspectives for using solar energy as a major source of electricity in the coming years and decades. Solar photovoltaic (PV) panels constitute the fastest growing renewable energy technology in the world since the year 2000 although solar is still less than 1% of the energy capacity worldwide. According to IEA the solar PV expansion would be lead by China followed by USA while STE could also grow in the USA along with Africa, India and the Middle East.

4. URBANIZATION AN OPPORTUNITY: Urbanization can be treated as an Opportunity for faster development and not as a Threat, according to the Indian Prime minister, Narendra Modi . He said that India needs at least 100 Smart Cities to match the speed of Urbanization.

4.1 The Sustainable development is defined as development that meets the needs of the present, without compromising the ability of the future generations to meet their own needs.

4.2 Global warming & climatic change: Industrial revolution, through fossil combustion, changing agricultural practices and deforestation, the natural composition of gases in the atmosphere is getting affected with the consequent climate change and the environmental degradation. The key green house gas causing global warming is carbon dioxide which has two major anthropogenic sources: Combustion of fossil fuels and changes in land use patterns. Since 80% of all the anthropogenic carbon dioxide comes from fossil fuel combustion, the world energy use has emerged at the centre of the climate change debate. Starting in the 19th century and intensifying in20th century, Industrial capitalism has relied on the mining of fossil fuels in the form of coal, oil, and natural gas from underneath the surface of the earth. The countries with the highest contributions to the global concentrations also have the highest economic wealth today. Similarly, the GDP growth rates for much of the past century have been synchronous with the growth in green house gas emissions. If future climate impacts are to be reduced to manageable levels, it has become clear that all countries need to shift their development pathways such that Global emissions peak well before2050. Even this, it appears, may barely be sufficient to provide a fighting chance for avoiding a 2 degree centigrade rise in global average temperature which is seen as 'guardrail' against the cascading climate affects. The impact of climate change has just begun to make its mark. Its most devastating effects will be experienced by the poorest in those countries that have emitted the least. Thus, Bangladesh, responsible for less than 0.2% of the cumulative emissions will face devastating challenges as a result of the sea level rise, flood sand landslides, affecting nearly 120 million people who are some of the poorest people in the world. Several small island states face the prospect of losing their land completely, creating a new category of 'climate exiles'. India too can expect to face more intense flooding, droughts, sea level rise and variability in monsoons accompanied by secondary effects such as destruction of ecosystems and threats to livelihoods, public health and food security. An emerging country like India needs to get serious about climate compatible development that prioritizes the provision of energy services for the 300 million or so of its poor. Planning cities, power stations, agriculture and modes of living that are sustainable for generations to come is the real challenge.

4.3 Water ways can revolutionize transport:-
India's waterways could contribute at least two percent to the country's GDP according to the Union Shipping Minister, Nitin Gadkari in an interaction with journalists. He said that developing waterways is our top priority as it will revolutionize (transport). Waterways were cheaper than Rail and road, less polluting and resulted in fewer accidents. He said that the government was planning to introduce sea-planes, water busses, Hovercrafts and floating hotels to connect coastal towns to boost the waterway tourism. We will turn all water bodies... dams, lakes etc.into water ports (like airports) he said. There will be revolutionary change in water transport and shipping in the coming two years. He also spelled out plans to develop the ship-breaking industry and shipping industry was his highest priority.

4.4 Climate change threatens food production: We all have heard about the dangers of climate change on world food security, but by2050 our ability to produce food may be lowered by upto10 percent due to rising air pollution according to new research published by 'Nature, Climate Change'."Human activities have increased the concentration of carbon dioxide by over 30 percent during the last 200 years and this figure is expected double by the end of the century says the lead author Arnold Bloom. Our report found this change in air pollution inhibits the growth of field grown wheat by 10 percent". According to Mr. Bloom air pollution will affect both urban and rural farming alike. Field-grown wheat is a staple crop for most developing countries, if not addressed, these findings show food security will suffer more than previously predicted. Adding to the crisis, worldwide food demand is set to rise by 50 percent in 2050. "Climate change is already making people being hungry" says Robin Willoughby Oxfam U.K.'s policy adviser on food." Rising temperatures and increasingly extreme and erratic weather patterns are making it harder to grow enough food to eat. Climate change threatens to put the fight to eradicate hunger back by decades.

4.5 The conceptual modelXYZ-3T: taken together with its sub-systems of Ideology, Methodology, Technology and Resources describe the energy economic system to strategize the Energy with a global perspective. The chosen Ideology and Methodology coupled with a proper choice of Technology help to conserve the material and Energy resources in the Energy-economic system to meet the development goals with minimum environmental impact. Global warming is expected to impact the availability of basic necessities like fresh water, food and energy.
India has not even utilised its fair share of the earth's carbon space nor, has it achieved basic minimum standards of living for its entire population. Environmental limitations of energy technologies have to be kept in mind while dealing with environment and never as, something external to the economy.

5 TRANSPORTATION FUEL HYDROGEN AS RESOURCE & HYDROGEN ECONOMY

The PV-electrolysis systems have the potential to become available for large-scale hydrogen production as well as for individual stand-alone applications .Electrolysis can also be used with hydro, wind, wave current, tidal and ocean-thermal energy conversion system produced electricity. The concept of a hydro-hydrogen clean energy system is under Investigation, in a 100 MW international project. The goal of this investigation is to prove the feasibility of conversion of the Canadian hydro power into hydrogen, the maritime transport of liquid hydrogen or methyl cyclo-hexane to Europe and storage, distribution and end use there. In the hydrogen energy system it is envisaged that from the production plants and/or storage, the hydrogen will be transported to consumers by means of underground pipelines and/or the hydrogen can be regionally transported and distributed both as a gas and as liquid by pipe lines or in insulated containers by road and rail transportation.

5.1 Efficient use of hydrogen in electricity generation will become very important for solar power plants where hydrogen serves as an energy storage medium.. When the supply of solar energy is higher than demand, the surplus energy can be used in electrolysers to produce hydrogen and when the demand is higher than the solar energy, electricity can be produced from hydrogen via 'FUEL CELLS'. Hydrogen/air fuel cells in conjunction with an electric motor are about two times as efficient as internal combustion engines and do not generate any emissions(except water). They are considered to be ideal for the new generation, zero emission vehicles. In Space vehicles, they carry their fuel as well as the oxidant necessary for the scheduled range...Fuel cells are similar to electrolysers but operate in reverse ie, generate D.C. Electricity using hydrogen and oxygen instead of producing hydrogen and oxygen using D.C.

6. MEGA TONS TO MEGA WATTS: ENERGY AND DIPLOMACY

Dr. Thomas Neff , a physicist at M.I.T. noted that the Soviets have been selling increasing amounts of natural and enriched uranium in western commercial market feeding downward price spiral that has driven some uranium producers out of business and threatened the uranium enrichment business of Americas Energy Department, the world's largest supplier of commercial fuel. This was one of the reasons for Dr.Neff to propose what was latter called the Mega tons to Mega watts programme in an editorial entitled ' Grand Uranium Bargain In the New York Times onOctober,24,1991.The Soviet Government was struggling to transform itself economically and politically while maintaining control of more than 24,000 nuclear weapons in the newly formed Independent Republics. Russians wanted to dismantle a few thousand nuclear weapons; they had little cash to do it safely so that the material would not fall into wrong hands. It was vital to carry out the programme cautiously keeping its non-proliferation objectives intact."The warheads contain substantial amounts of valuable material that can be processed for use in commercial nuclear power plants. It may be advantageous to U.S. to buy or barter for such materials and turn them safely to commercial use. This can be done in ways that protect Western and Soviet security and commercial interests" Dr. Neff proposed . Under the proposal , Russia down-blended 500 tons of enriched uranium into15,259 tonnes of reactor grade uranium over a period of 20 years .U.S .gave back to Russia a similar quantity of natural Uranium to that used to down blend the highly enriched uranium(HEU). This historic project which concluded on December 31, 2013, is the largest and most successful nuclear non-proliferation program to date.

7. ETHIOPIAN RENAISSANCE DAM ON BLUE NILE COULD RECONFIGURE POLITICAL POWER IN EAST AFRICA[7]

The Blue Nile escapes Lake -Tana in the Ethiopian high lands, tumbling thousands of meters westwards through narrow gorges, carrying 86% of the Nile's Eventual flow..At Khartoum , in Sudan the river joins the White Nile and heads north through the Egyptian desert and drains into the Mediterranean sea through the Nile delta that nourishes 60% of Egypt's85 million people. Once complete, the Renaissance dam shall stand 145 meter tall at the head of a 74 billion cubic meters (b c m) reservoir, a volume greater than the Blue Nile's annual flow. Egypt gets 85% of it's fresh water from the river Nile.

The Ethiopian government insisted that the Nile was safe as the Renaissance dam was intended to generate electricity rather than for irrigation. In the diplomacy that followed the rhetoric, the two countries agreed to deepen existing consultations on the down-stream impacts of the dam. on reconfiguration of political power along the Nile basin. For the eight other riparian nations, Burundi ,DR Congo , Kenya, Rwanda,, the Sudans, Tanzania and Uganda , the dam has triggered a much needed conversation: A colonial water sharing framework guarantees Egypt almost two thirds of th e Nile's yearly flows, gives it the power to veto any project on the river even as denies all other nations, except Sudan, the right to draw water without prior permission. "I think it would be important to have the discussions in a new context" said African union chair person Nikosazzana Dlamini-zuma at a press conference " not in the context of the colonial powers but in the context of an Africanism and African renaissance."

The most intriguing piece of the Nile puzzle is that, despite building Africa's largest hydropower project on the river Nile, Ethiopia is the least likely to substantially eat into the Egypt's water supply. The Renaissance dam is 25 km from the Sudan border and so is unlikely to be used for consumptive purposes like irrigation.. Egypt's major head ache is how Ethiopia chooses to fill the giant74 bcm reservoir. Both Ethiopia and Egypt have a legitimate point. The Ethiopian point is correct that this dam will not cut Egypt's water supply after The Renaissance dam is completed because Ethiopia will ant to release water in order to generate hydro 'power "said Dale Whttington , a professor of environmental sciences and engineering at the university of North Carolina, U.S.," Egypt has a legitimate concern about how the reservoir is filled and also how the reservoir will be operated during periods of future drought." If Ethiopia chooses to fill its reservoir in years when the river is high, excess flood waters can simply be diverted into the reservoir. The Ethiopian government said that the reservoir would be filled in five to seven years-which implies a diversion of ten to fifteen bcm. or between 20% to25% of the Blue Nile's annual flow. By contrast, filling the dam during a period of drought shall have serious repercussions for Egypt and Sudan. Prof Whittington points out that the Renaissance dam and Egypt's Aswan high dam need to be viewed as two offsetting parts of a larger hydrological system. At the current levels, the reservoir at Aswan high dam reservoir looses about14 bcm a year to evaporation. Once the Renaissance dam is filled, the Aswan reservoir will run at a lower level loosing less water through evaporation and will compensate for evaporation losses from the reservoir behind the Grand Renaissance dam, as it will be cooler than at Aswan, due to cool climate, less surface area because of the greater depth at the Grand Renaissance dam reservoir in Ethiopia.

8. 2014 PHYSICS NOBEL PRIZE FOR LONG LASTING BREAKTHROUGH IN LEDs: The 2014 Physics Nobel prize recognizes contribution to saving natural resources. The Nobel committee said LEDs contribute to saving the Earth's resources because about one-fourth of the world's electricity consumption is used for lighting purposes. LED technology holds particular promise in lighting up parts of the developing world with poor electricity grids, Nobel committee member Olga Bother said. Ultraviolet LEDs can be used to sterilize water. The LEDs tend to last 10 times longer than fluorescent lamps and 100 times longer than the incandescent light bulbs.The red and green light emitting diodes have been around since the mid-20th century and the scientists had struggled for decades to produce the shorter-wave-length Blue LED needed in combination with Red and Green LEDs to produce the white light when the three Nobel laureates made break-through in the early 90s. Their work enabled LED lights more efficient long-lasting than the previous light sources to be used in a range of applications .. The Nobel committee said" Incandescent light bulbs lit the 20th century; the 21st century will be lit by LED lamps.Solar powered LED lights are also taking the world by storm. Today LEDs are used in smart phones and lamps. White light from LEDs is more efficient. In contrast to the incandescent bulbs and fluorescent lamps, LEDs directly convert electricity into light with a higher efficiency.

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10. APPEENDICES:

10.1 A Hyderabad based company-'Smart Track': Working in the field of solar energy, has developed a power plant on the top of roof by collaborating with IIT –Mumbai to set up a one Mega Watt solar power plant on the roof of Academic building in IIT-Mumbai campus. The company used its own tracking technology with a promise of45% enhanced Power production compared to the conventional non-tracking solar power plant with the help of a microprocessor based controller which represents an indigenously developed roof top tracking technology. Green energy is an area of strategic, technological leadership for India to build upon over the next decade. India's Future energy security depends on taking as many villages as possible outside national grid.

*Use of Nuclear fuels for power generation will avoid the release of carbon dioxide where- as use of a clean energy source like Hydrogen will replace carbon dioxide simply by water vapour.

*Using the potential energy of water near the Grand renaissance dam will convert it into electrical energy releasing the entire water flow to the downstream side. Using grid connected solar photo-voltaic roof top solar power plants we can increase the share of solar energy in the Energy-Economic System of any nation.

*The combined nuclear power and desalination plant as in the case of the Kalpakam Fast Breeder reactor at Chennai is a typical example of Combined Heat and Power (CHP) Strategy which can easily be adapted in the proposed Sagarmala Project by the present Government with several such Nuclear reactors in a row all along the sea coast on either side of India.

*Russian president Vladimir Putin and Indian Prime Minister, Narendra Modi discussed the possibility of building another pipeline planned along the route of the TAPI (Turkmenistan-Afghanistan- Pakistan-India) to carry hydrocarbons to India.

10.2 Deregulation of Diesel: The biggest wave of economic reforms since coming to power, the NDA Government on Saturday deregulated the price of diesel and announced a new price for the domestically produced natural gas. With the cabinet decision, the price of diesel, as in case of petrol

would be market linked without any government intervention and retail rates reflecting price changes in the global market impacting the prices of fertilizers, CNG,PNG and power costs as well.

29th Indian Engineering Congress

Technical Session V

MANUFACTURING - KEY TO INDUSTRIAL DEVELOPMENT

The Institution of Engineers (India)
Andhra Pradesh State Centre

INVITED TALK

MATERIALS SCIENCE AND ENGINEERING: A NEW PARADIGM

Dr N.R. Bandyopadhyay,[1]

ABSTRACT

We are currently at the early but secure and irreversible stages of a remarkable and far reaching materials revolution. The materials sector has emerged as a science based knowledge intensive high technology area with serious repercussion for technical change, competitiveness, growth in employment, trade patterns, location of manufacturing activities and global division of labour. Moreover new materials development is an essential part of attempts to resolve the pressing environmental problems in mining, metallurgy and global eco-system.

Materials scientists and engineers are now able to intervene at the electronic, atomic and molecular structure of matter, in order to both synthesize and process new materials. These breakthroughs in materials science and engineering are having two consequences. Firstly, the new insight has permeated traditional and conventional materials leading to marked improvement in processing technologies. Secondly, the transformation underway have spawned proliferating clusters of high performance, knowledge based new and advanced materials, high temperature super conducting materials, advanced composite, engineering polymers etc.

Technical change across all high technology fields today critically depends on advances in the development of materials. For example existing materials cannot meet the stringent technology requirements of the next generation electronic devices, which necessitate even more highly advanced materials synthesis and processing technologies and the critical understanding of Physical Metallurgy and Quantum Mechanics.

This view is best understood in Japan, at both Government and senior management level. Advanced material programme have been in place since the early eighties in Japan. In the USA, several experts have identified advanced materials as most important issue facing the economy in the 1990s.

India is in the process of devising long run material strategies. Over the last 30 years, even in our country, many firm in traditional industries such as steel, petrochemicals, glass, ceramics, electronic material have been reducing their dependence on commodity material production while moving towards knowledge intensive higher value added specialties and diversifying into new and advanced materials.

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Development of materials: 21st Century approaches

The development of materials for the coming century has to follow from clear vision/composite functionality, i.e. the combination of service performance, processing advantage and ecological sustainability. Service requirement specificity is one of the key factors playing an important role in materials activity In the high temperature application area, intermetallic are considered as immensely important. Intermetallic like Ni_3Al, Fe_3Al, Al_3Ti and many others are of great concern for 21st century. The different atom species occupy different designated lattice sites and have strong bonds to make them intrinsically very strong. Interesting to note, is that Ni_3Al, a major constituent of nickel based super alloy, exhibits an anomalous sharp rise in strength with increase in temperature. But the room temperature brittleness of these intermetallic renders them unsuitable, till date, for structural application.

It is the order of the day to talk about functionally graded material, i.e. the specific material for just meeting the specific needs, without having any over design whatsoever in anywhere, yet processing and product character being eco-compatible. The high specific strength materials will fall under this category. The materials of interest may be ultra high strength steels (250Mpa) having very high toughness. Steels superior to mar aging variety is in the offing, for being used in aerospace for the supersonic speed of carriers. The other variety of interest is the high strength low alloy steel where the conservation of natural resources is the philosophy underlying the development. Only micro level alloying is meant to be responsible for giving high strength and high toughness at sub ambient temperatures. So the 21st century will witness ultra high strength steels with high ductility at room temperature and at sub ambient temperatures—a combination of mutually opposing material properties.

There are examples of energy-efficient new materials that are developed or being studied by the materials scientists and engineers. Gas-Filled Panels (GFP), use thin polymer films and low-conductivity gas to create a device with amazing thermal insulation properties. GFPs are basically airtight plastic bags that can take on a variety of shapes and sizes. Inside the outer barrier is a cellular structure called baffle. They are filled with gases like argon, krypton gas and xenon. Energy use of domestic refrigerator/freezers is directly influenced by the overall thermal performance of the cabinet and doors. An advanced thermal insulation technology can improve the efficiency of appliances such as refrigerators.

Insulation materials are vital in buildings designed for low energy use and good thermal comfort. Increasing the thermal resistance of the insulation is an useful strategy to lower heating costs when thermal loads are subjugated by the building envelope. Thermal insulation will be increasingly important in the future development of cars, because major improvements in gas mileage can be achieved by downsizing the heating, ventilation and air-conditioning tools. Waste reduction and higher thermal performance compared to close-cell foam is possible using Gas-Filled Panels.

Another important newly developed material is Aerogel. Aerogel is a lightweight, advanced material that consists of more than 96 percent air. The remaining four percent is a matrix of silica, a principal raw material for glass. This material is one of the lightest weight solid ever developed. Possible uses of Aerogels include environmentally friendly, energy-efficient, recyclable alternatives for polyurethane foam in freezers, refrigerators and refrigerated vehicles, alternative insulators in appliances such as water heaters and ovens, aerospace industry applications, optoelectronic applications, magnetic composites that may be useful for paramagnetic cooling at ambient temperatures.

Another field of materials research having tremendous importance is improvement of solar cell. Now the effort is to develop materials such that a single system of alloys incorporating indium, gallium, and nitrogen can convert virtually the full spectrum of sunlight-from the near infrared to the far ultraviolet-to electrical current. If solar cells can be made with this alloy, they promise to be rugged, relatively inexpensive and the most efficient ever created.

Development of a solid oxide fuel cell (SOFC) promises to generate electricity as cheaply as the most efficient gas turbine. This innovation, which paves the way for pollution-free power generators that serve neighborhoods and industrial sites, lies in replacing ceramic electrodes with stainless-steel-supported electrodes that are stronger, easier to manufacture, and most importantly cheaper. This latter advantage marks a turning point in the push to develop commercially viable fuel cells.

In the field of space research the focus is to make the space vehicle lighter. One of the ways to make space vehicles lighter, safer, more reliable and better performing is to design advanced chemical propellants for use across the entire range of propulsion requirements. These new chemical species have significantly higher performance limits than conventional or near-term advanced propellants. Some candidate propellants include liquid hydrocarbons for heavy-lift booster rockets, cryogenic propellants for upper stages, liquid and solid oxidizers for boost and upper stages, and monopropellants for upper stages and satellite propulsion

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Smart materials have properties that can be radically changed. A range of smart materials already exists, and is being researched expansively. These are piezoelectric materials, magneto-rheostatic materials, electro-rheostatic materials and shape memory alloys. Some everyday items are already including smart materials and the number of applications is growing steadily. Each type of smart material has a special property, which can be extensively altered.

The property that can be changed control the types of applications of the smart material.

The super conductors with (high Tc) is the other important material, the people of 21st century are supposed to produce and use. Not only the chemistry is very important for them equally important but the means of manufacturing the same. Concurrent with this, one is now needed to know the characteristics of ultra pure materials — a concept ignored till recent times. Thermodynamically, contaminated solids are energetically more stable and hence one is not aware of the characteristics of absolutely pure materials and the effect of addition of other pure elements of known amount on properties. Conceptually it is very important for electronic materials. However the task is uphill, needing one to go against the known rule of thermodynamics. Will this need base approach give birth to a new law of thermodynamics? But the target is very clear for 21st century -its a purity of nine to eleven nines (99.9999999) compatible to the need for super performance of electrical and electronics devices proposed to meet the challenges of rapidity of 21st century. The development of ultra strong permanent magnet is equally needed in the 21st century will witness the usage of Fel6N2magnetic materials along with iron-rare earth metal-nitrogen [Fe-REM-N] type strong permanent magnet. The element nitrogen known hitherto harmful to magnetic materials is now so important for them acting as an interstitial element.

Many of the fantastic materials revealing their potentials for 21st century are oxides. A very charming observation is that, to go against the nature by metals and alloys by isolation of components of oxides is a temporary event as the products are brought back to what nature are, i.e. oxides, through the process of corrosion -a fantastic thing! Let us further note that the oxides are emerging as potential super materials in many areas. The study of oxide as a bulk and specifically as a surface material lags behind the needs identified in them. The main reasons are the less understanding in the complex crystallography in them and the difficulty in the available experimental techniques. Nevertheless, to exploit the potential of oxides as advanced materials, happens to be a severe challenge in the of the 21st century, since the oxides are quite near to what our earth is born with and enables one to maximize eco-compatibility by ensuring the equilibrium state of this planet. The construction of 21st century is framed in balancing social, economic and ecological needs. Reminded by Paul Kennedy through his book 'Preparing for 21st century that the greatest test for human society as it is to confront 21st century is how to use power of technology to meet the challenges thrown by power of population, one is enticed to believe that unless the concept of power of balance is resorted to the appropriate weighing of today's demands against tomorrow's needs in the perspective of meaningful environmental protection, with some fairness and equity among the rich and poorer members of the global community, the world is going to be damaged; so much so that all the efforts to construct a new century will turn futile.

In lieu of conclusion:

Many of the wonders of ancient world including that of iron Pillar at Delhi, have been the monuments of the desire of human being to posit themselves and to illustrate their intellectual evolution in terms of structures they were capable of constructing. Here-in comes the very pertinent question of how the history will judge us! What are those emblematic we leave behind as the landmark of our intellectual progress - are these the floods and draughts, the hazardous wastes or any such by products of advanced technology? In this respect, the materials technology can influence a lot by way of being re-described as a powerful tool to secure a balance between the present and future, between consumption and conservation. It is the challenge to this generation to create a new relationship between human kind and its materials, linking the brilliance of nature and life with its wisdom and technology so that the creative powers of man are continued to be nurtured in a meaningful way during 21st century too.

NOVEL CONDUCTING PAPER FROM BACTERIAL CELLULOSE AND POLYANILINE

Divya Anand[1] and Mudrika Khandelwal[2]

Abstract:

Development of new greener material for conducting paper is sought for applications such as security paper, actuators, and anti-static packaging. It is required that these materials possess low density and good mechanical integrity. For this purpose, cellulose substrates are explored. Bacterial cellulose has been shown to be a better substrate due to ultrafine microstructure and porosity. The synthesis protocol has been optimized with respect to the molar ratio of aniline monomer to oxidizer. Preliminary results with optimized synthesis protocol and bacterial cellulose as substrate has shown promising microstructure.

KEYWORDS:-Bacterial Cellulose, Filter Paper, Conducting Polymer Composite, Polyaniline.

INTRODUCTION

Conducting paper constitutes a class of materials suitable for applications such as sensors, actuators, anti-static packaging, biomedicines, protective clothing and potential battery applications. For the above mentioned applications, it becomes necessary to develop materials which possess good conductivity, mechanical flexibility, along with light weight, low cost [1]. With increasing environmental concern, greener materials and processing technologies are also sought.

Given these requirements, polymers are bound to play an important role due to their exceptional low density. Polyaniline (PANI) is one of the preferred conducting polymer, while others include polypyrrole, polyacetylene, polythiophenes and so on, because of its good environmental stability, high electrical conductivity, facile synthesis and relatively low synthesis cost [2].Unlike other conducting polymers, PANI can be synthesized in water with an oxidizer [3]. It exists in various forms which differs in chemical and physical properties [4]. It exhibits three different oxidation states (a) leucoemeraldine-white/clear and colorless (b) emeraldine-green for the emeraldine salt and blue for emeraldine base (c) (per) nigeraniline-blue/violet [5]. The green protonated (emeraldine) state is usually preferred because it has conductivity higher than many polymers and similar to semi-conductors [6]. Its sensitivity to changes in its physicochemical properties makes it a suitable candidate in various applications such as organic electrodes, sensors, and actuators [7-8].

However, there are several problems associated with using PANI for the proposed purpose. One major problem with conducting polymers is lack of mechanical integrity. Therefore the difficulty in processibility limits its potential applications [10]. Large ranges of materials with good mechanical properties have been used as substrates to produce PANI composites. These substrates include cellulose, rubber, plastic and textile [11-14]. Cellulose and its derivatives are preferred

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These substrates include cellulose, rubber, plastic and textile [11-14]. Cellulose and its derivatives are preferred because of their abundance, low environmental impact. It can be obtained from many sources such as trees, plants, algae, fungi and bacteria.

It is said “there are as many polyaniline as the number of people who prepare them” [9]. Thus a major challenge is to always optimize protocol of PANI synthesis in each lab.

The proposed work aims to provide direction towards greener, flexible, light weight conducting paper from bacterial cellulose and polyaniline composite. This work reports optimization of the strategy to obtain the composite by in situ polymerization.

MATERIALS AND EXPERIMENT

Aniline monomer and ammonium persulfate (APS) were purchased from Sigma-Aldrich, India. Toluene and hydrochloric acid were ordered from Alfa Aesar India. Laboratory prepared bacterial cellulose was donated by Dr. Mudrika Khandelwal from her previous work for this research. FESEM was used to study the morphology of both the substrates. Filter paper and bacterial cellulose was gold coated and imaged at 10 kV. The penetration studies were performed on filter paper and bacterial cellulose in order to get an idea of absorption of toluene and HCl.

In order to produce polyaniline, several synthesis chemistry protocols were tried. Two sets of experiments were conducted -

1. 0.2 M Aniline in 37% HCl and 0.2 M APS in water were used in molar ratio 5:1, 3:1, 1:1, 1:3, 1:5

2. 0.2 M Aniline in Toluene and 0.2 M APS in 37% HCl were used in molar ratio 3:1, 1:1, 1:3 The reaction was carried out at room temperature for 24 hours. The polymer was obtained by using a filter paper and washing with DI water and acetone.

Further FTIR was done in order to verify the presence of functional groups in polyaniline. Finally a composite was prepared by carrying out polymerization in presence of BC as substrate.

RESULTS AND DISCUSSION

1. Choice of substrate

a) Microstructure - Filter paper and BC

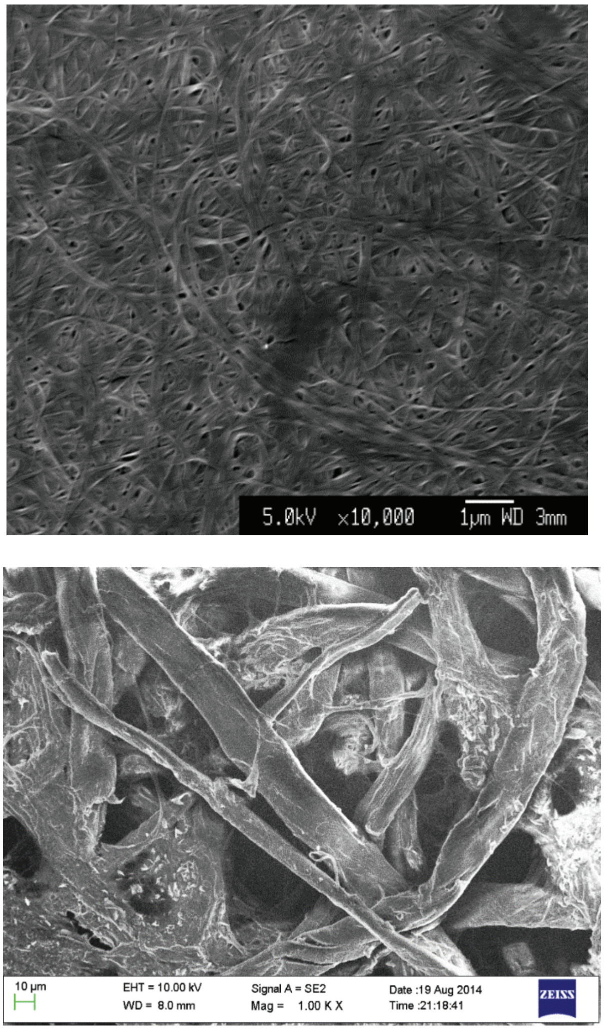
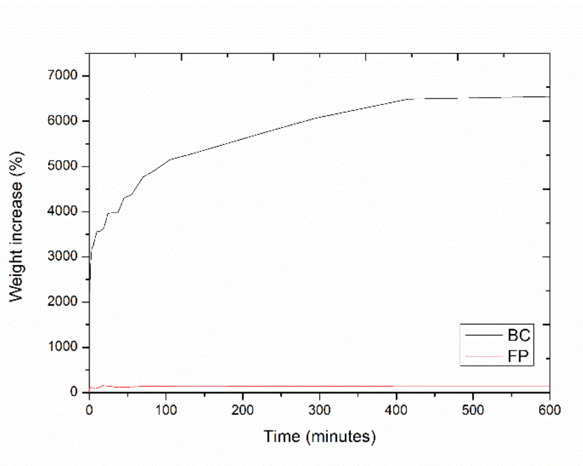


Figure 1 SEM images of (a) Bacterial Cellulose and (b) Filter Paper

Figure 1 shows fibrous structure of bacterial cellulose and filter paper. The difference lies in the dimension of fibres forming the two cellulose matrices. The bacterial cellulose fibres are in nano dimensions whereas the filter paper is composed of micro sized fibres. BC fibres are uniform while filter paper fibres have varied dimensions.

b) Penetration kinetics

In order to perform in situ polymerization, permeability of matrix is very important because for the polymerization to happen, the solvents carrying monomer and oxidising agent should travel inside the matrix. From the literature, toluene and HCl are commonly used in polyaniline synthesis, therefore the study has been carried out on these liquids.



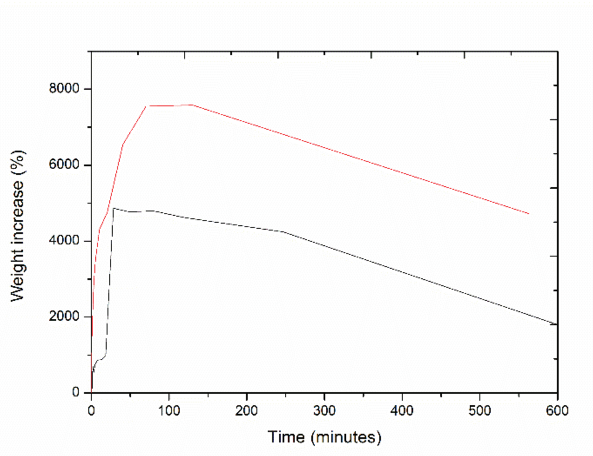


Figure 2: The gain in weight with time for BC and FP in toluene (BC=black, FP=red) and 37% HCl (FP=black, BC=red)

Figure 2 shows that the rise in weight is quicker and more for BC as compared to FP. This is because of high porosity and higher holding capacity of BC.

2. Synthesis

Two synthesis protocols have been tried as described in experiments above. The obtained results are summarized below.

Green coloured powders were obtained in most experiments, which is a signature of emeraldine polyaniline. The yield varied.

a) Experiment 1:

Aniline was dissolved in HCl and APS was dissolved in water. The molar ratio was varied. Green powders were obtained in systems with Aniline / APS molar ratio more than 1. Brown powders in the rest. Yield scaled up with volume. Table 1 below shows photos of powders obtained and weight. The yield has been quantified in terms of final weight of powder with respect to weight of reactants. Yield was higher for molar ratio more than 1.

b) Experiment 2:

Aniline was dissolved in HCl and APS was dissolved in Toluene. The molar ratio was varied. Dark green powders were obtained in all.

FTIR spectra for all the powders is discussed below. Further work was done with Aniline/ APS =1 using conditions in experiment 1.

Experiment 1

APS/Aniline molar ratio: -5:1

Polyaniline obtained - 0.0378 g
Brown powder was collected

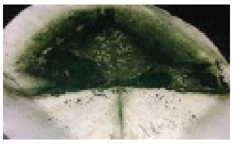
APS/Aniline molar ratio: -3:1

Polyaniline obtained - 0.0486 g
Brown powder was collected

APS/Aniline molar ratio: -1:1

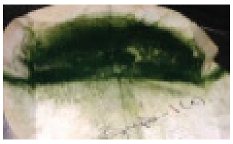
Polyaniline obtained - 0.0745 g
Dark Green powder was collected

APS/Aniline molar ratio: -1: 3



Polyaniline obtained - 0.054 g
Dark Green powder was collected

APS/Aniline molar ratio: -1: 5



Polyaniline obtained - 0.0719 g
Dark Green powder was collected

Table 1: Experiment set 1: molar ratio, weight of reactants, final powders and yield

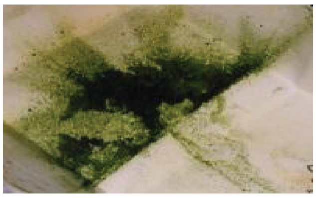
APS/Aniline molar ratio	Weight of APS+Aniline	Weight obtained	Weight obtained/Weight of APS+Aniline
5:1	1.23	0.038	0.01
3:1	0.77	0.048	0.06
1:1	0.64	0.075	0.12
1:3	0.51	0.054	0.1
1:5	0.69	0.072	0.1
1:1	0.96	0.157	0.16

Experiment 2

APS/Aniline molar ratio: -3:1

Polyaniline obtained - 0.1106g
Dark Green powder was collected

APS/Aniline molar ratio: -1:1



Polyaniline obtained - 0.0318g
Green powder was collected

APS/Aniline molar ratio: -1: 3

Polyaniline obtained - 0.13025g
Yellowish green powder was collected

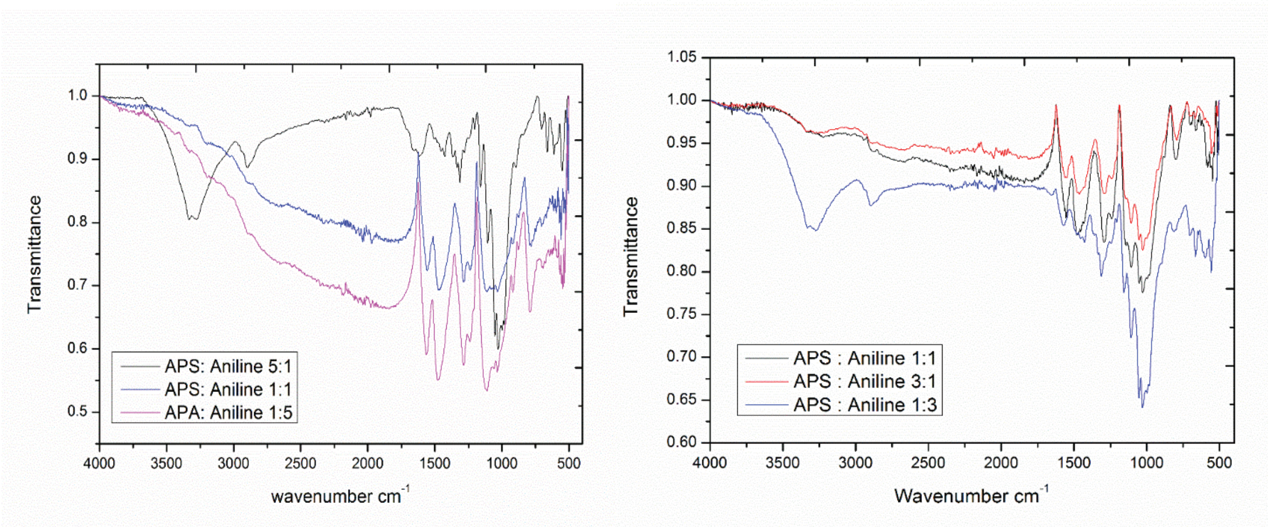
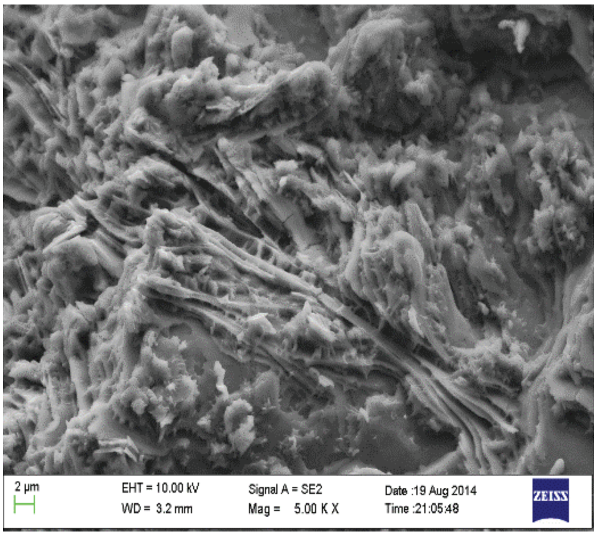


Figure 3: FTIR Spectra for experiment set 1 and 2 with indicated molar ratios

In the FTIR spectra, peaks corresponding to polyaniline can be identified. The absorption peaks observed include those corresponding to the stretching of quinone and benzene ring in PANI. The absorption band for the stretching of the C-N band and vibration of C-H in benzene are also visible. The absorption peak of N-H, C-O and C-N stretching is also seen. This confirms formation of PANI. However, a few extra peaks may be seen for molar ratio Anilne/APS less than 1.

3.Preparation of Composite

Further BC/PANI Composite was prepared using 1:1 composition of APS/Aniline which was conducting hence can easily be studied under FESEM image without using gold coating. It may be observed that BC nanofibres are well coated with PANI.



CONCLUSIONS

It has been shown that bacterial cellulose is a better substrate than filter paper due to its nanofibrous network and better porosity. Effect of Aniline to APS molar ratio on polyaniline synthesis has been studied. Ratios above 1 are favorable in terms of quality and yield. A preliminary result has been presented which shows good coating of the nanofibrous network with polyaniline. On the basis of these results, further work will be directed towards measurement of conductivity and mechanical properties and optimization of composite preparation accordingly.

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DYNAMIC RESPONSE OF HONEY COMB SANDWICH PANELS

PC Jain[1], G Jayanthi[2], Arindam Sarkar[3] & PSR Anjaneyulu[4]

ABSTRACT

Honey Comb sandwich construction uses thin, dense, strong facing materials bonded to a thick light weight core. Such construction provides weight effective solution for transferring the loads in bending action. The merit in structural applications of the panels is due to their extreme efficiency in terms of stiffness to weight and strength to weight ratios. Honey Comb structures find wide application in Aerospace and Mechanical Industries. A state of the art Finite Element Model is generated for the Honey Comb Panel to Predict the Mode Shapes and Frequencies of the Panel. The results of Finite Element based simulations are compared with experimental re-sults. A good match between the prediction and measurement proves the validity of simulation model. Such simulation models are further used for Honey Comb's parameter optimization and robust design.

Key Words: Honey Comb Panel, Finite Element, Modal Analysis, Frequency, Mode Shape.

1.INTRODUCTION

Most of the structural forms are derived from nature, so is Honeycomb, which closely resembles the bee's Honey comb (Fig 1a), found in nature. Structural Honey comb (Fig. 1b) consists of an array of open cells, formed from very thin sheets of material attached to each oth-er, usually cells from hexagons. The basic concept of Honey Comb sandwich construction is to use thin, dense, strong facing materials bonded to a thick light weight core, each component by itself is a relatively weak and flexible but when working together they provide an extremely stiff, strong and light weight structure. The Honeycomb sandwich construction is shown in Fig 2 . Honey Comb sandwich construction provides weight effective solution for transferring the loads in bending action. The bending action of plate causes outer surfaces of cross section to experi-ence maximum stresses and zero at neutral axis. Centre portion of cross section carries shear load. In case of flanged beam the flanges take the bending load one in compression and other in tension with the web taking all the shear loads, this concept works well where weight is not a critical concern. To reduce weight on flanged beam, flange thickness need to be reduced, which may cause a local buckling problem of flange tips, thus entire flange does not carry stresses up to material yield capacity. On the other hand the honey comb core completely supports the facing so very thin facings can be used which will not buckle. These skins can work up to material yield capacity. Thus honey comb sandwich construction is beneficial where weight of structure is critical. Honey comb panels demonstrates greater fatigue resistance as the honeycomb panel facings are continuously bonded to the core and therefore no stress concentration is seen. Various researchers have looked in to design aspects of honeycomb structures. Paik at el. [1] investigated the strength characteristics of

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aluminum sandwich panels with aluminum honeycomb core theoretically and experimentally. Gaetano al el. [2] discussed the theoretical and quantitative design and analysis of a honeycomb panel sandwich structures.

For the chosen material the facing sheets and core were analyzed for failure. Meifeng [3] introduced the

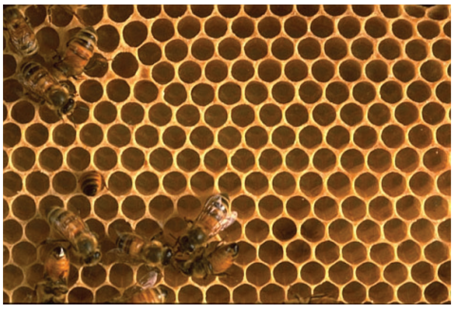

Fig1a: Bee's Hive (Honey comb)

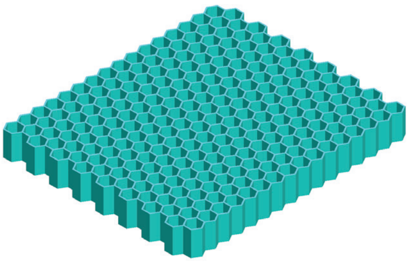

Fig1b: Hexagonal Honey comb cells

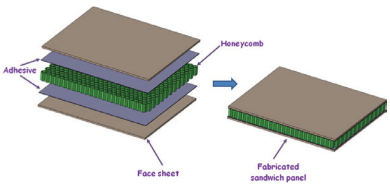

Fig. 2 The Honeycomb sandwich construction

mechanical properties of honeycomb sandwich panels and the weight ratio range of honeycomb core were used for design purpose. Jorg at el. [4] proposed a strain energy-based homogenization procedure. Hu at el. [5] considered sandwich plate theory to obtain equivalent models for numer-ical calculation. Kress at el. [6] addressed the phenomenon of face-sheet undulation of multi-material sandwich structures with honeycomb cores and also studied the effect of the deviation of the core geometry from the ideal of a regular hexagon. Petras at el. [7] investigated the failure modes for sandwich beams of Glass Fiber Reinforced Plastic laminate skins and Nomex honey-comb core. Bezazi at el. [8] carried out FE simulations to calculate in plane Poisson's Ratio and Young's Modulus for the new centre symmetric honeycomb composite structure under uni-axial loading condition. Balawi atel. [9] modeled the effective properties of honeycomb core by con-sidering that the honeycomb core cell walls are curved instead of linear in the vicinity of inter-section points of the hexagon due corrugation or expansion during manufacturing. Tom Bitzer [10] in his monograph discussed in great details the honeycomb sandwich construction, the man-ufacturing process and wide applications of honeycomb sandwich panels. First author [11] has provided brief description and advantages of using sandwich structures in his article.

Design of Honey Comb sandwich construction is based on the assumption that the facings take bending load (one skin in compression and other in tension) and the core takes shear load. It is also assumed that the facing stresses are uniformly distributed and the honey comb offers no resistance to bending There is uniform shear stress distribution throughout the core thickness. Preliminary design can be done using basic beam theory. Shear deformations are very important as the core shear modulus is low, some time design mechanical properties of honeycomb sandwich panels and the weight ratio range of honeycomb core were used for design purpose. Jorg at el. [4] proposed a strain energy-based homogenization procedure. Hu at el. [5] considered sandwich plate theory to obtain equivalent models for numer-ical calculation. Kress at el. [6] addressed the phenomenon of face-sheet undulation of multi-material sandwich structures with honeycomb cores and also studied the effect of the deviation of the core geometry from the ideal of a regular hexagon. Petras at el. [7] investigated the failure modes for sandwich beams of Glass Fiber Reinforced Plastic laminate skins and Nomex honey-comb core. Bezazi at el. [8] carried out FE simulations to calculate in plane Poisson's Ratio and Young's Modulus for the new centre symmetric honeycomb composite structure under uni-axial loading condition. Balawi atel. [9] modeled the effective properties of honeycomb core by con-sidering that the honeycomb core cell walls are curved instead of linear in the vicinity of inter-section points of the hexagon due corrugation or expansion during manufacturing. Tom Bitzer [10] in his monograph discussed in great details the honeycomb sandwich construction, the man-ufacturing process and wide applications of honeycomb sandwich panels. First author [11] has provided brief description and advantages of using sandwich structures in his article.

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2.MATHEMATICAL MODELING - FINITE ELEMENT BASED SI-MULATION

Honey Comb Sandwich panel of Size 300 mm x 300 mm was fabricated with material of Density 8360 kg /mm3 and Young's Modulus 220 GPa. The panel having core of Hexagon Shape with following dimension is considered.

Top & Bottom face sheet thickness = 0.5 mm
Core Sheet thickness = 0.1 mm
Core Height = 5 mm
Core Cell Size = 4.2 mm
Total Depth of Panel = 6 mm

Top, bottom plates and Honey comb core modeled using SHELL63 element available in ANSYS. The element has six degrees of freedom at each node: translations in the nodal x, y, and z directions and rotations about the nodal x, y, and z-axes. This element has both bending and membrane capabilities.

Both in-plane and normal loads are permitted. The Finite element model of the Panel is shown in the Fig 3 . The zoomed view of elements in the portion of top plate covered over the single core is shown in Fig 4. The Finite element model of the core alone segregated from full mesh is shown in the Fig 5 . The zoomed view of the core is shown in Fig 6.

Due to complex Honey Comb structure it is essential to automate the model genera-tion. Such automation is achieved using ANSYS Parametric Design Language (APDL). First the Single Hexagon Cell is constructed, then translated and copied in the x-direction. The row thus generated is translated and copied in y-direction. The top and bottom plates are glued to the periphery of Hexagon cells. During such model generation operations several duplicate entities are generated, which essentially need to be merged. Based on geometry input parame-ters the APDL program generates the geometry automatically. Such entities are further utilized for generating the Finite Element Mesh. To manage the large size of mesh, it was essential to use the component based approach in the ANSYS.

The thickness of top and bottom plate (0.5 mm) is assigned through real constant. Similarly the core sheet thickness (0.1 mm) assigned through separate real constant. The anal-ysis has been carried out for free-free Vibration condition. In order to get mode shape and fre-quency, free vibration analysis is carried out using Finite Element Method. Mode shapes of the system provide insight into expected deformation pattern under external excitation.

The Governing equation for modal analysis is given in Eqn 1. Standard Eigen value problem is solved using Block Lanczos Method [12].

$K\Phi = \omega^2 M\Phi$ .... Eqn. 1

Where

K - Stiffness matrix

M - Mass matrix

Φ - Mode shape vector

ω - Natural frequencies of the system

Based on modal analysis of free-free panel the first mode frequency is 273 Hz and second mode frequency is 407.2 Hz. The model has been further tuned to testing condition described in next section.

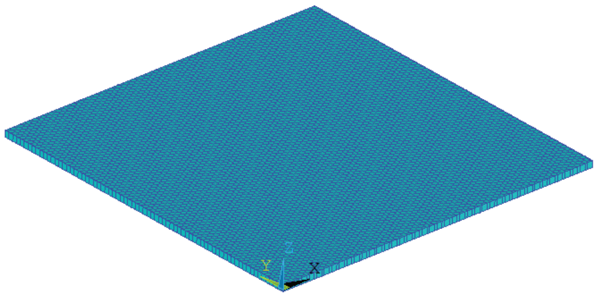


Fig 3 Finite Element Model of Honey Comb Panel

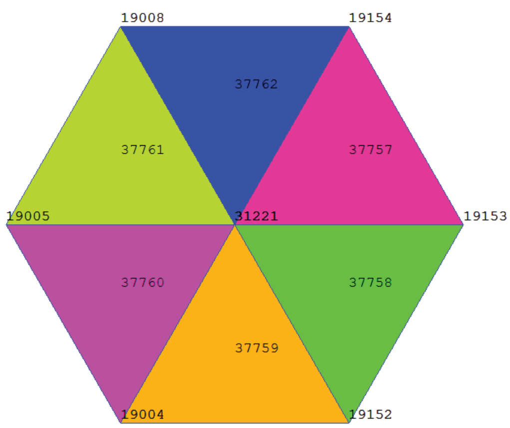


Fig 4 Zoomed view of Finite Ele-ment Mesh on top plate over single core

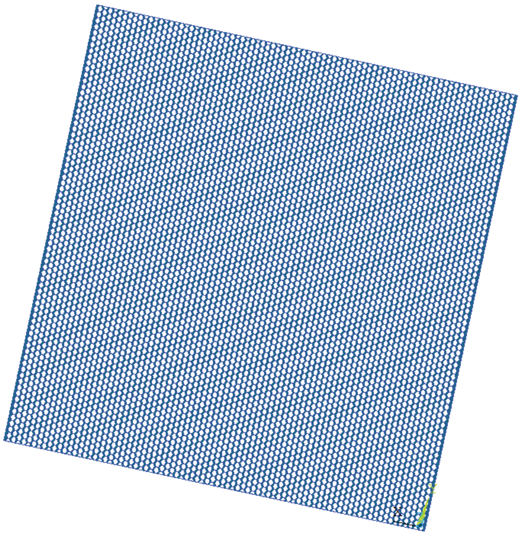


Fig 5 Finite Element Model of Core

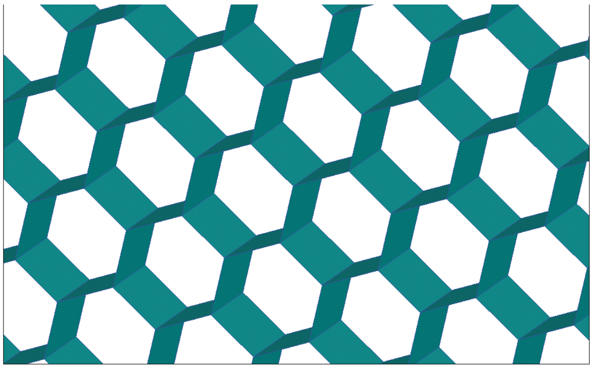


Fig 6 Zoomed View of Core

3. CORRELATION OF FE RESULTS WITH MEASUREMENT

Honey Comb panel is suspended with soft suspension cord as shown in Fig 7. Total 09 accelerometers were mounted on the panel at the locations shown in Fig. 8. The first mode measured frequency is 254.9 Hz and the second mode frequency is 386.53 Hz

In the testing condition additional mass is experienced on the panel due to shaker rod and ac-celerometer mass. In order to simulate testing condition 30 grams mass for shaker and 18 grams mass for accelerometers is added to the panel at appropriate place. The frequencies ob-tained after mass updating are compared in the Table -1. The experimental mode shapes matches well with the Finite Element Analysis predicted modes. The first mode shape is com-pared in Fig 9 and Fig 10. The Second mode shape is compared in Fig 11 and Fig 12.

Table-1 shows that measured Mode-I Frequency is 5 % less than the predicted frequency. For Mode-II such variation is 3.5 %. Although mismatch to this extent is acceptable, however this mismatch may be attributed to imperfection during manufacturing as plate was not perfectly flat, there was some warping. The thicknesses of top, bottom and core plate may have varia-tions locally. Also the bonding of top and bottom facing may have de-bonding at few places which leads to flexible configuration.

Table - 1

Comparison of FE results with Measurement

Mode	FE Simulation Frequency (Hz)	Experimental Frequency (Hz)
I	267.78	254.89
II	400.02	386.53

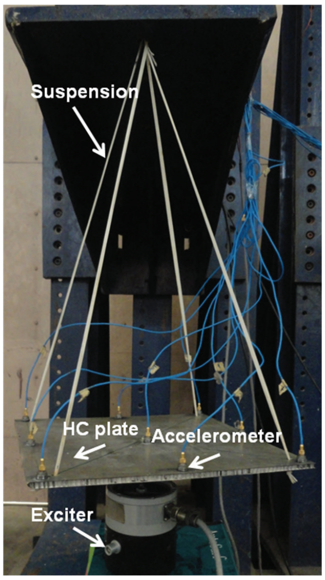
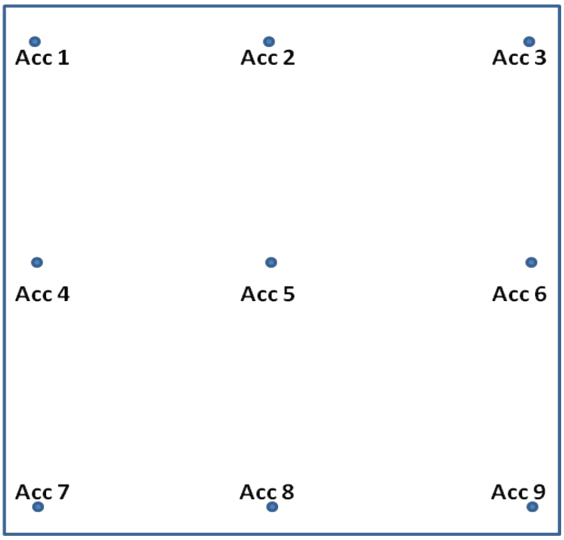


Fig 7 Honey Comb Panel suspension during Dynamic Testing



Accelerometer	X, m	Y, m
Acc 1	0	0
Acc 2	0	0.14
Acc 3	0	0.28
Acc 4	0.14	0
Acc 5	0.14	0.14
Acc 6	0.14	0.28
Acc 7	0.28	0
Acc 8	0.28	0.14
Acc 9	0.28	0.14

Fig 8 Honey Comb Panel Showing Accelerometer mounting location

Finite Element based methodology thus established will be further utilized for optimization of Honey Comb Panel, where Hex cell dimensions (side and thickness), top and bottom plate thickness and the core thickness need to be optimized for given structural application. Final structure to be checked for various failure modes using several different types of analysis. Specially to focus are facing failure which may occur in either compression or tension face, Caused by insufficient panel thickness or facing thickness. Transverse Shear Failure Caused by insufficient core shear strength or panel thickness. Flexure crushing of core Caused by in-sufficient core compressive strength or excessive beam deflection. Local crushing of core caused by low core compression strength. General Bucking caused by insufficient panel thickness or insufficient core shear rigidity. Shear Crimping caused due to low core shear modulus or low adhesive shear strength. Face Wrinkling ,It may buckle inward or outward, depending on relative strengths of core in compression and adhesive in flat wise tension. In-teracell buckling (dimpling) occurs with very thin facings and large core cells. This effect may cause failure by propagating across adjacent cells, thus introducing face wrinkling. The modeling approach proposed in this work can be used for any complex shaped Honey Comb Structures. It is propose to use Honey comb type of construction for Hypersonic vehicle. A typical non-prismatic section proposed to be made of Honey Comb construction is shown in Fig. 13.

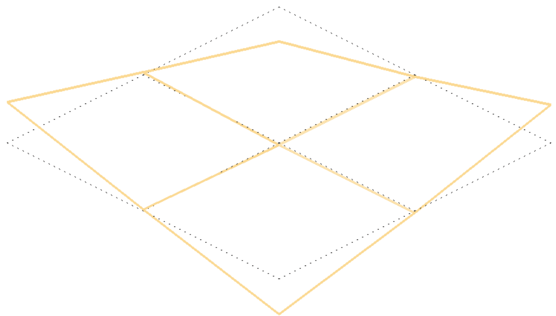


Fig 9 Experimental Mode-I (Freq 254.9 Hz)

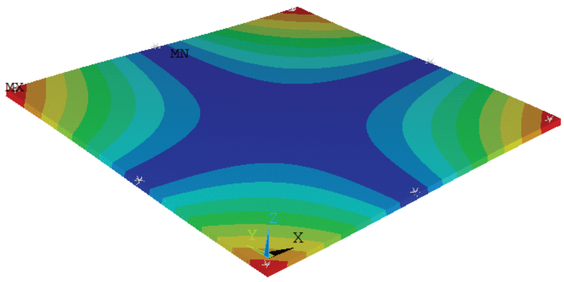


Fig 10 Predicted Mode-I (Freq 267.7 Hz)

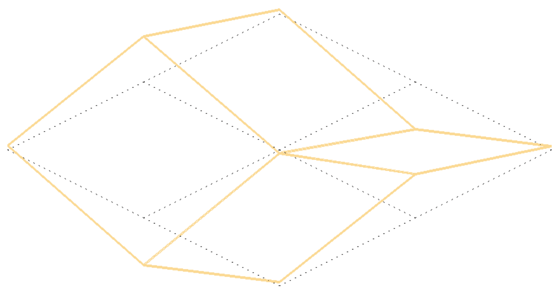


Fig 11 Experimental Mode – II(Freq 386.53 Hz)

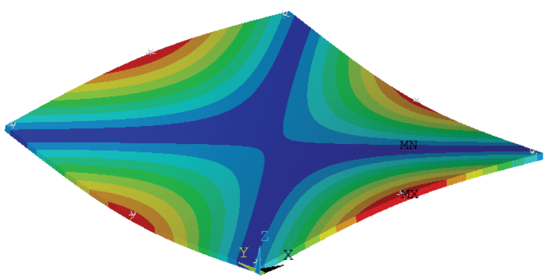


Fig 12 Predicted Mode – II (Freq 400 Hz)

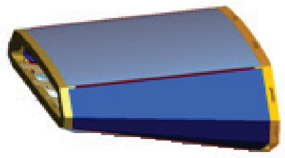


Fig 13 Non-prismatic section proposed to be made of Honey Comb

CONCLUSIONS

High fidelity Finite Element Based model is generated for the complex Honey Comb Panel using the automated algorithm. To manage large size Finite Element meshes , the com-ponent based strategy is suggested. Mode shapes and frequencies obtained using simulations are presented. In order to verify the accuracy of Finite Element Model the panel was subjected to dynamic testing. Experimental mode shapes and Predicted mode shapes matches well. The frequencies matched with 3-5 % difference. Mismatch may be attributed to imperfection dur-ing manufacturing. Such fine tuned model find wide application in further optimization of Honey Comb Panel, where Hex cell dimensions (side and thickness), top and bottom plate thickness and the core thickness need to be optimized for given structural application. Final structure to be checked for various failure modes using several different types of analysis. The modeling approach proposed in this work can be used for any complex shaped Honey Comb structure subjected to varied loading for which the simplified methods do not work well. Methodology also demonstrates the need for automation and parametric modeling for large problems high fidelity models.

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GREEN MANUFACTURING TECHNOLOGIES – A REVIEW

Darapu Swathisri[1] & Darapu Srikanth Satish Kumar[2]

Abstract:

This paper presents a review of green manufacturing technologies. The details regarding different types of modern and eco friendly manufacturing technologies that are being practiced by various industries are discussed. The prominence and steps to be followed for adopting green manufacturing technology is synopsized. The use and necessity of environmental friendly manufacturing technology is mainly focused upon. Need for replacing existing manufacturing technology for a particular industry with eco - friendly method is emphasized. The examples of different companies across the world implementing green manufacturing technologies are discussed. The savings of energy consumption by using renewable energy resources is compared to that of conventional energy resources.

KEYWORDS

Additive manufacturing, green technologies, metal working fluids, centralized controlled examination of pollution.

1.0 INTRODUCTION

Manufacturing is a derived word from middle French in Medieval Latin Manufactura (Manu + Factura) which means made by hand. From the stone age of ancient humans, many manufacturing techniques have been developed. But the first signs of modernized manufacturing method adoption were seen in the mid of sixteenth to seventeenth century. Manufacturing is a series of processes comprising of – selection of raw materials, production or fabrication of object or objects, building or constructing, assembling the parts, inspection or examination and finally dispatching. This is represented by the figure-1. It's the responsibility of industrialists to develop the economy of a country with their products and modern manufacturing techniques. Modernization is going at faster rates so as the needs of the humans. In order to meet their needs the Industrial sectors of many of the countries are following modern manufacturing techniques. Along with the modern methods they should see that new or existing method is not harming the natural resources and is not disturbing the chain of the ecosystem. Since the availability of natural resources is not in surplus their utilization should be optimized for future generations. The consumption of natural sources and hence energy by the human resource is being increased exponentially. So the need of the hour is 'frugal engineering'.

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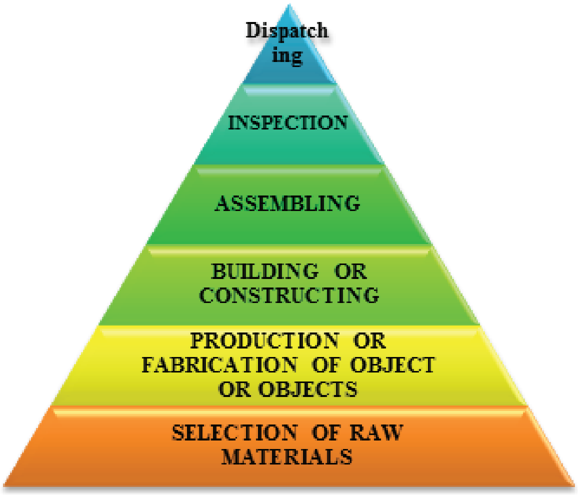


Fig-1: Sequence of manufacturing

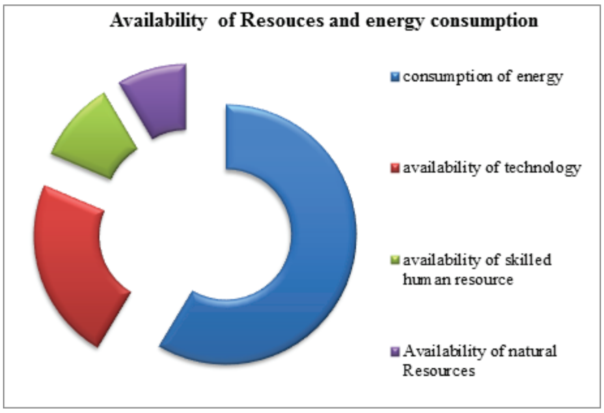


Fig-2: Comparison between Availability of Resources and energy consumption

2.0 CONVENTIONAL MANUFACTURING TECHNOLOGIES

There are many conventional manufacturing technologies such as casting, moulding, forming, machining, joining, additive manufacturing, rapid manufacturing etc. In most of the cases manufacturing is related to production industry.

Casting – A traditional manufacturing process in which a metal in its molten form is poured into a cavity of desired shape and left for cooling. After it gets solidified the mould is taken out of cavity. In this we have metal casting, plaster casting, concrete casting and plastic resin casting.

This is traditional practice. Modern casting is divided into two categories expendable and non-expendable casting. Expendable casting is used for sand, plastic, plaster and wax mouldings.In this method the moulds are of temporary and non reusable which increase the manufacturing waste which is a non biodegradable product. In non-expendable casting the mood need to be reformed after each cycle In this permanent mold casting, die casting, semi solid metal casting, centrifugal casting, continuous casting are done. There many other modern methods of casting but the waste disposed from casting industries is main criteria. This adds to pollution and has an enormous detrimental effect on the environment. Due to its nature of work and environment casting industry is polluting the environment. Few of the environmental issues associated with casting industries are foundry waste comprising of lead, zinc, cadmium which are very harmful to the workers, release of hazardous air pollutants that include carbon materials, gaseous pollutant benzene which gets released from cupola furnace is very harmful to health. An environmental management system is designed for planning, execution, checking and acting model for continual regulation of waste and examination on the production. But this system's spread is confined to large industries in which modern infrastructure is available. For small scale industries the level of pollutant emissions are high. There should be a centralized system to be developed to control level air pollution.

Machining – A process in which the raw metal block is cut into desired shape by controlled metal removal with help of some machines such as lathe, slotter, driller, planner etc. Machining includes abrading, cutting, drilling, grinding, slotting and shaping, etc. These processes are done by different machining processes such as ultrasonic machining, electrochemical machining, computer numerical machining, photochemical machining, dry machining, conventional machining etc. Chip generated in machining process is wasted and it is a time consuming method. For cutting purpose cutting, fluids such as water based - emulsions (soluble oil), chemical solutions (or synthetic fluids), mineral oils - fatty oils, composed oils, extreme pressure oils (EP), multiple use oils are used. These metal working fluids cause pollution because once the operation is performed they can't be used for more cycles, this is thrown out into the water bodies, soil causing hazardous pollution. This should be minimized by reduction in volume working fluids, using recycling technologies, alternative metal working fluid application strategies, etc. Additive manufacturing assists in less material loss and use of cutting fluids is also minimized. But the release of toxins is not reduced even in this manufacturing technique. It doesn't provide any fair and quantitative comprehensive life cycle assessment. Whether it is conventional machining or additive manufacturing but the health problems and pollution caused by both techniques due to working fluids are of the same extent. Hence there should be continuous examination of pollutant levels at each and every stage of manufacturing.

3.0 NEED FOR GREEN MANUFACTURING TECHNOLOGIES

A business would be successful if it focuses on the trends within the industry and in the global market. Now-- days in any developed or developing country a common word is being echoed in every industrial sector i.e., "Green Technology". It is mainly associated with production industry. Due to different types of production techniques there have been many green house gases released into the atmosphere since 100 years. This led to environmentally extremely detrimental phenomena of 'global warming'. And now it's the time to save our planet from the effect of these harmful gases. Hence many sustainable practices and eco-friendly operations have been standardized in every industry. Since there is enormous amount of energy consumption in conventional manufacturing methods, in order to reduce that usage many industries adopt green technologies. Green technologies optimize resource consumption, reduce wastage, adopt recycling and reuse techniques, so that the cost of production can also be optimized.

3.1 Different Types of Green Manufacturing Technologies

1. Operation of Energy Audits- The prime step for an industry to meet the eco-friendly status is to conduct energy audit on day to day basis and to observe where energy is being consumed in large amounts and replace it with green-technical equipment. For example replacing of traditional light bulbs with Compact Fluorescent Light Bulbs (CFLs). The change in consumption doesn't get notified at

once, but on long run there will be change in energy consumption. As there is decline in availability of fossil fuels and the global ecological balance is also being disturbed, hence the only survival strategy is to minimize the energy consumption. This holds for an industry as well as for an individual. Green products, which are embodied with less usage of energy, when employed in manufacturing and production would enhance the reduction in carbon emissions.

2. Use of Renewable and alternative energy – Shifting to consumption of conventional power which is produced by fossil fuels to power produced by solar, wind, tides, biomass etc. is the need of the hour. It's always a better option of constructing own eco-power source on-site so that the needs are met and emissions are reduced. Many governments provide incentives and tax free production for production of power from green technologies. If it's not possible for construction of such power source, they can be purchased from an external source which will be slightly costlier than conventional power. The costs incurred for the construction of green power sources may be high, but when compared to ecological benefits and optimization of energy, that would be a huge success in long term.

3. Application of 3 R's (Reduce, Reuse and Recycle) – Another way to reduce the production cost is to recycle of the production waste and construction of recycle plants so that wastage removal cost would be reduced.

4. Minimize the usage of water – Many of the industries add to water pollution - mainly production, textile, leather and construction.

5. Choosing alternative manufacturing techniques

6. Usage of telecommuting

7. Usage electronic mails rather than paper

8. Shifting to hybrid vehicles

3.2 Companies implementing Green Technologies

1. The world's leading industrial product is steel. Along with its production the green house gases released from its conventional manufacturing techniques are also high. Almost 1.5 billion tons of steel is being produced per year throughout the world. Each ton of steel production releases 2 tons of carbon dioxide into the atmosphere! This constitutes nearly 5% of the pollution and global warming. The researchers of Massachusetts Institute of Technology (MIT) have developed a technology that reduces the carbon emissions. Material Chemistry professor Donald Sadoway invented a new process of producing highly pure steel with nearly 0% carbon emission - instead oxygen is produced. The process comprises of using Iridium anode that uses Iron oxide to produce oxygen in abundance. This process is proposed by him during his research work of producing oxygen on lunar soil with the assistance of NASA's grant. Since the anode used is Iridium which is very expensive makes the production of steel expensive in small industries. If the production is carried out at larger scales then it would be reliable and feasible. But finding alternative to such a metal with high melting point (17230C) is difficult. Another Professor Antoine Allanore of metallurgy department amended the

current production method by replacing the anode electrode with same material but less thickness which is sufficient to produce electricity then the production could be done at viable cost. But this process is still on the laboratory scale waiting for proto type **c**onstruction and its result analysis.

2. The main motto of any production process is to complete manufacturing with less impact on the environment, consumes optimum energy for its production and produces minimal waste. Adopting green manufacturing techniques has a direct impact on the environment - by producing secondary product from the primary source. For example in Japan Kao's company- by using energy saving techniques which directly reduces the emission of green house gases - the carbon emissions were reduced by 1,00,000 tons from 1990 to 2008. One of the technique adopted by them is cogeneration – combined heat and power which is employed in plants that produce electricity from primary sources (oil, natural gas, biomass) at a temperature of 500 0C and is again reused as input into boilers as steam. From the date of adoption of this technique the conversion rate has been increased from 35% to 65%. By using this method nearly 80% of the primary source is converted into the product or service. The prime motive of Koa's is to curb the CO2 emissions. Kao's started using heat pumps which are used for refrigerating and air conditioning. Heat pumps have capacity to transfer heat from hot bodies to cold bodies and vise versa. From 1970's they started shifting to renewable energy sources from fossil fuels.

3. Production of solar photo voltaic cell, which is mainly comprised of silicon, by polysilicon manufacturing technique associates with handling of hazardous gases and usage of high power nearly 120 KW for producing one kilogram of silicon. This process mainly handles trichlorosilane gas which is very dangerous to workers and the surrounding atmosphere. Silicors process doesn't need handling with such type of gases and produces same amount of silicon as that above mentioned with just 20 KW to 30KW of power. The process comprises of melting metallurgical grade silicon which has impurities of boron and phosphorus in an aluminum smelt around 10230 K temperature. During this step the silicon achieves nearly 97 % of purity. After this the silicon forms into flakes and the impurities remains in aluminum, on cooling the silicon flakes gets solidified and the aluminum impurities are drained out, which can be used in purification of water. Acid is poured onto the silicon flakes so that rest of aluminum layer can be removed by just draining. Finally there will be very thin layer of aluminum coated over silicon that can be removed by simple techniques and this is last step of achieving pure silicon.

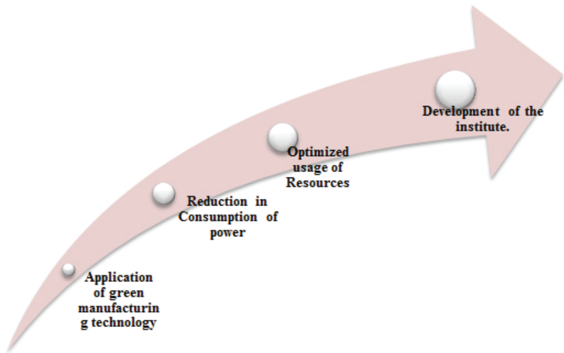
4. Construction industry is one of major sources of pollution and releases 4% of particulate pollutants into the atmosphere. It contributes to air pollution, water pollution and noise pollution. Construction of eco – friendly structure will not only help in provide better outdoor atmosphere but also healthier indoor atmosphere. Conventional construction materials and structure had lead

to many health problems. Along with the biological pollutants such as dust mites the chemical pollutants from paints, varnishes, solvents, plastics and composite timber are the main reasons for health problems like asthma, headaches, depression, eczema, palpitations and chronic fatigue syndrome. They have even secondary and tertiary effects. Green buildings constructed of natural and non-toxic products eliminate many of these problems. For over 5000 years lime was used as a building material. The modern constructing materials comprise cement. In UK many of the ancient buildings are of lime. Lime can be used in many forms such as lime putty; lime mortar and lime wash for construction purpose. When lime is in plaster form it absorbs carbon dioxide from the surrounding and form a thick calcium carbonate layer. It allows the moisture from the inside surface to outside, which is done in case of modern paintings on buildings with some toxic gases liberation. It also traps the necessary moisture. When cement, lime and sand are mixed in 1:2:9 proportion forms a tough mortar or plaster mix. But in wet state it is caustic which reduces its usage and the surfaces where lime coating is to be done they should be primed in order to get adhered. If these two draw backs of lime are rectified then lime would be a better construction material than cement. Use of Cob building techniques, natural insulation materials, biomass and green roofs make the building green

5. Some of the multi-national companies are claiming to go green. IKEA (Ingvar Kamprad Elmtaryd Agunnaryd) is using timber for

3.3 Result of Green manufacturing Technologies

The following diagram represents the development of an industry and hence the country when it adopts green manufacturing technologies. A country or industry is said to be developed not with the highest production rates or modern manufacturing technologies, but when it is successful at its production rate with the adoption of eco friendly manufacturing technologies. Its development is achieved step wise.



4.0 CONCLUSION

A development that has less impact on the surrounding atmosphere should be achieved by the industries throughout the world. Green technologies are not confined to regulate the pollution or recycling processes but it focuses on reducing the impact of manufacturing processes at each every stage of production. Green production is asserted which makes financial sense for business of all scales. Green Manufacturing focuses on primary goals such as minimization of emissions, effluents, accidents, use of virgin and non renewable energy resources, life cycle cost, product and services. An industry which was established already cannot shift suddenly from its conventional manufacturing methods to green manufacturing techniques since they initially incur high investment costs, but the budding industries can start directly with these green technologies so the cost of maintenance of the industry gets reduced on long run and our environment is safeguarded.

5.0 ACKNOWLEDGEMENT

This paper is dedicated to my parents Sri Busala Baburao and Smt. Lakshmi.

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The Role of Innovation and Key Strategies in Defence and Aerospace Manufacturing

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ABSTRACT

In the recent past, India has grown up in global manufacturing and climbed into the top 15 rankings of world's largest manufacturing countries. In the economic growth of any developed country, innovation and advanced manufacturing played a critical role for their development. Though, India has strong human resources to innovate and create, the effort towards R&D is very limited and mostly confined to government sponsored institutes. Recently, India is concentrating towards innovations and R&D sector for industrial growth and even private sector are actively participating in few areas. For the past two decades, India has made a strong presence in the automobile manufacturing sector. In defence and aerospace industry, India is now emerging as a preferred hub for aerospace manufacturing. Some of the key strategies in Defence and Aerospace manufacturing for economic growth of the country are discussed. With these strategies, India with definitely emerge out as a leader in Defence and Aerospace manufacturing by 2025.

1.0 Introduction

The manufacturing sector plays a vital role in the country's economy. Globally, the manufacturing output continues to grow by about 2.7 percent annually in advanced countries and 7.4 percent in large developing countries. In the recent past, countries like China, India and Indonesia have grown up in global manufacturing and climbed into the top 15 rankings of world's largest manufacturing countries.

The Ministry of Commerce and Industry, Government of India has set a target to increase the manufacturing contribution to the GDP from the current level of about 16 percent to 25 percent, by 2022. Industrial production is the key indicator of economic growth. In the growth strategy for manufacturing, the technological innovation plays a key factor and envisaged as the significant driver for economical growth and Industrial production. Most of the world's top economies are driven by innovation. One of the basic driver behind the innovation process is the human factor. India has a great potential of human resources having the capacity to innovate and create. Hence, nurturing human resources at all levels and in all sections of society is crucial for developing the foundation for innovation. Innovation leading to the inventions of new products and processes, as well as improvements of existing processes, leads to higher productivity and thus influences the real economy.

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2.0 Innovations and Technologies for Defence & Aerospace Manufacturing

The economic growth of any country is measured by their outputs in terms of quality products. Industrial Production is a complex system with interlinked factors including innovation, production activities and supporting services. The complexity of production process and the degree of innovation involved in the industry dictate strong links between R&D and production. In the interface between the innovation and the industrial production lies the Advanced Manufacturing. Advanced manufacturing is a multifaceted concept with Advanced products, Advanced processes and Technologies, Smart manufacturing, Advanced enterprise concepts, smart business models etc. Advanced Manufacturing as manufacturing that builds on and encompasses the use of science, engineering and information technologies, along with high precision tools and methods integrated with a high - performance innovative workforce, and smart business or organizational models, to improve existing or create entirely new materials, products and processes.

The effect of Innovation in manufacturing processes and advanced manufacturing technologies in the product design impacts the prospects for manufacturing in Defence and Aerospace Industry. Certain new innovations and technologies that are identified as drivers for the advanced manufacturing are;

1.Micro and Nano manufacturing of structured surfaces

2. Additive and Precision Manufacturing

3. New types of Materials and Multi – scale manufacturing

4. New production processes, automation and robotics in manufacturing

5. Green and Sustainable Manufacturing technologies

6. Advanced Manufacturing Information Systems

7. Manufacturing business models

2.1 Micro and Nano Manufacturing of structured Surfaces

This involves the synthesis and structuring of functional and multi-functional materials at the micro-scale [10-6m] and nano-scale [10-9m] from the bottom up approach. Micro manufacturing may lead to the development of high sensitive, small sizes sensor packages for different applications such as pressure, temperature, acceleration, humidity etc. Micro Manufacturing also focuses on manufacturing of micro sized features on macro sized components. These applications may be employed for the development of injectors, swirlers for micro propulsion systems, actuation and positioning systems, antennae etc. Nano structuring of surfaces may lead to higher density batteries, high efficient solar cells and ultra strong composites. These technologies do not simply modify materials as they exist in nature, but create synthetic materials that may not have direct counterparts in the natural world.

2.2 Additive and Precision Manufacturing

This refers to the set of technologies that build up solid objects from small particles. Some additive manufacturing technologies such as Selective Laser Sintering, Fused Deposition Modeling and Stereolithography are most popular technologies for the manufacturing industry today. This category of technologies includes new manufacturing processes that build up macroscopic parts layer-by-layer and achieve complex three-dimensional shapes starting from raw materials in powder or wire form. These processes are completely numerically controlled and avoid the need for expensive custom tooling. The creation of actuators, seeker systems, thin walled components and sensors that can operate at small scale also fits into this group.

2.3 New types of Materials and Multi-scale manufacturing

The need for new capabilities and higher performance in materials, are driving the innovations in materials. There are challenges to reduce manufacturing cost, achieve multi scale and subsequently develop new applications. Recent advances in materials such as nano materials and light weight composites rekindled interest in the processing of these materials in manufacturing. Nanotubes and graphene created from nano confined graphite forms have been used to develop high performance transistors and ultra strong composite materials.

2.4 New production processes, automation and robotics in manufacturing

Some of the innovations in production processes are Virtual manufacturing, Digital Modeling Simulation and Visualization, Advances in Industrial Robotics etc. In Virtual Manufacturing, Digital Modeling, Simulation and Visualization, based on the inputs from product development and past production data (such as machine performance, machining time etc) and with the help of advanced computational methods, a digital model of the entire manufacturing process can be created. A 'Digital factory' can simulate the complete production system including all machinery, labour and fixtures. In addition to this, the advancement in sensor technologies, help to synchronize the production line with reality. Recently, Robots are more widely used in industries such as automotive and electronics manufacturing. While industries such as food and beverage, rubber and plastics, metal products started employing robots in their areas where, it can be effectively utilized. Robots are more concentrated in advanced economies where the wages of manpower are higher and the workforce is highly educated.

2.5 Green and Sustainable Manufacturing Technologies

The main drivers of adoption of these technologies are to improve productivity and reduce green house gas emissions. This effort focuses primarily on closing material loop cycles through reuse, remanufacturing and recycling of materials as well as the minimization of energy consumption during manufacturing. In order to achieve Green and Sustainable manufacturing in industries, there is a need to upgrade the existing less productive technologies to newer technologies and better processes with minimum energy consumption and reduced gas emissions.

2.6 Advanced Manufacturing Information Systems

The key drivers for manufacturing information systems are supply chain management, information technology, Advanced Analytics, Data mining, social technologies and internet. Advanced optimization models are employed for inventory management, vehicle routing, logistics support etc. in supply chain management. The application of sensors to track the RFID tags on products have helped to improve inventory management while reducing the overheads and logistics cost. In customer dependent activities, social technologies can generate the deeper insights of the customer requirements to fine tune the product development and provide a way for customers to participate in the development of new customer oriented products and features.

2.7 Manufacturing Business Models

The competitive environment compels manufacturers to adopt new business models that are more responsive to swings in input costs and faster product cycles. Manufacturers are pushed to respond to the demand and need for customized products for new market segments. Emerging business models emphasize efficiency and resource productivity. The emerging business models are Mass Customization, Circular economy and frugal innovation.

- In mass customization, for consumer products, the manufacturers are increasingly focusing their efforts on tailor made products by using advanced analytics to identify specific sub groups.
- The circular economy is an emerging trend that hold hands with green manufacturing with the aim to improve sustainability and environmentally friendly economy and provides an alternative to the existing "take - make - dispose" business models. The circular economy is built on four principles such as designing products with their entire life cycles in mind, maximizing product life cycles, recycling materials from end of life products and reusing materials across diverse industries and value chains.
- Frugal innovation is a business model that emphasizes on shorter launch cycles and commercialize the product on the market quickly and improving its performance in subsequent generations.

3.0 Perspectives on Defence and Aerospace Industry in India

India, in the post-independent era, till mid-1970s, acquired its military technologies from foreign sources and undertook limited indigenous developments and collaborations. From the mid '70's to mid '90s, with the policy of globalization and flourishing IT industry, India's GDP improved from mere 2-3% during '70s to 7-8% post the year 2000.

India is one of the most attractive Aerospace and Defence market in the world. It has overall economic growth 7% each year on average since 1995. It is expected to be 60% size of US economy by 2025. Government of India is committed to liberalize Aviation/Defence sector and develop flexible, networked and mobile defence system. Today's situation is not very encouraging as, nearly 70% of Defence assets and 80% civil Aeronautics assets are imported. Success growth story of electronics, telecom, automobiles are not happening in Defence. There is a large gap in Aerospace/ Defence industry capability, R&D compared to advanced countries.

Aerospace and Defence Manufacturing were in the domain of Defence PSUs. Recently, Government of India has opened the Defence sector and allowed FDI upto 49%. To give the boost to domestic Aerospace and Defence sector, an offset policy has been introduced in Defence procurement policy, where foreign company have to outsource certain hardware/ technology from Indian companies.

4.0 Key Factors and Challenges for Defence and Aerospace Manufacturing

Defence and Aerospace a manufacturing is a high technology industry that involves complex interwoven processes and integration. The use of high end technology for manufacturing provides not only the opportunity to overcome known industry related challenges and solve complex issues, but also adds the greatest value through innovations in manufacturing. The key factors in Aerospace and Defence systems are typically characterized by;

- Complex designs and long project cycles
- Large R&D investments
- Large investments in manufacturing and test equipment
- Special materials of unique specifications
- Requires advanced manufacturing techniques
- Physical sizes ranging from micro meters to meters
- Small batch size for production — in many-cases like ships, etc, one off
- Quick technology obsolescence
- Diverse multi-disciplinary technologies
- Intensive technical, quality and safety requirements
- Stringent regulatory environment
- Poor supply chain management
- Poor linkage of R&D and production especially in the Indian context
- High emphasis on long product life requiring very efficient product support systems.

In Indian Aerospace and Defence, for a long period of time, the Research and Development has remained largely in the public domain with government institutions like Hindustan Aeronautics Limited (HAL), National Aerospace Laboratories (NAL), Defence and Research & Development Organisation (DRDO), Indian Space Research Organisation (ISRO) and Council of Scientific and Industrial Research (CSIR).

5.0 DRDO's Role in Aerospace and Defence Manufacturing

Defence Research and Development Organisation (DRDO) started working in the year 1958 on various technologies for our armed forces and today has grown into an Organisation with over 50 Labs engaged in a wide variety of technology disciplines ranging from aeronautics, naval systems, materials, life sciences, ballistic missile defence, strategic missiles and armaments.

DRDO has demonstrated its capability in developing defence and aerospace hardware by development of complex systems like missiles, launching systems, main battle tanks, Combat engineering equipments like (assault bridges of various spans, mine laying and flailing equipments etc), Radars and allied electronic systems, armaments and more recently composite products. Apart from the development time, the bulk production time in this is very slow as the components produced are done by conventional processing and inspection and assembly are done manually. Main focus like productivity, precision and reliability are not exploited to full extent.

Existing requirement of all armed forces is in modernization of their military equipments. This has paved a way of using new materials and processes. The field of composites has emerged out in a big way, in last decade. These materials ensure better performance systems at lower weight and in-turn increases the efficiency of weapon systems of armed forces. These materials are mostly imported but more recently reinforcing material and matrix materials are developed by Indian manufacturing companies.

6.0 Current Status of Defence and Aerospace Manufacturing

Even though, manufacturing processes are thousands of years old, the pace of process improvements and the pace of developments of new manufacturing processes continued on par with the changes in civilization and technology development in the other fields in engineering. New materials, new processes, creative use of existing resources and pervasive use of information technology plays an indispensible role in the technology drivers for development of manufacturing.

Modern technologies such as CAD/CAM, CIM, CAPP, FMS and robotics represent the most important building blocks for achieving agility, quality, and flexibility at considerably less cost and time. Application of concepts such as agile manufacturing, lean manufacturing, virtual manufacturing, supply networks, just-in-time, quality systems and concurrent engineering in modern manufacturing technology qualified the product for consumer driven market with enhanced quality, high flexibility to customer requirements, and good reliability with a well guaranteed life time.

The recent changes in the materials and development of advanced materials such as high strength and tough alloys, ceramics and composites put forth a great challenge on the manufacturing sector for processing of these materials.

The aerospace alloys such as Nickel base alloys, cobalt base alloys, iron based alloys and titanium alloys have superior mechanical, chemical and high temperature properties and severely hinder its machinability with conventional processes and are generally referred as "difficult to machine materials". These alloys have poor thermal conductivity and have a tendency to react with standard tool materials resulting in reduced tool life, poor surface finish, limited choice of tool material, and poor performance. Moreover, in line with development of more efficient structures the designers have flexibilty to generate complex shapes which demands more modern machine tools and robotics systems to realize the products.

Development in composites such as Metal Matrix Composite (MMC), Ceramics Matrix Composite (CMC), Carbon-Carbon composites (CCC), and Fiber reinforced plastics are being extensively used in aerospace and Defence sector. Machining of composites with conventional processes is a challenging task as these materials are inhomogeneous resulting in intermittent cutting leading to difficulties in penetration of tool into material, faster tool failure and poor surface finish.

Since last decade, development is inclined towards miniaturization where multi disciplinary systems are getting integrated. These challenges has initiated the development in manufacturing leading to the development in various non conventional machining processes or changing the process, tool materials, high speed machining or near net shape manufacturing by changing from top-to bottom approach to bottom-up approach.

7.0 Future ahead in Aerospace and Defence manufacturing

World is exploring field of MEMS and NEMS by bringing this technology in defence and aerospace. As an example, USA has developed and implemented various sensors like accelerometers, gyroscopes, spin sensors, impact sensors, armament fuse (safety and arming devices) in actual armaments with much more reliable system at lower cost (<1 $) and high productivity processes required for conventional counterparts. Due to increased requirement of miniaturising the equipments for defence and aerospace services, MEMS and NEMS devices will play key role in Defence and Aerospace manufacturing.

Innovations in the areas of development of new materials, new manufacturing processes like additive manufacturing, hybrid machining, jet machining, high speed machining, hard machining, machining using lasers, for high productivity, net / near net shaped manufacturing technologies, increased usage of composites, robotics in material handling of hazardous materials, High precision and micro machining, development of nano structured surfaces for special applications, special processes for surface treatment and surface coating technologies, advanced measurement and non destructive evaluation technologies, simulation of manufacturing processes prior to actual production, Green and Sustainable manufacturing technologies to reduce wastes etc. need to be explored further in Aerospace and Defence manufacturing sector in India to make use of its potential in improving the economy. Advanced manufacturing business models and innovations in supply chain need to be focused by Aerospace and Defence manufacturing sector in India.

Recently, there is an increased participation of academic institutions and private industries holding hands with these government R&D institutions for the development of products for aerospace and defence systems. To achieve great economic growth in manufacturing, the innovation and knowledge from the various organizations and institutions such as government research institutions, PSU's, private industries and academia to a tapped to a common pool with focus on manufacturing. There is a need for creation of central hub for innovation to contribute in defence and aerospace manufacturing. Also, it is necessary to mobilise the private sector to help in financing the innovations for the development of Aerospace and Defence manufacturing sector in India.

8.0 Conclusions

In the present days, it is clear that Defence and Aerospace manufacturing faces critical changes and challenges. In this dynamic competitive environment, Defence and Aerospace manufacturing in India should focus on key strategies as discussed and implement new and innovative technologies, reduce development cycles and cost without conceding quality. With these strategies, India with definitely emerge out as a leader in Defence and Aerospace manufacturing by 2025.

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29th Indian Engineering Congress

Technical Session VI

POVERTY ALLEVIATION AND HEATH CARE - IMMINENT NEED TO FOR THE COUNTRY

The Institution of Engineers (India)
Andhra Pradesh State Centre

INVITED TALK

Poverty Alleviation and Health Care through Community Managed Nutrition cum Day Care Centers (NDCCs)

A Murali IAS[1]

Introduction

Through the Andhra Pradesh Rural Poverty Reduction Program (APRPRP), which was implemented during 2004-2009, the Society for Elimination of Rural Poverty (SERP) had aimed to "eradicate poverty, promote human capital development, focus on the welfare of children—particularly girls, women, the old, and the infirm; and build an equitable society in which people participate in making decisions which affect their lives and livelihoods". End term evaluation studies showed that by the end of project period, APRPRP had contributed to a considerable reduction in percentage of BPL households from 29.4 % to 20.7 % between baseline (2004) and end term (2009) in comparison to the poverty ratio for non participants (27.2 %). In the case of SCs, the decline was 14.7 percentage points compared to 6 percentage points among the non-participants, and for ST households the poverty among participant households declined by 15.5 percentage points against 8 percentage points among the non-participants. At the Institutional Level, systems have been put in place, especially for last mile service delivery of banks, insurance, H&N, etc. which are performing well even after the project period. SERP as a mechanism and associated institutions have built up a considerable capacity for innovating and delivering rural development.

Context

Malnutrition is a major factor of poor health that acts as one of the greatest barriers in overcoming poverty. The Andhra Pradesh Rural Poverty Reduction Project has been working since 2002 to empower community-based organizations comprised of poor rural women to demand health and nutrition services focused on preventing the need for expenditure on health. One of the success stories of the project is the community managed Nutrition cum Day Care Centers, or NDCCs. The NDCCs serve as a preventive intervention to address the issues of malnutrition and ill health before they become a financial and psychological burden to the women and their families. As the NDCCs are owned and managed by the communities they serve, they are adaptable to the demands of the beneficiaries. The NDCCs take a holistic, life-cycle approach to improving the nutritional status of the pregnant women to avoid anemia and also to prevent child malnutrition from the womb. It also serves as a platform to bring about sustained behavior change as the

1 The Andhra Pradesh Rural Poverty Reduction Project (APRPRP) is a statewide, community-driven rural poverty reduction project implemented since 2000. Key investments include: building institutions of the poor and developing social capital; developing financial services for the poor; reducing vulnerability; promoting social action; and improving local governance.

2 Society for Elimination of Rural Poverty (SERP) is an autonomous society and implementation agency for the Rural Development Department's poverty alleviation programs. SERP's foundation is the SHG network and their federations at Village. Mandal and District levels

1. CEO SERP-Telangana, Hyderabad

Health Activist (HA) trains the women on health and nutrition aspects every day.

Problem Analysis

In rural Andhra Pradesh (AP), the nutritional status of pregnant and lactating women as well as young children found in the past National Family Health Surveys 1998-1999 and 2005-2006 have been below the international recommended nutritional status. NFHS-III indicated that 40% of reproductive age women in AP fall below the WHO recommended Body-Mass Index of 18.5. Due to low micronutrient intake in diet, 63% of women at reproductive age are anemic. Among children under three years old in AP, 12.7% were found to suffer from wasting, 33.8% were found to suffer from stunting and 36.4% were found to be underweight . The situation is even worse among scheduled tribe and scheduled caste communities where 45.9% of children are underweight and 44.2% are stunted.

This situation results from a cycle of malnutrition and poor growth, where reproductive age women bear low birth weight babies who subsequently are malnourished and become underweight and stunted children. Among these children, young girls enter reproductive age without improved nutrition, remain underweight, hence remain susceptible to disease. As a result, time and wage loss due to illness and expenditure for curative health depletes family savings, increase loans, leaving the family in an impoverished state.

Key Elements

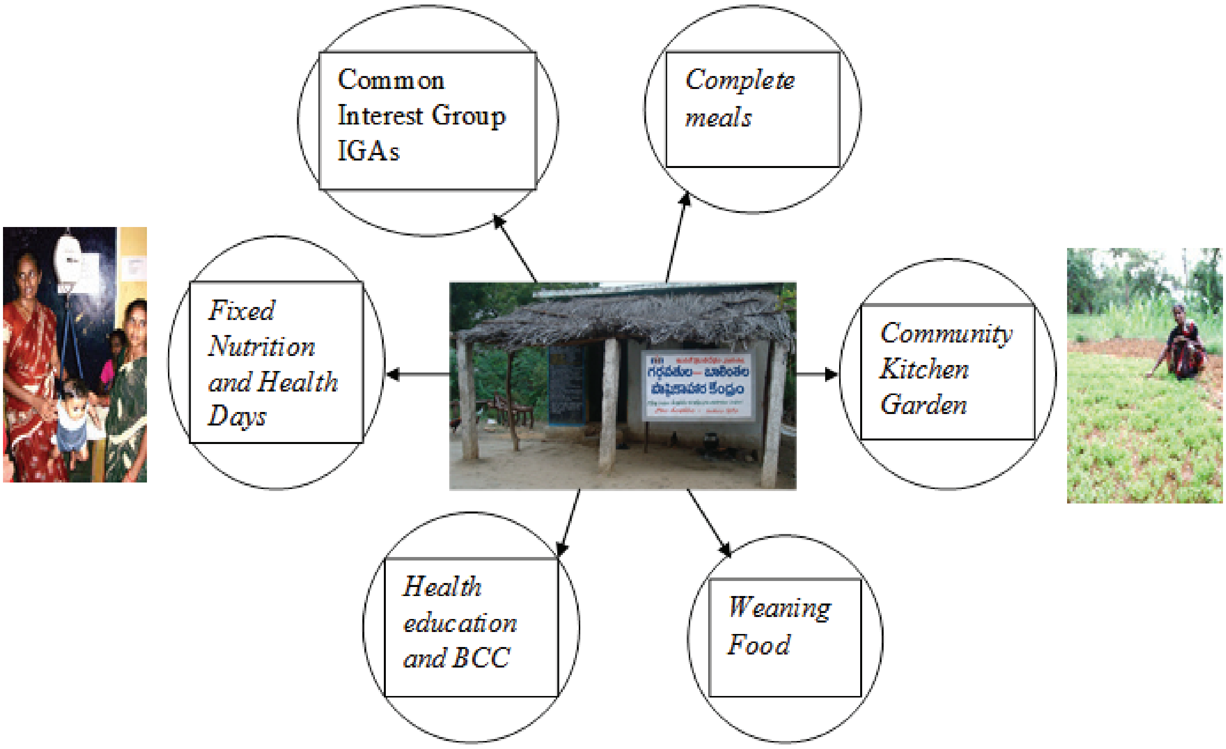
SHG women have started up the community-managed Nutrition cum Day Care Centers as an innovative way to break this cycle of malnutrition. They focus on nutritional needs of pregnant and lactating women so that child malnutrition is prevented from the womb. They also enroll children under 2 years of age so that existing malnutrition is reversed and the children would grow up without stunting, wasting or underweight. The NDCC is different from traditional 'feeding center'utrition interventions. Instead it addresses the issue through the following holistic approach:

3. Health Activist, who is a community member selected and trained on maternal and child health topics, sits with the beneficiaries at the NDCC and shares with beneficiaries the importance of ANC and institutional delivery, components of a balanced diet and knowledge of common diseases

4. The National Family Health Survey (NFHS) is a large-scale, multi-round survey conducted in representative sample of households throughout India. The most recent round of survey (NFHS-III) was conducted in 2005-2006.

5. Body Mass Index (BMI) is an index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as weight in kilograms divided by the square of the height in metres (kg/m2).

6. Data source from DHS STATcompiler (NFHS-III). Wasting is reflected by weight-for-age of a child which is strongly related to mortality of young children. Stunting is reflected by height-for-age of a child with reference population of well nourished and healthy children. Underweight is reflected by weight-for-age of a child with reference population of well nourished and healthy children.



1. **Complete meals:** The NDCC provides two well-balanced meals each day to pregnant and lactating women and children less than 2 years of age. The meals are served at the NDCC rather than given as take-home ration so that the beneficiaries are assured to receive the complete meal instead of shared with other members of the household.

2. **Health Education and Behavior Change Communication**: Aside from providing meals, the NDCC serves as a venue for health education and behavior change communication. A Health Activist, who is a community member selected and trained on maternal and child health topics, sits with the beneficiaries at the NDCC and shares with beneficiaries the importance of ANC and institutional delivery, components of a balanced diet and knowledge of common diseases while the women comes to the centers for daily meals

3. **Infant and Young Child Feeding Practices (IYCF) and Growth Monitoring**: Twice a month the mothers of children 6 months to 1 year of age gather at the NDCC to prepare weaning powder to supplement breastfeeding for the children. Correct methods of feeding, including importance of maintaining hygiene while feeding young children is discussed and inculcated among the mothers. Regular Growth Monitoring and Nutrition Counseling provided by HA to tackle malnutrition

4. Community Kitchen Garden: A few community members take the lead to establish a Community Kitchen Garden to produce vegetables to be used in the meals prepared at the NDCC. They grow a variety of vegetables rich in micronutrients that are often not available in foods prepared at home. There is a particular focus on growing green leafy vegetables as a source of iron to reduce anemia among the pregnant and lactating women.

Benefits and Impacts

Maternal health outcomes: An independent assessment on the early outcomes from NDCCs related to maternal and child health was conducted during December 2008 . The study results showed that a greater percentage of NDCC beneficiaries had three ANC visits during their pregnancy compared to similar women from non-intervention villages (95.6% compared to 88.6%). Analysis on average weight gained during pregnancy found that women enrolled at NDCC gained 9.01 kg, which is significantly higher ($t = 9.181$, $p < 0.001$) than average weight gained by women from non-intervention group (7.22 kg) On the other hand, The level of anaemia detected during pregnancy in both groups were high, ranging from 33 – 35%. This suggests that stronger focus in educating women on the importance of having iron-rich green leafy vegetable in their diet and taking iron supplements is needed at the NDCC. (Table 1)

Neonatal outcomes: Beneficiaries who enrolled at NDCCs had newborn with birth weight averaging 2.912 kg compared to an average of 2.588 kg from newborns in the non-intervention group. The NDCC beneficiaries gave birth to newborns with significantly higher mean birth weights ($t = 8.143$, $p < 0.001$) than women from non-intervention villages. The distribution of birth weights in the study result showed that there is significantly higher proportion of underweight babies in the non-intervention group compared to those in NDCC villages as shown in Table 1 below.

Indicators	NDCC Beneficiaries (N = 234)	Non-Intervention Group (N=243)	Significance
Mean weight gain for pregnant women (kg)	9.01 (SD = 0.1557)	7.22 (SD = 0.1097)	$t = 9.181$ $p < 0.001$
Anaemia detected during pregnancy (%)	35	33	$p = 0.922$
Mean Birth Weight (kg)	2.912 (SD = 0.20)	2.588 (SD = 0.32)	$t = 8.143$ $p < 0.001$
Weight Class (kg)	NDCC Beneficiaries (N=193)	Non-Intervention Group (N=181)	
< 2.5	12.8	53.5	$p < 0.0001$
2.5-2.99	28.7	33.2	$p < 0.0001$
≥ 3.0	56.1	24.4	$p < 0.0001$

Table 1. Maternal and Neonatal Health Outcomes

7.Early Outcome Assessment studied maternal and child nutritional status and the level of health knowledge and health-seeking behavior among NDCC beneficiaries in pilot villages compared to non-intervention area s.

Health knowledge and health-seeking behavior: Significantly higher proportion of NDCC beneficiaries was found to register their pregnancy at public health facilities (p = 0.004). Throughout their pregnancy, significantly higher proportion of women from NDCC attended all three ANC check-ups at public health facilities (p = 0.003). Specifically, significantly higher proportion of women from NDCC received full-course of iron-folic acid (IFA) supplements compared to non-intervention group (p = 0.001). Significantly higher proportion of women chose to have institutional deliveries rather than home deliveries (p = 0.0001). (Table 2)

Indicators	NDCC (N = 234)	Control (N = 242)	Significance
Proportion of women registering pregnancy* at Public Health Facility (PHF) (%)	92	84	p = 0.0037
Proportion of women with all three ANC Check-ups** at PHF (%)	66	54	p = 0.003
Proportion of women received full-course IFA (%)	81	65	p = 0.0012
Proportion of women choosing PHF for delivery** (%)	68	51	p = 0.0001

Table 2. Health knowledge and health-seeking behavior

Notes: **Includes women who were pregnant within 24 months of survey date (delivered within the 18 months prior to survey date)*

***Includes women who delivered within 24 months of survey date*

Neonatal Care practices: Besides the impact observed in maternal health and health-seeking behavior, an improvement in neonatal care practices was observed as well. Significantly higher proportion of women from NDCC fed their newborns with breast milk within one hour of birth (p = 0.028). In addition, significantly smaller proportion of women from NDCC compared to non-intervention group gave pre-lacteal fluids to their newborns (p < 0.001). Immediate wrapping of newborn, delayed bathing until 7 days and exclusive breastfeeding for at least six months, were not found to be significantly different between the NDCC group and non-intervention group. This appears to be a practice difficult to change due to traditional practices. It is an important focus area for the health education sessions. In the first year after birth, significantly more mothers brought their child to receive full immunization as per schedule than mothers in the non-intervention group (p = 0.05). (Table 3)

	NDCC Beneficiaries N = 234	Non-Intervention Group N = 242	Significance
Colostrum Feeding N (%)	164 (79)	132 (67)	p = 0.028
No Pre-Lacteal Fluids N (%)	178 (86)	131 (66)	p < 0.001
Immediate Wrapping N (%)	205 (98)	195 (98)	p = 0.993
Delayed Bathing (7 days) N (%)	53 (25)	37 (18)	p = 0.167
Exclusive Breastfeeding for 6 months N (%)	88 (49)	95 (56)	p = 0.243
Child receive full immunization per schedule N (%)	135(90)	120 (85)	p = 0.05

Table 3. Neonatal Care practices

Personal Impact of the NDCC: Vasam Kalamma is 25 years old. She belongs to the ST community and hails from Kollapuram village in Warangal district. She has 3 children. During her second delivery Vasam Kalamma suffered from anemia. The doctor advised her to eat sufficient nutritious food, but she could not do so as she was not only poor but there were many members in the family to feed. As a result, she had a difficult delivery. The baby weighed just 2 kgs. Kalamma did not have sufficient breast milk to feed her child, and suffered from frequent illness.

Within a year she conceived again. Since she suffered from anemia she was given blood transfusion in the 8th month of her pregnancy. She had to spend Rs.5000/- borrowed from a local money lender. A few days after the delivery, the Health CRP visited her village. Vasam Kalamma made it a point to attend the meeting organized by the Health CRP to talk about the Nutrition Center its activities. She stressed the need for a balanced diet so very essential for a healthy pregnancy. This had an impact on Vasam Kalamma's mind. She enrolled in the Nutrition Center and started eating nutritious food. In the months that followed, her health improved. She started getting sufficient breast milk for her new born. Her baby is 9 months old now. Vasam Kalamma continues to take food at the Nutrition Centre and she is also repaying her MCP loan.

Now, she gets other pregnant women and lactating mothers enrolled in the Nutrition Center in her village. She says, "I'm happy that such a Nutrition Center is functioning in our village."

Lessons Learned

At the policy level, a very significant number of policies that have been changed or introduced at State level have been influenced by the work of SERP, such as Indira Amrutha Hastham (IAH), (the one hot cooked meal program for pregnant and lactating women by ICDS), which has been started based on the learning from community managed NDCC. The project has also influenced livelihoods programs in other States under the National Rural Livelihoods Mission.

The critical factor for successful replication of the NDCC intervention by communities in other states of India or other countries is the enabling environment provided by the women's group federations. In AP, the SHG women and the community resource persons are the human resources responsible for the Nutrition cum Day Care Centers. An accountable structure of women's group from the village level to the district level that is responsive to demands from the community, in addition to the technical inputs and systematic knowledge provided by SERP will be the true driving force for long-term success of this program.

INVITED TALK

Health care in India –current scenario

Jayanthy Ramesh[1]

ABSTRACT:

Current health scenario in India is akin to a huge canvas with different hues! Contrasting shades of malnutrition, infectious diseases, increasingly prevalent obesity, diabetes and cancer afflicting young and old Indians with vengeance makes the canvas awesome and puzzling. The challenge thrown by these myriad problems is mind boggling.

Poverty and lack of accessibility of basic health needs such as potable drinking water, sanitation and hygiene continues to haunt large majority of the rural population and urban slum dwellers. Rapid urbanization, stress, life style changes and pollution are contributing to rising incidence of diabetes, heart attacks, vitamin D deficiency and cancer etc.

Modern medicine relies on clinical and laboratory evaluation and evidence based medical practice guided by scientific principles & reasoning. The treatment modalities vary from medical, surgical to psychological approach depending on the nature of the illness. It plays a major role in the health care delivery system in India.

Medical advances in various specialties are playing a pivotal role in providing the state of art tertiary level care to the patients. While the advances in genome mapping opened newer avenues in gene therapies of inborn errors of metabolism and genetic disorders, stem cell therapy is now a reality offering much scope in many areas. Advanced imaging technologies are helping in early diagnosis of cancers and stereotactic surgeries and robotic surgeries are useful in precisely guided minimally invasive surgeries.

Health care in India offers enormous potential for concerted efforts involving many scientific disciplines such as medicine, biomedical engineering, informatics, communications, electronics and robotics not only in planning but also in implementation of health care delivery system, spanning from basic community level at primary health centre to the secondary and tertiary care facility offering a most advanced techno driven health care with a humanistic touch.

Human body is an elegant example of a highly sophisticated architectural marvel, based on sound bioengineering principles. It is a three dimensional structural and functional integrated unit, complimented and essentially driven by the super computer par excellence the brain.

And so, health is viewed through physical, mental and spiritual planes being influenced by genetics, nutrition, environmental and psychological factors.

Current health scenario in India is akin to a huge canvas with different hues! Contrasting

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shades of malnutrition, infectious diseases, increasingly prevalent obesity, diabetes and cancer afflicting young and old Indians with vengeance makes the canvas awesome and puzzling. The challenges thrown by the these myriad problems is mind boggling.

Poverty and lack of accessibility of basic health needs such as potable drinking water, sanitation and hygiene continues to haunt large majority of the rural population and urban slum dwellers. Rapid urbanization, stress, life style changes and pollution are contributing to rising incidence of diabetes, heart attacks, viamin D deficiency and cancer etc.

Traditional health system in India had been patient centric with emphasis on understanding the patient's body constitution and its reaction to the environment .On the contrary, modern medicine relies on clinical and laboratory evaluation and evidence based medical practice guided by scientific principles & reasoning. The treatment modalities vary from medical, surgical, to psychological approach depending on the nature of the illness.

Health for all and health care delivery still remains a major challenge in India with its vast population and varied cultural moorings. Health education and awareness should be made integral to the basic life teachings , so that it can viewed as a natural human resource aiding in enhancing the productivity of the family and the society underlining the fact i,e health is wealth.

True to the adage child is the father of man, concrete steps have to taken to focus on the health of the baby in the womb as children are the future of the nation. That obviously means improving the care of the mother even well before conception , during pregnancy and delivery taking adequate essential steps at each stage of pre natal,natal and post natal services. Every pregnant woman in india has a story to tell and is a carrier of the future of the nation's health. Maternal health disorders such as malnutrition, anemia, high blood pressure, diabetes, thyroid and other conditions can affect babies health through intra uterine stress. Both low birth weight and high birth weight babies are at risk of developing diabetes and heart disorders when they become adults as their system get programmed in utero due to exposure to hostile intra uterine environment as a fetus. Studies have shown that exclusive breast feeding up to at least 6 months after delivery improves the health and immunity of the child and prevents obesity and diabetes. Further it not only offers a highly economic and effective early infant nutrition improving the parent infant bonding but also transforms the mother into a responsible caregiver. Health of the school going children and adolescents reflects the level of awareness in the family as a unit and society at large regarding the importance of proper nutrition, physical activity and recreation besides emphasis on academics. Unfortunately schools and colleges have become breeding ground for life style disorders such as diabetes and obesity and hormonal problems. This fact calls for immediate attention from people of all walks of life. Doctors, engineers, artists, planners ,economists and parents should together devise corrective measures and with the help of government, implement effectively so that every child can bloom into a healthy adult.

In conclusion, though rapid strides have been made in the heath care sector in our country, of late, investigations and medications seem to be taking precedence over a holistic approach in the care of patients. A comprehensive approach involving detailed clinical history ,physical examination .rationalistic investigative procedures and diagnosis with focus on educating the patients, and their family about the various treatment methods and the likely effects and the side effects and advice regarding lifestyle measures will help.

Evaluation of Economically Viable Watersheds in Drought Prone Area in Kadapa District –A Case Study

T. Kiran Kumar[1] & N. Kumara Swamy[2]

ABSTRACT

Kadapa District is one of the four districts of Rayalaseema Region of Andhra Pradesh State. The region receives about 700mm of rainfall annually. With increase in population and the corresponding water demand, this region is experiencing drought-like situations frequently. Unlike floods, droughts are long duration phenomena and they are not recognized until they set in causing damages and economic losses. Drought has significant impacts on the economy, environment, industries and the community. The mitigation of the impacts of drought has been a key area of focus of the Government of India (GOI) since 1950s The concept of watershed management has evolved to overcome consequences of drought. Government of India sanctioned 198 watersheds for drought prone of Kadapa district. The watershed programmes carry many changes in environmental parameters such as land utilization, water availability, change in the crop pattern and change in the socio-economic status of the people. There is a need to know the magnitude of the change in economical, social status of the people due to the availability of water resources, fertility and crop yield fodder and milk yield in order to measure effectiveness of watershed programmes.

The environmental impact assessment studies were conducted in both quantitative and qualitative parameters in the study area covering the 198 watersheds from 2004 to 2007. The weightage factor for each parameter was given based on benefit achieved from the watershed. Based on quantitative and qualitative parameters 11 best economically viable watersheds namely Velpula-2, Nawabpet & Duggannapalli, Yerragudipalli & Bakarapuram, Diguval kalava katta-1, Nandyalampalli, Kondapayapalli, Pemmadapalli, Cetimapuram-1, Settyvaripalli-2,Vempalli-4, Reddypalli watersheds are selected in 198 watershed in eleven schemes covering 28 mandals of Kadapa district in Andhra Pradesh.

1. INTRODUCTION

Watershed has been rightly recognized as a convenient unit in planning for overall development of

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an area and thus the concept of watershed management is a holistic approach aimed at optimizing the use of land, water and vegetation in an area, so as to provide an answer to alleviate drought, moderate floods, prevent soil erosion, improve water availability, and increase fuel, fodder and agricultural production on a sustained basis that has emerged.

In this programme the development is not confined just to agricultural lands alone but covers the entire land. Watersheds start from the highest point (ridge line) to the outlet of the natural stream. This involves implementation of ameliorative measures on barren hill slopes, marginal lands, privately owned agricultural lands and badly eroded gullies and river courses. Watershed management thus not only improves the productivity of lands but also is an investment in the nation's future to stabilize the ecological balance of environment. The comprehensive development of a watershed so as to make productive use of all its natural resources and also protect them is termed as watershed management. The Bamawe terraces in Indonesia and those in Nepal, Mediterranean and Andes are examples of integration of human elements into a system of land management, which is an early achievement in watershed management (F.A.O, 1986).

Watershed management is the process of formulating and carrying out a course of action involving the manipulation of resources in a watershed to provide goods and services without adverse effects. Watershed management must also consider the social, economic and institutional factors operating within and outside the watershed area.

Watershed management involves management of land, water, energy and greenery integrating all the relevant scientific approaches appropriate to socio-economical background for a pragmatic development of a watershed. Availability of water in a given soil environment is a critical factor which is adversely affected through surface run-off, erosion and siltation, due to loss of beneficial plant cover. Water management is best done on a natural unit, like a watershed, which is a distinct drainage basin of any small or big water course or stream etc. Thus, this broadly encompasses availability of entire water resource which can be utilised through dug wells, tube wells, small farm ponds etc. Stabilisation of watersheds, to be achieved through massive afforestation programmes is recommended.All watersheds contain many kinds of natural resources - soil, water, forest, rangelands, wild life, minerals etc.. In developing and managing a watershed, the use of some natural resources will be useful while others will be competitive. For example water logging may affect water resources and recreation. Changing intensive land use to less intensive ones may benefit soil and water resources.

The key is to use these resources as efficiently and perpetually as possible, with minimum disturbance to the watershed as a whole.

Agro-forestry system brings about less solar radiation, low soil temperature, higher ambient soil moisture in summer months, improved soil organic matter, soil pH, lower incidence of pests and diseases of crops and overall improvement in macro-climate. All these are conducive to the holistic management of watershed through judicious admixture of various biological components that would promote an integrated management system so that the system produces goods and services to fulfill the needs and demands of the society.

Watersheds lie at heights as well as along coastal tracts of the sea. If the upper watersheds are not protected, the conservation measures and progressive approaches along the lower catchment are liable to damage from uncontrolled runoff from the upper area. The stability of land use in the lower areas is dependent upon the stability of hilly watersheds. Thus, the watershed management should commence from upper reaches and progressively proceed towards lower levels. Watershed management is not merely anti-erosional and anti-runoff approach but also a comprehensive, integrated approach of land and water resources management. The approach is preventive and progressive, corrective and curative as well. Wasteland resources could fruitfully be harnessed into a productive face for rural development.

In this paper, the environmental impact assessment of watersheds is conducted by using quantitative and qualitative parameters. The attributes considered for evaluation of watersheds are based on standard Hariyali guidelines. A weighted average approach has been adopted for all these parameters to identify well performing watersheds.

2. STUDY AREA

The Kadapa District is surrounded by Kurnool District on the North, Chittoor District on the South, Nellore on the East and Anantapur on the West. Total geographical area of the District is 15,379 Sq.Kms with 3 Revenue Divisions, 12 Blocks, 51 Mandals, 851 Gram Panchayats, 965 Revenue villages and 4533 Habitations. Kadapa lies between the 13043' and 150 14' Northern Latitudes and 77055' and 79029' of the Eastern longitude. Location map of Kadapa district is given in Figure 1.

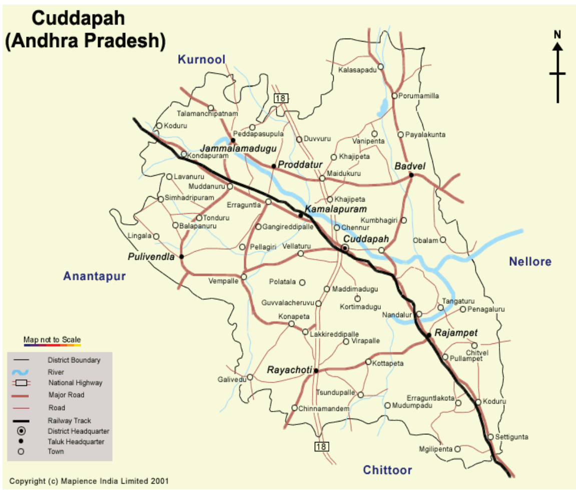

Figure 1: Location of the Kadapa District in Andhra Pradesh

In Kadapa district, out of 12 blocks, 7 blocks are identified, as DPAP blocks ((1) Rayachoty, (2) L.R. Palli, (3) Pulivendula (4) Jammalamadugu, (5) Kamalapuramm (6) Porumamilla, (7) Muddanur) and the remaining 5 blocks are as non-DPAP blocks ((1) Proddatur, (2) Rajampet, (3) Kodur, (4) Sidhout, (5) Kadapa)

3. METHODOLOGY

The watershed programmes carry many changes in environmental parameters such as land utilization, water availability, change in the crop pattern and change in the socio-economic status of the people. There is a need to know the magnitude of the change in economical, social status of the people due to the availability of water resources, fertility and crop yield fodder and milk yield.

Although project evaluation has long been characterized by multiple methodological approaches, until recently evaluators tended to favour either quantitative or qualitative studies (Patton 1997).

Typically, quantitative studies reflect a positivist view that reality takes a single form that can be perceived and measured objectively. Qualitative approaches, by contrast, reflect a more constructivist view, implying that reality is not separable from individual experiences and that multiple versions of it may exist.The environmental impact assessment studies were conducted in study area covering the 198 watersheds from 2004 to 2007. The details of watersheds for environmental evaluation purpose under different schemes are given in Table 1.

Table1:Watersheds for Environmental evaluation purpose under different schemes

S.No.	Name of the project	Period	No.of watersheds
1	DPAP – I	1995 – 96 to 1988 – 99	17
2.	DPAP – III	1997 – 98 to 2000 – 01	21
3.	DPAP – IV	1998 – 99 to 2001 – 02	33
4.	DPAP – V	1999 – 00 to 2002 – 03	21
5.	DPAP – VI	2000 – 01 to 2004 – 05	6
6.	DPAP – VII	2001 – 02 to 2005 – 06	10
7.	DPAP – VIII	2002 – 03 to 2006 – 07	9
8.	IWDP – II	1997 - 98 to 2000 – 01	25
9.	IWDP – V	2003 – 04 to 2007 – 08	8
10.	EAS	1995 – 96 to 1998 - 99	29
11.	RIDF – VI	2000 – 01 to 2002 – 03	19
			198

The attributes considered for evaluation of watersheds are based on the standard Hariyali guidelines (Modified and Reissued as guidelines of Hariyali in April 2003 by Ministry of Rural Development, Govt of India) to obtain the representative and relevant data. The various parameters considered for the environmental evaluation are given in the Table 2. A weighted average approach has been adopted for all these parameters to well performed watershed.

Table 2: Environmental evaluation

Table 3: Environmental evaluation

S.No.		Parameter	Weightage of factor
1.	Water level in wells	>3m	1.0
		2m to 3m	0.9
		1m to 2m	0.7
2.	No. of wells rejuvenated		
	> 40 – 1.0	100%	1.0
	Upto 40 – 0.9	50%	0.7
	20 to 45 – 0.8	25%	0.5
	10 to 20 – 0.6		
	> 10 – 0.5	0	0
3.	Additional net area brought under cultivation	Above 50 acres	10
		21 to 50 acres	0.5
		Upto 20 acres	0.3
		< 10	0.0
4.	Reduction of Labour migration	81 to 100%	1.0
		61 to 80%	0.8
		41 to 60%	0.6
		21 to 40%	0.4
		10 to 20%	0.2
		< 10%	0
5.	Increase in milk yield per day	≥100 litres	0.5
		50 to 99	0.3
		25 to 49	0.2
		< 25	0.1
6.	Percent of amount intended for work spent through SHS	Above 50%	1.0
		26 to 50	0.7
		Upto 25	0.3
7.	Horticulture and Afforestation in additional areas	Above 100	1.0
		51 to 100	0.8
		31 to 50	0.6
		≤ 30	0.4
8.	Increase of agricultural productivity	> 70%	1.0

The weighted factor for each parameter was given based on benefit achieved from the watershed. Based on quantitative and qualitative parameters 11 best watersheds are selected in eleven schemes covering the 28 mandals of Kadapa district Andhra Pradesh.

4. RESULTS & DISCUSSIONS

Watershed programme promotes changes in ecosystems and improves socio economic status of people. Changes in environmental variables due to implementation of watershed programme in study area are discussed in subsequent sections which are observed in environmental impact survey. The best performance watersheds in Kadapa are given in table 3 based on qualitative and quantitative performance index.

Table3:Weightage is allotted to each parameter

S. No.	Parameter	Range	Marks	Total Weightage
1.	SC & ST Population	Upto – 100	1	
		101-200	2	
		201-300	3	
		301-400	4	
		401-500	5	
		501-600	6	
		601-700	7	
		701-800	8	
		801-900	9	
		901-1000	10	
		1001-1100	11	
		1101-1200	12	
		1201-1300	13	
		1301-1400	14	
		1401-1500	15	
		1501-1600	16	
		1601-1700	17	
		1701-1800	18	
		1801-1900	19	
		1901-2000	20	20
		2001 & above		5
2.	Percentage of literates	Less than 20%	5	5
3.	Agriculture Labour	Less than 50%	2	5
		51 to 70%	3	
		71 & above	5	
4.	Drinking Waters scarcity	No source	5	5
5.	Fluoride affected (quality)	Fluoride	5	5
6.	Active NGO/CBO	Yes	5	5
7	Active DWCRA/SHG	Yes	5	5
8.	Status of Ground Water	D/S	10	5
9.	Contiguity	Yes	5	5
10	Priority APSRAC	V. Low	6	
	On parameters of evapo-Transpiration	Low	12	
	Sedimentation	Medium	18	
	Rate, Rainfall, etc.	High	24	
		V High	30	30
11	Live Stock	Les than 1000	2	5
		1000 to 2000	3	
		> 2000	5	
				100
12.	Area irrigated more than 40%		To be deleted	
13.	Area already treated more than 70% in the past 3 to 4 years		To be deleted	

4.1 Quantitative Parameters

4.1.1 Water levels in wells and number of wells rejuvenated

The rainfall of the district is precarious. The western portion of the district receives more rainfall during South-West monsoon, whereas the eastern portion of the district receives more rainfall during the North-East Monsoon. The principal rainy season is from June to September. Delayed rains also occur in the months of November and December due to the occurrence of depression in the Bay of Bengal during the North East Monsoon. The average rainfall in the district for the past 10 years is 660mm. Because of precarious rainfall, the district experiences recurring droughts. During 2004 – 2005 out of 51 mandals in the district 44 mandals were declared drought-affected mandals due to erratic scarcity rainfall with long dry spells. It is informed that the river Papagni is dry for the last 3 years. This is having a bearing on the results of watershed programmes especially on this parameter of increase in water level in wells and on number of wells rejuvenated. The rainfall figures in the last 10 years in the 28 mandals where in the 198 watersheds taken up for evaluation are located is enclosed which shows the declining trend on rainfall in the district. It is known fact that in Kadapa district open wells are only a few and not much compared to the neighbouring districts and they are defunct and almost abandoned. So the farmers mainly depend on bore wells for water for irrigation and for drinking purposes. This component as seen from the methodology for allotment of weightage to be followed suggests only in respect of open wells hoping that the maximum increase in water level as 3mt.

The increase in level of water is almost nil, in view of the acute drought conditions and erratic rainfall almost for the last 3 to 4 years which is below 660 mms per year and, due to increase in the number of bore wells, the effect of watershed treatment under any component is not conspicuously felt and the impact of this can be felt only when the district receives normal rainfall. It is also observed during the evaluation that most of the farmers in the watershed villages are digging bore wells to depths ranging from 125meters to 312.50 meters even though water level is there at 56.25meter to 62.5meter to get assured water supply for their lands under any adverse circumstances. An ambitious farmer in Bonala-II watershed has dug a borewell to 312.50meter depth but to his misfortune he got only 1½ water where as he was getting earlier at 400’ to 500’. Thus there is over exploitation of ground water in the watershed by digging more bore wells and that too going deeper than that required wherein the water level is available. But however there are sporadic heavy rains in certain watershed villages and also certain watershed works carried out such as stone terracing, C.C.Ts, Check Dams, P.Ts had good impact on water table in and around these places and in such areas there is increase in water levels both in open wells and bore wells.

The following observations are made in the 198 watershed villages evaluated. Water level increased between 2 to 3 mts in 68 watershed villages evaluated. Water level increased between 1 to 2 mts in 20 watershed villages evaluated. Water level increased between 0 to 1 mts in 32 watershed villages evaluated. No increase in water level in 78 watersheds. Accordingly weightage has been assigned during evaluation.

4.1.2 Additional area brought under cultivation

There is substantial increase in area under cultivation in all the watershed villages. This is mainly attributable in bringing more Government land / Wasteland hitherto left as fallow under cultivation mainly by SC/ST and landless people in the villages. It cannot be said with certainty that this is due to the implementation of the watershed activities. This appears to be more by way of cumulative action, resulting due to implementation of several schemes of different agencies in the same area.

Because of awareness created among the villagers as a result of watershed programmes, more area were brought under rainfed cultivation by growing groundnut, sunflower etc., taking risk of erratic rainfall in the areas. Besides, under the watershed programmes, lot of land improvement activities like stone terracing, CCT, Dug out ponds, rock fill dams, check dams, contour bunding and free supply of sweet orange, mango etc., plants to the farmers have been taken up and people have become more conscious about soil and especially water conservation in the areas. Drip irrigation and sprinkler irrigation have been developed to conserve and utilize optimum water for irrigation in such adverse rainfall conditions, but this is only marginal increase

All these factors have contributed for increase of area under dry cultivation and it is a good sign as the people in the villages will be engaged and thus watershed programmes have helped in bringing more area under cultivation. An area of 25,966.5 acres has been brought under dry cultivation.

4.1.3 Reduction of Labour Migration

Inspite of drought, because of additional area being brought under rainfed irrigation and following soil and water conservation techniques like drip, sprinker etc., and as a result of availability of works under watershed programmes like RFDs, dug out pods, check dams, stone terracing, contour bunding, other mining activities (Mudipentla- I WS) the local labour have sufficient work and migration has come down to 80-90% in the watershed villages. This is a good sign.

4.1.4 Increase of milk yield

In the adjoining Chittoor district majority of the watershed villagers are eking there livelihood by maintaining a couple of milch cattle and selling milk and this is possible there because of good marketing facilities and establishment of dairy units.

But in this district this activity of milk production has not picked up and for most of the villagers this component is negligible and milk available is being used only for local consumption.

Now it is seen that all villagers in the watersheds are well connected by black top roads and by creating more awareness among the villagers and by taking up entry point activity like milch cattle rearing by supplying buffaloes, cows, etc., through watershed funds and loans through banks and through Dwacra group funds.

The marketing network has to be improved and Dairying has to be developed by opening new dairy units and reopening dairy units closed like at Pulivendala. The Community Development Society, Pulivendala (NGO) has already taken up motivating people in supplying milch cattle to the villagers. The project Authorities have to concentrate on this component, which helps in improving the economy of the people and in turn reduces factions in the villagers, as people will be engaged on work instead of keeping idle. It is seen during evaluation as a result of motivation created by PIAs in yerragundipalle and Bakarapuram watersheds (DPAP-IV Batch) the farmers are following rotational grazing to provide fodder to the cattle all through the year and the approach is laudable. It is found during evaluation that in spite of all the above problems that 29,896 litres of milk is being produced daily both in the mornings and evenings in the 198 watershed villagey

4.1.5 Increase in Agricultural Productivity

Inspite of drought conditions in Kadapa district, the watershed activities in the watershed villages have created more awareness among them on soil and moisture conservation.. The villagers in the watershed have gone for stone terracing, contour bunding, C.C.T.S, dough ponds, check dams, rock fill dams, Gabian structures, etc.,and in spite of below normal rainfall, there is sufficient water in the wells nearby the structures.

Besides, the villagers, because of awareness created on water conservation, are going for drip and sprinkler irrigation. The Sweet orange gardens and the plantain gardens in Lingala, Simhadripuram, Pulivendala, Thondur, Vemula, Vempalli etc. mandals, the income per acre has gone to Rs.1,00,000 to Rs.1,50,000 as against an expenditure of Rs.30,000 to Rs.40,000 per acre. The villagers have changed the cropping pattern also depending on the rainfall between groundnut, sunflower, and plantain crops to achieve increased agricultural productivity. The farmers are also going for vegetative propagation pursuing tissue culture plants of plantain and other sustained agricultural practices. These activities have helped in increasing the agricultural productivity. The increase in agricultural production in the 198 watersheds is 10.8%.

4.1.6 Horticulture and Afforestation in Additional Areas

There is more increase in area under horticulture than that under afforestation. Under afforestation programme avenue planting, the success rate of which is less, a little extent of area under block plantations has been taken up.But however, the area under horticulture has increased as good Sweet orange Mango, Sapota, Seethaphal, Pomegranate, Tamarind, etc were supplied to the villagers in the watersheds by the PIAs. Out of all this, the area under Sweet orange is more and the said gardens are yielding good revenue to the beneficiaries.

The district has done exceedingly well in planting sweet orange in a big way in private lands. The Stone Terracing, C.C.T.S., Contour Bunding, Drip irrigation etc. works carried out for conserving soil and moisture has motivated the farmers to go for the horticulture in a big way. The soils in this area are red soils suitable for growing Sweet orange.

Besides, the district has done exceedingly well in plain cultivation using drip because of the above factors. The plain gardens are giving net revenue of Rs.1,00,000 a year. Tissue culture plants are being used to get maximum yields. The markets for this produce are at Delhi, Bangalore, Bombay and Chennai. All these methods like sustainable agriculture, conserving Ground water by going for drip and sprinklers, decrease of use of chemical fertilizers, Soil and moisture conservation works, increase in soil fertility by using vermin compost etc., are giving good yields.

This horticultural development can be seen in a big way in upland dry areas in Lingala, Pulivendala, Simhadripuram, Thondur etc. mandals, where the watersheds are located in valleys surrounded with reserved forests and unreserved on the hillside. The location of the areas on the slopes, the availability of drip at subsidized rates has helped in horticultural development in a big way here.

It is remarkable to see that not a single piece of land has been left fallow in some of the watersheds seen and the entire area has been developed giving an appearance and feeling of a delta area in this interior dry upland belt.

In most of the sectors under watershed programmes now, what matters and means to them are only civil structures.

Watershed integrated activity is not complete without vegetative activity and afforestation. But here it is heartening to see that vegetative activity in the form of horticulture has gained importance and changed the scenario.

The watersheds under evaluation have done exceedingly well in planting a few lakhs of sweet orange, mangoes and plantain in Government and Private lands in all the mandals and stupendous assets have thus been created and the villages in the watersheds are protecting and maintaining them. It is also heartening to note that in these watershed villages most of the farmers are having small holdings of 3 to 4 acres each and not bulk areas of 40 to 50 acres. There the farmers are able to concentrate and develop their lands following modern sustained agricultural practices like stone terracing, drip and sprinklers etc., and all these factors helped in increasing full work for the villagers and their economy also has improved.

As a result of watershed programmes in the villages and motivation and awareness activities taken by the PIAs, work has been created to most of the farmers in the watershed programmes and this helped to some extent in reducing factionism in these villages.

In Simhadripuram mandal, watershed programmes were taken up in Paidipalem-I & II watersheds under EAS programme between (1995-96 to 1998-99). Sri Ravindranath Reddy was Chairman of Paidipalem – I watershed. These watersheds were under Government of India PIA and now transferred to NGO PIA-CDS Pulivendula. Sri Ravindranath Reddy took lot of interest in the development of the watershed areas by carrying out stone terracing over 200 acres of individual farmers lands, contour bunding over 400 acres and continuous contour trenches covering 10,000 cum of earth work. Sweet orange plants brought from Kodur have been supplied to the farmers and sweet orange plantations were raised over 300 acres under horticulture component and they are said to be yielding. The village has developed well economically as a result of these sweet orange gardens and the villagers have recognized this. The village got the best watershed reward also in the district. The water table also has gone up by 2.10 mtrs as a result of these soil and moisture conservation works and rainfall between September 2003–September 2004. Thus, as a result of watershed programme under horticulture, additional areas has been brought to productivity. This is a success story here and the villagers have to be congratulated for this achievement for development of the area through soil and moisture conservation works and horticulture.

A total area of about 15,407.75 acres has come under horticulture with plantain, sweet orange, mango etc., crops. Due to continuous years of drought over 4 to 5 years, the yields have suffered and some gardens dried up.

4.2 Qualitative Analysis

4.2.1 Meeting

The general body meetings are being held in the watershed and deliberations recorded in the minutes books.

The general body meetings are being held in the watershed and deliberations recorded in the minutes books. It is observed that as against 800 to 2000 general body members the attendance varies between 60-150. Hence there is need to create more awareness about the watershed programme in the villages. It is also seen that in certain schemes, only general body meetings are being held in which it is said that the committee members participated. Such things may be streamlined by following the guidelines.

Since in the grading formats communicated for assessment, no separate distinction has been made regarding the attendance for general body/committee meetings and as such grading has been taken on the basis of attendance recorded in the monthly committee meetings.

Most of the works in the watersheds were executed by other departments involving only user groups and meetings involving watershed committees on completing works were not held and recorded and they have to be streamlined.

4.2.2 Shramadan

This programme is about the voluntary work turned out by the villagers in the respective watersheds without involving watershed funds or watershed development funds. This shows the awareness created in the programme as a result of carrying out entry point activity in the watershed villages and the interest of the villagers in the programme.

4.2.3 Women Participation

The women representation in committees in the old programmes is marginal and it is 100% in the ongoing schemes like DPAP-VII, DPAP-VIII etc. This aspect has to be examined and the minimum number of women members have to be associated in the committee as per the guidelines.

4.2.4 Self-help Groups

Works have been executed to an extent of 28.8% through self-help groups in the watersheds and the balance through user groups, individual farmers and watershed committees.

During evaluation, it has been observed that in Porumamilla area, 5% of the amount spent on works is being earmarked to have been spent through self help groups where as in Rajampet and other areas the subject of allotment of works to the self help groups is being discussed at the meetings and works allotted and recorded in the minutes book. The project authorities have to look into the matter and to see that works are allotted to self help groups duly discussing the issue at the meetings and recorded in the minutes book without arbitrarily fixing any percentage of amount to self help groups.

4.2.5 Maintenance of Structures

the structures in the old projects on completion have to be maintained with the Watershed Development Fund (WDF) available. During evaluation, the list of structures damaged are identified, and it is seen from the list of structures mainly rockfill dams, loose boulder structures, dugout ponds, check dams have been damaged in 105 watersheds as against 198 watersheds evaluated. Most of the structures were damaged due to flash flood and heavy rains.

The table 4 shows the best watersheds in different projects due to additional area brought in under cultivation. In some of the watersheds, it is due to increase in groundwater table, reduction in labour and increase in Horticulture and afforestation.

Table 4: Best performance watersheds in Kadapa using Quantitative and Qualitative performance

S. No.	Name of the Watershed	Name of the Project	Weightage Factor
1.	Velpula –2	DPAP – I	188.457
2.	Nawabpet & Duggannapalli	DPAP – III	187.27
3.	Yerragudipalli & Bakarapuram	DPAP – IV	183.95
4.	Diguvalkalavakatta-1	DPAP – V	123.48
5.	Nandyalampalli	DPAP – VI	117.84
6.	Kondapayapalli	DPAP – VII	115.83
7.	Pemmadapalli	DPAP – VIII	99.06
8.	Cetimapuram-I	IWDP – II	153.67
9.	Settyvaripalli-2	IWDP – V	180.21
10.	Vempalli-4	EAS – I	168.09
11.	Reddypalli	RIDF – VI	68.00

5. CONCLUSION

Based on quantitative and qualitative performance index, 11 watersheds are selected as best watersheds in 28 mandals out of 198 watersheds. The increase in agricultural production in 198 watersheds is 10.8%. Reduction in labour migration has come down 80 to 90% in watershed villages. The ground water level in 28 mandals, due to the implementation of watershed programme in the study area, has enhanced in 128 villages. The following observations are made in 198 watershed villages evaluated. Water level increased between 2 to 3 mts in 68 watershed villages evaluated. Water level increased between 1 to 2mts in 20 watershed villages evaluated. Water level increased between 0 to 1mts in 32 watershed villages evaluated. No increase in water level in 78 watersheds. Accordingly, weightage has been assigned during evaluation.

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Stunting And Marginalisation- Role Of Safety Nets In Food And Nutrition Security In India

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ABSTRACT

Malnutrition across the world is a global issue but in the developing countries it is catastrophic. Poverty affects nutrition and nutrition affects poverty. While income poverty is important to nutrition, it is not strongly correlated. India continues to have high incidence of malnutrition and stunting among children and has a greater share of the world's poorest now than it did thirty years ago. Stunting, as a manifestation of deprivation in early childhood, is a common problem among young children. . This paper analyses the cycle of poverty and consequences to health and nutritional status among the rural poor and also examines the relationship between poverty, marginalization and health in the context of stunting, under weight and wasting among children, malnutrition in women and adolescent girls and the role of safety nets like school lunch (mid day meal) in promoting food and nutritional security among children in India.

Key words: food security, mid day meal, nutritional security, stunting.

I.POVERTY AND STUNTING IN INDIA- AN OVERVIEW

India ranks poorly in the Human Development Index at a low 136 among 187 countries based on a measure assessing progress in life expectancy, access to knowledge and a decent standard of living or gross national income per capita (United Nations, HDI, 2013). HDI Report, 2013 also places India at the near-bottom of countries which have reached 'medium development'. The Multidimensional Poverty Index (MPI) indicates that 53.7 per cent of the population continue to live in multidimensional poverty, while an additional 16.4 per cent were vulnerable to multiple deprivations.

Income poverty, as an indicator used by both the World Bank and the UN, reflects an understanding of poverty that is solely based on levels of monetary income. People living on less than US$1 per day are living in extreme poverty, and people who earn less than US$2 a day are in moderate poverty (UNDP, 2004). However, human poverty encompasses the multiplicity of dimensions associated with poverty which include deprivation on a material level, e.g. lack of proper diet, clothing, shelter, work and social deprivation, such as denial of to employment, participation in social institutions, and education (Krieger, Nancy, 2002). The framework adopted by United Nations includes both the human poverty as well as income poverty.

Studies have shown on the linkages between poverty, type of livelihood, food security and nutritional status (Balatibat, 2004). Food

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shortages are reported among households with incomes above the poverty threshold and therefore income does not always guarantee adequate food on the table. Besides, food security does not directly translate into nutrition security and adequate nutritional status, partly because the latter is not only determined by food intake but also by health and care variables.

At a global level, the new framework for nutrition action is represented by the Scaling Up Nutrition movement, with its priority on the 1,000 days window from a child's conception to two years of age. Almost no poor mothers and young children among the 2 billion affected by "hidden hunger" have access to affordable and nutritious products suited to the needs of growing young children during the first 1,000 days period in which nutritional status defines lifelong outcomes for individuals. Inappropriate infant feeding practices, for example non-exclusive breastfeeding of infants 0-6 months, or introduction of complementary foods of low nutritional value (low in micronutrients and good quality protein and energy), contribute to anaemia, reduced cognitive development, growth faltering and heightened susceptibility to common infectious diseases, resulting in a rapid decline of nutritional status of such children with stunting, developmental delays, increased risk of illness and death.

Despite economic progress, India continues to have high incidence of malnutrition and stunting among children (ADB, 2013) and has a greater share of the world's poorest now than it did thirty years ago. India which was home to one fifth of the world's poorest people 30 years ago, today has one-third - 400 million surviving on 82 pence per day or less (World Bank, 2013). India has 43 per cent of under-five children that are underweight during the period 2000–2007. Undernourished children under-five years constitute 48 per cent in India according to the Nutrition Report (NFHS-3, 2009).

Major findings on Nutritional health in India according to IHDR, 2011, are

- A high percentage (21.5%) of babies are born with low birth weight (NFHS-3, 2005-06)
- Child malnutrition is higher in rural areas than in urban areas
- More than 50 per cent of Scheduled tribes (ST) children are underweight and stunted
- The prevalence of anaemia among adolescent girls is very high with severe anaemia being more prevalent among them than among pre-school children. More than 75 per cent of ST children are anaemic
- Scheduled Castes (SCs) and STs have a higher percentage of women with BMI<18.5
- About 30 per cent of all adults (33 per cent of women and 28 per cent of men) have a BMI (Body Mass Index) less than 18.5, which defines adult malnutrition
- There is intergenerational stagnation of height among Indian women, with no improvement in the heights of daughters over mothers.

Poor nutritional status is caused by:

- Insufficient access to affordable and nutritious food throughout the year
- Lack of good care for vulnerable groups - the mothers and young children
- Inadequate access to health, sanitation and clean water.

Hunger, malnutrition, and severe forms of material deprivation, affect large number of children and women resulting in infant mortality and maternal mortality among other impacts to their health and their quality of life. The right to food is the right to have regular, permanent and unrestricted access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of the people to which the consumer belongs, and which ensure a physical and mental, individual and collective, fulfilling and dignified life free of fear (OHCHR, 1999).

Hunger as 'a condition, in which people lack the basic food intake to provide them with the energy and nutrients for fully productive lives' (Hunger Task Force, 2003) is a violation of the right to food. Over time, the combination of low birth weight and high rates of infection due to malnutrition can result in the stunted growth of children. The most extreme manifestation of continued hunger and malnutrition is mortality. Hunger has three major dimensions viz., (a) chronic or endemic hunger, (b) latent hunger, and (c) transient hunger (IHDR, 2011, p.121). Hunger Index of India (HII) is alarming although it declined from 31.7 in 1990 to 24.1 by 2010. Half the world's hungry people live in India. In India systemic problems rooted in discrimination result in high mortality rates, particularly during childhood and in their reproductive years.

Malnutrition is a matter of serious concern despite declining income poverty in India because the overall per capita intake of calories and protein declined consistently over a 20-year period from 1983 to 2004–2005 (National Sample Survey, 2004-05). Declining per capita intake of calories and protein is higher among rural population at 8 per cent than in urban population at 3.3 per cent. Rural calorie consumption per day declined from 2,221 kcal in 1983 to 2,047 kcal in 2004-2005 while the urban calorie consumption fell from 2,080kcal to 2,020kcal. Studies also highlight that rural protein consumption fell by 8 per cent over the same period while urban protein consumption remained unchanged (Planning Commission, 2008). The poor households are at additional disadvantage owing to poor purchasing power limiting their scope to diversify food consumption.

Similar trends of declining protein –calorie intake among children is observed. Studies by the National Nutrition Monitoring Bureau (NNMB, 2002, 2006) reported that protein-calorie adequacy is less than 30 per cent among children and it has been decreasing for all age groups. The report in 2006 identifies that there is nutrient inadequacy leading to malnutrition in children and adolescents with a daily 500–600 kilocalorie deficit in energy intake (almost 40 per cent of their requirement) and multiple nutrient deficiencies such as fat, calcium, iron, riboflavin, vitamin C (all 50 per cent deficit), and Vitamin A (70 per cent deficit).

India has an infant mortality rate (IMR) of 47 during 2011, down from 125 per 1,000 live births in 1992. Different forms of malnutrition are evident from 59 per cent children being stunted (height for age), 42 per cent underweight (weight for age) and 11.4 per cent wasted (weight for height) (HUNGaMA Survey Report, 2011). Of the children suffering from stunting, about half are severely stunted.

Though India has great diversity of food habits and food culture, the food served in schools and Anganwadi centres is not as diversified and is very poor in protein. As a result the poor and the disadvantaged are becoming shorter while the rich in every community of the country have been growing taller by 4 to 6 cms with every succeeding generation (Shatrugna, 2012).

Studies indicate "that full recovery from early malnourishment is possible, with faster than normal growth in malnourished children" through what is called as "catch-up growth" (Singh , 2014). Studies revealed 'some degree of reversibility in stunting even until relatively late in childhood (Singh, 2014). Assessment of the impact of MDM in Andhra Pradesh has shown positive changes both on the weight and the height of children and a similar effect was significantly observed among children whose nutrition was adversely affected as a result of droughts in early childhood.

The following section of the paper discusses role of Mid Day Meal programme owing to its importance of covering all school children in the country. The MDM has great potential to arrest nutrition deficiencies and contribute to catch-up-growth among school going children.

II. MID DAY MEAL – SAFETY NET FOR FOOD AND NUTRITIONAL SECURITY

There are several safety nets in addressing the issues of hunger and malnutrition. Important programmes in the area of food and nutrition security, implemented across the country, include the Targeted Public Distribution System, Integrated Child Development Services and the school mid day meal scheme (MDMS). Other measures like Minimum Support Price and Food Procurement Policy also play significant role in promotion of food and nutritional security among the poorest families.

The Mid Day Meal Scheme is a flagship programme of the Government of India designed to improve the nutritional status of school-age children nation wide. It is the world's largest school feeding programme that reached out to about 104.5 million children spread across 1.16 million schools during the year 2013-14. The program provides one cooked meal to all the children attending primary and upper primary schools. The MDM addresses the goals of universalisation of elementary education as well as improving the nutritional and health standards of children in the country. The MDM programme involves 2.57 million cooks –cum-helpers and 0.67 million kitchens across the country.

The National Programme of Nutritional Support to Primary Education (NP-NSPE) was initiated on 15 August 1995, initially in 2,408 blocks of the country, with the objective of improving effectiveness of primary education by improving the nutritional status of primary school children. The NP-NSPE was expanded to cover entire country by 1997–98 providing a cooked mid-day meal with 300 calories and 12 gram of proteins to all school children in from classes I to V. Subsequently in 2007, the programme was expanded to students of upper primary classes of from VI to VIII and the name was changed to National Programme of Mid Day Meals (MDM) in Schools. Allocation for the MDM scheme has increased from Rs 6,700cr to over Rs 10,300 cr between 2007-08 and 2011-12.

Implementation of MDMS comprises two models viz., Decentralized model and Centralised model. The decentralized model is run by community based organisations (local SHGs, parent-teacher associations, or village committees) and the meals are cooked on-site adhering to a participatory approach and allowing flexibility to include local cuisine, food cultures, and minimizing costs on transportation besides providing jobs to the local people. The Centralised model engages an external organization through public-private partnership approach, for cooking school lunch in large scale and delivering the meal to schools.

The mid-day meal aimed to provide daily at least one-third of recommended calories and half of the proteins to every school child.

Nutritional contents of mid day meals for minimum amount of food and calorie content per child per day, both for primary and upper primary, are as under:

Table 1 :Entitlement norm per child per day under MDM

Items	Quantity per day/ Child	
Food grains/ Nutrient	**Primary School**	**Upper Primary School**
Pulses	100 gms	150 gms
Vegetables (leafy also)	20 gms	30 gms
Oil & fat	50 gms	75 gms
Salt & condiments	As per need	
Energy (in Kilo Calories)	450	700
Protein (in Grams)	12	20

Menu for school lunch is fixed by the state governments and varies across the states. The school lunch menu is cereal based.

Table 2 : Mid Day Meal Menu in Schools – At a Glance of a few states in India

State/ Day	Andhra Pradesh	Madhya Pradesh	Odisha	West Bengal
Monday	Sambar with rice	Chapati /Rice with Pulses (Tuwar / Arhar) & vegetable of potato/ green peas & Tomato	Rice and Dalma	Potato Kumro, with rice
Tuesday	Vegetables with rice	Puri / Pulav with Kheer & Vegetable of Potato & Tomato	Rice and Soyachunk curry	Papaya, potato, Dal , Bengal gram with rice
Wednesday	Dal and vegetables with rice	Chapati / Rice with Mung Pulses & Vegetable of Rajma	Rice and egg curry	Soyabean, potato, Dal with rice
Thursday	Sambar with rice	Chapati / Rice with Pulses (Tuwar / Arhar) & Green Vegetable	Rice and Dalma	Potato, peas, Ghugni, with rice
Friday	Vegetables with rice	Chapati / Rice with Mung Pulses & Green Vegetable	Rice and Soya Chunk	Cabbage, fish (chingri, total 10 kg. For 100 students) with rice
Saturday	Dal & vegetables with rice	Chapati / Rice with Pulses (Tuwar /Arhar) & Rajma	Rice and egg	Alu, Patal, Chatni with rice
	Egg/ banana, twice a week			

Although the MDM has been effective in improving school enrolment, there are serious shortcomings in achieving the goal of full coverage and regularity in serving of meals. There are several delivery problems that affect MDM and design related issues such as nutritionally balanced meals in terms of micronutrients, convergence with school health programme and growing shift towards centralised MDM model. The state wise Fifth JRM reports mention flaws in fund flow, delays in notifying revised cooking costs for school lunch resulting in providing school lunch at old rates even after a lapse of a year. Meals were not provided during summer vacations and in drought affected areas.

Food grain utilization has decreased from 87% in 2010-11 to 76% during 2011-12 and during 2012-13 slight increase to 79%. There has been an overall decrease of 8% during three years in Assam. Similarly, cooking cost utilization has decreased from 85% in 2010-11 to 76% in 2011-12 and slight increase during 2012-13 to 82%. Irregularity in supply of the food grains also disrupted serving of meals in most of the schools due to the mismatch in availability of food grains and cooking cost. Also a matter of concern is that MDM is implemented for only 88 % of working days at Primary stage and 82% at Upper Primary stage in Assam (MDM – Assam, 2013).

JRM reports stress an urgent need to strengthen convergence with NRHM for the effective implementation of School Health Program. Essential micronutrients were not provided in 50 to 54 % of the schools in 2013 (MDM – Assam, 2013). Other issues include failure to provide serving plates in 71% of the schools.

Centralisation of cooking under MDM programme is a major concern. There are reports that food served to children under the centralised model is of poor quality. The Ministry of Human Resource Development revealed that 95% of tested meal samples prepared by NGOs in Delhi did not meet nutritional standards in 2010–12. “Response towards the Mid Day Meals served in schools by Akshaya Patra was not very positive in most of the schools. In one school, out of the total enrolment of 130 children only 30-50 children take meals in school depending upon the menu” (MDM-Assam, 2013 p.95). The JRM on MDM – Andhra Pradesh reviewed Centralised kitchens run by Akshaya Patra and Nandi. “The mission was surprised to notice that centralized kitchen is serving MDM in the schools in Medak district, where proper kitchen sheds, kitchen devices and cook-cum-helpers all are available. It is hard to understand why the school based kitchens are replaced with centralized kitchen” (MDM-Andhra Pradesh, 2013).

III. IMPACT OF MDM ON FOOD AND NUTRITIONAL SECURITY OF CHILDREN

Studies indicate significant improvement in enrolment rates, reduced drop out rate and bridging of gender gap There have been a few studies in the recent years covering small samples of schools across India. Joint Review Missions on MDM in 2013 examined impact on health and nutrition. While these reports highlight shortcomings in the implementation of the MDM, also provide indications of positive impact on health and nutrition of the school children.

Mid Day Meal Scheme in India is monitored through 38 independent Monitoring Institutes, Joint Review Mission and Office of Supreme Court Commissioner. “Many independent evaluations have reported that MDMS has helped in preventing classroom hunger; promoting school participation and fostering social equality and enhancing gender equity” (DSE&L, 2014). There is a need to examine food norms to provide additional food matching with their growth requirement during adolescence.

The Joint Review Mission on MDM 2013-2014 covering 18 States revealed that 12 states had 20.19 per cent (Delhi) to 31.65 per cent (Arunachal Pradesh) moderately malnourished boys, while 8 states had 21.2 per cent (Tripura) to 31.53 per cent (Gujarat) moderately malnourished girls. It also revealed an alarming percentage of 30.73% of boys and 21.02% of girls severely malnourished in Uttar Pradesh. Table 3 provides details of nutritional status of a sub-sample of children taking mid day meal.

Table 3: Percent Prevalence of Under-nutrition among children taking MDM

Name of the State	Prevalence (%) among boys		Prevalence (%) among girls	
	Moderately malnourished (-2SD)	Severely malnourished (-3SD)	Moderately malnourished (-2SD)	Severely malnourished (-3SD)
Gujarat	26.62	17.87	31.53	9.83
Tamil Nadu	31.65	24.3	29.18	14
Assam	21.16	8.84	15.06	10.34
Uttar Pradesh	26.04	30.73	21.9	21.02
Manipur	6.93	1.94	4.11	0.72
Madhya Pradesh	25.12	2.17	6.33	7.01
West Bengal	15.7	9.5	11.45	5.73
Puducherry	23.94	16.67	17.69	6.35
Tripura	23.91	6.04	21.2	5.24
Delhi	20.19	13.46	21.64	4.48
Jharkhand	24.81	6.25	18.48	2.72
Meghalaya	10.63	3.19	6.93	2.22
Arunachal Pradesh	6.08	2.03	4.63	1.54
Himachal Pradesh	21.29	6.08	22.61	1.54
Maharashtra	25.84	0	22.64	0
Odisha	16.24	10.4	12.67	7.6
Bihar	29.79	0	23.66	0

Source: DSE&L (2014).

CONCLUSION

The shortfalls in policy and program implementation of MDM and recommended diets for schools and Anganwadis, needs to be corrected. The recommended diet needs to provide wider choices to address anomalies in nutrition standards of our children. Children of poor households in Anganwadis, government schools and hostels must have adequate proportion of animal protein, from milk, mutton, chicken, beef, fish, eggs, oil, etc to enjoy their right to food and their right to grow normal. "More varied menu should be there" as the JRM on MDM - West Bengal Report 2013 recommended. Fifth JRM Reports on MDM -2013 also recommended improvement in dietary quality of food both in quantity and quality, inclusion of local foods (fruits and vegetables), convergence with School Health Programme, promotion of kitchen gardens and balanced nutrition with proper attention to protein. There is clear need for flexible, regional specific and cultural sensitive food norms for the MDM program. Local food cultures need to be incorporated into the MDM to be acceptable and nutritionally rich. There is also need to examine demand for additional/ diverse recommended diet to suit specific needs of the school children of different regions.

Measures in post harvest technology, commercial fortification, crop bio-fortification and food fortification to control inadequacies of multiple micronutrients by increasing the density of nutrients through addition of nutrients at levels higher than those found in the original food. Double fortified salt is one of these kinds of low cost high impact interventions, which is now introduced in ICDS and MDMS to control the twin deficiencies of iron and iodine. Role of biotechnology is gaining attention with convincing evidence of the efficacy and effectiveness of implementation of fortified foods in improving the status and other health related outcomes (Radhika et al., 2011). Technologies like ULTRA RICE and wheat fortification using encapsulation or nano particulated micronutrients, and bio fortification promise great potential in correcting micronutrient deficiencies among populations.

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STUDY ON GODAVARI RIVER INFLOWS DURING RABI SEASONFOR GODAVARI DELTA SYSTEM, ANDHRA PRADESH

Gopi Nitta[1], N S Anil Kumar Banda[2], B K Nageswara Rao[3], & K Siddhartha Kumar[4]

ABSTRACT

Surface Water is an important source for irrigation and the availability mainly depends on the annual rainfall of the catchment area. The river flows are inconsistent. For managing these inconsistent flows and effective utilization of these surface water flows water storage/diversion structures are essential. In this Paper, an attempt has been made to assess the flow pattern of the River Godavari in Rabi Season. The Godavari River inflows in Khariff season are abundant (from 15th June to 15th November) but there is a shortage of water in the Rabi season (from 1st December to 30th April). The inflows of river Godavari from Rabi 1966 to Rabi 2004 are being analyzed with simple Probability methods and corresponding plots with best fit trend lines distributions are prepared for individual months in Rabi season. From these analyses, Monthly Probability equations are developed from the inflow data which enables to assess the Minimum surplus flows and dependable surplus inflows in the future. Based on the distribution equations, the percentage probability of exceedance (i.e. 65% dependability, 75% dependability & 90 % dependability) for each Rabi Month is calculated for the Minimum surplus, Maximum Surplus flows. These flows are not sufficient with respect to demand in the Rabi Season and Deficiency in water requirement varies from month to month.

KEY WORDS: Surplus flows, Godavari River, Statistical Methods

1.INTRODUCTION

Surface Water is an important source for irrigation. Surface water availability mainly depends on the annual rainfall in the catchment area. In India, Rain water availability is plenty and abundant in monsoon and about 4000 bcm of rainfall is being received every year.In this rainfall, only 48% ends up in Indian Rivers and, out of this , only 18% of the rain water is being utilized for our water demands. These river flows are inconsistent. For managing these inconsistent flows and effective utilization of these surface water flows, water storage/diversion structures are essential. In Deltaic regions diversion structures (i.e., Barrage/Anicut) are the most economical structures to divert the water into irrigation fields.The performance of the Barrage in Rabi is most important to cater to irrigation demands and it mainly depends on the flows of the river in Rabi season.

Sir Arthur Cotton Barrage at Dowlaiswaram is a Diversion structure across River Godavari and it irrigates 10, 13, 161 Acres in East & West Godavari Districts, Andhra Pradesh. Polavaram is on upstream of Dowlaiswaram on River Godavari.

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The Godavari River inflows in Khariff season are abundant (from 15th June to 15th November). The surplus water flows into Bay of Bengal. On the other hand there is a shortage of water in the Rabi season (from 1st December to 30th April).

In this Paper an attempt has been made to assess the flow pattern of the River Godavari in Rabi Season. The inflows of river Godavari from Rabi 1966 to Rabi 2004 are analyzed with simple Probability methods.

The daily river flow data (in m3/sec) of the 39-year period from1966 to2004 at Polavaram gauge station for Rabi season (i.e. from 1st December to 30th April) is collected.

Based on the available data, average monthly flows for respective years were calculated in m3/sec. These values are converted into TMC (Thousand Million Cubic feet).

The Table 1 provides the irrigation demand for the corresponding month in Rabi season, and it is obtained from the local authorities. Based on these demand calculated the surplus flow is arrived by subtracting the Demand from monthly mean flow for every year for each Rabi month. These Monthly mean flows and Surplus flows for each year from 1966 to 2004 for all the Rabi months are tabulated in Annexure 1.

Month	December	January	February	March	April
No. of Crop days	31	31	28	31	30
Irrigation demand in TMC	10.08	13.92	18.62	16.12	13.53

Table 1 – Number of Crop Days & Irrigation Demand in Godavari Ayacut at Polavaram
(Data Collected from Local authorities)

2. METHODOLOGY

Let x1', x2', x3',........xm',..........xn' be the original independent observation that are recorded in the same sequence of their occurrence. Let x1, x2, x3,........xm,..........xnbe the same observations arranged in the descending order of magnitude such that x1> x2> x3>.......>.xm>.......>xn. The suffix "m" in the order of sequence of observations is called Rank of the Observation. This, then, means that the highest value among the observations gets a rank of 1, the next highest gets a rank of 2, and so on while the observation with the least magnitude gets a rank "n" which is the size of sample.

If the variable under the consideration is an annual event such as the annual flow etc., we can say the random variable takes a value equal or more than xm on the average once in (n+1)/m years, which is known as return period (Tr).

The Weibul's formula for Return period

$$T = \frac{n+1}{m}$$

$$P(x)_m = \frac{1}{T_r}$$

Fig 1 – Map Showing Godavari Basin Map including all major Tributaries

The Probability of exceedance (P(Xm)): In the order of sequence if we considered the observation with rank m, this value Xm is equaled or exceeded m times out of n times, and therefore from the frequency interpretation of probability, we can write

Now, if a plot is made between the value of variable as abscissa and the corresponding exceedence probability as the ordinate, the resulting graph is called a distribution graph or a probability plot. This plot may be interpolated to obtain the exceedence probability corresponding to a magnitude of the variable or to obtain the magnitude of the variable corresponding to any specified exceedence probability.

The available river flow was analyzed by the above procedures and corresponding plots are prepared for individual months in Rabi season. The best fit trend line distribution is arrived based on the R2 coefficient for the all plots and equations are obtained for each trend line (Fig. 2 to Fig. 7).

Based on the equations the percentage probability of exceedence (i.e. 65% dependability, 75% dependability & 90 % dependability) for each Rabi Month is calculated by using solver in Excel.These values along with the Minimum surplus, Maximum Surplus are tabulated in the Annexure 1.

1. CONCLUSIONS

Godavari Delta system is an existing Irrigation system having an ayacut of 10,13,161 Acres and the Total Irrigation demand is 72.27 TMC in the Rabi season. The flows are not sufficient in the Rabi Season and Scarcity of water varies from month to month in the Rabi season. Scarcity flows are analyzed by simple Statistical Methods from Rabi 1966 to Rabi 2004 (Total 39 Years).From this analysis monthly probability equations are developed from the inflow data which enable to asses the scarcity.

From the analysis the following observations are made

• The total yearly mean flow of Rabi season is 152.06 TMC & Mean flows are about 100% more from existing demand

• By considering 65% dependability, the availability of water is nearly sufficient to meet the Irrigation demands in the months of February, March and April. (Surplus flows = 1.92 TMC, 3.13 TMC & 0.75 TMC respectively)

• By considering the 75% dependability, the availability of water is insufficient to meet the Irrigation demands in the months of February and April .(Deficient flows = 0.60 TMC & 1.24 TMC respectively)and nearly sufficient in the month of March (Surplus flows = 0.82 TMC).

• By considering the 90% dependability, the availability of water is insufficient in the months of February, March and April. (Deficient flows = 4.05 TMC, 2.36 TMC & 3.98 TMC respectively)

• The Maximum Surplus Flows in Rabi season is 230.30 TMC

• The Minimum Surplus Flows 8.54 TMC is available in December month only.

3.ACKNOWLEDGMENT

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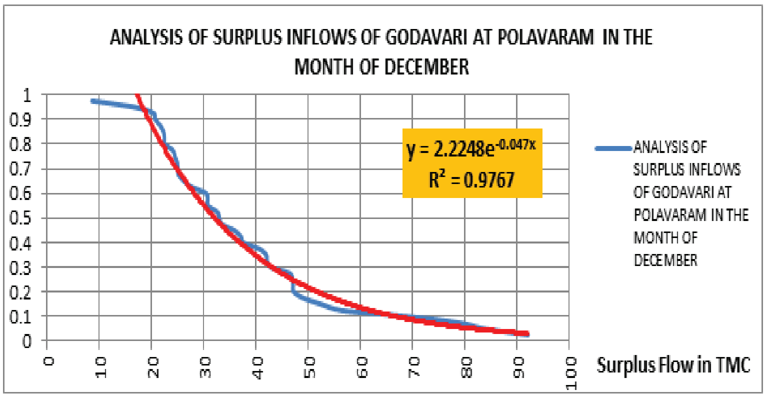

Fig 2 – Graph Showing Probability of exceedencevs Surplus flows in the Month of DECEMBER

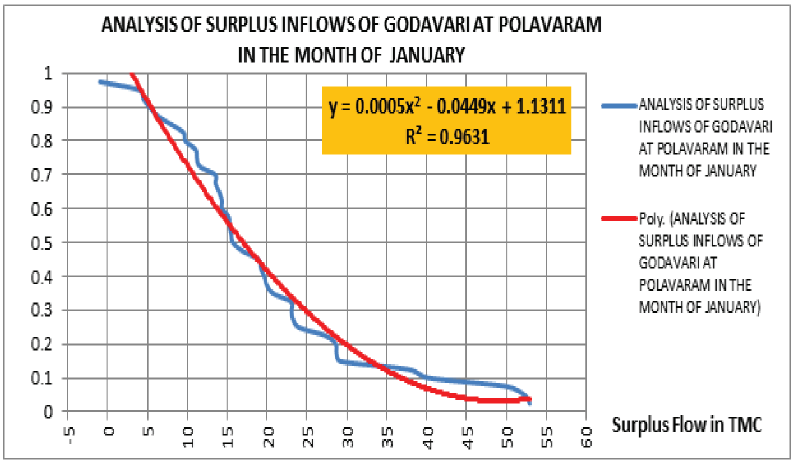

Fig 3– Graph Showing Probability of exceedencevs Surplus flows in the Month of JANUARY

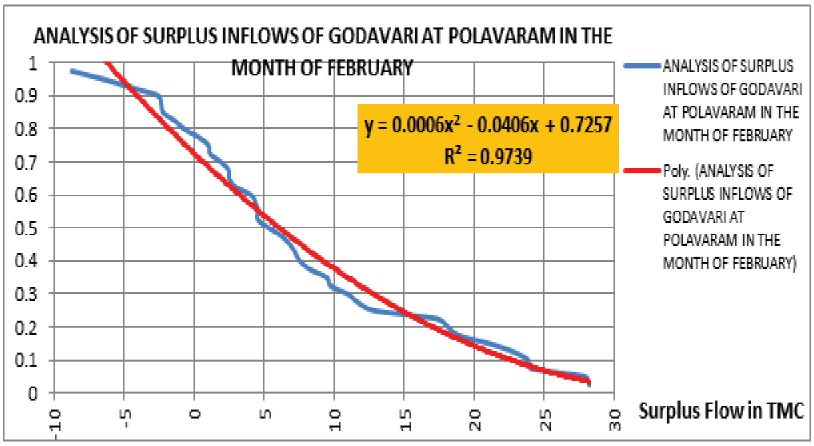

Fig 4 – Graph Showing Probability of exceedencevs Surplus flows in the Month of FEBRUARY

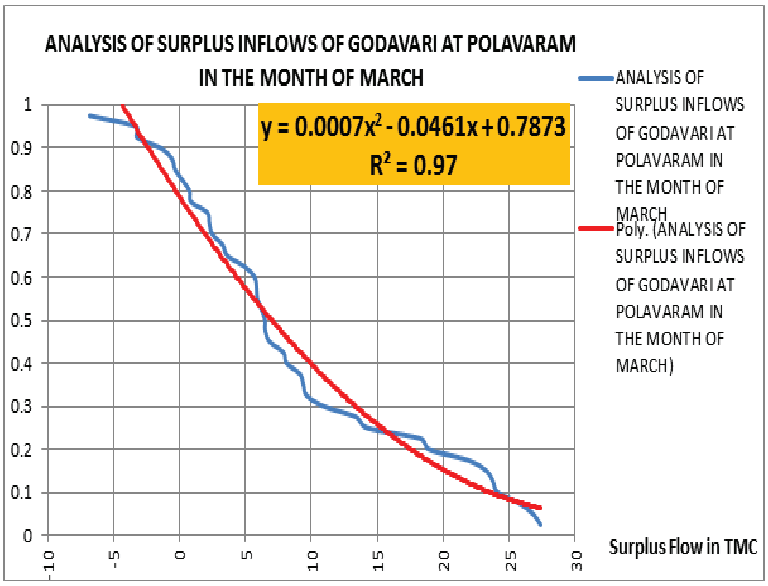

Fig 5 – Graph Showing Probability of exceedencevs Surplus flows in the Month of MARCH

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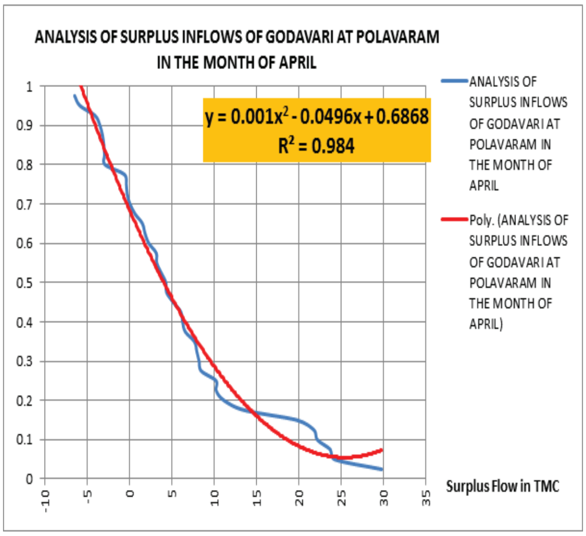

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Fig 6 – Graph Showing Probability of exceedencevs Surplus flows in the Month of APRIL

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ANNEXURE – 1 - ANALYSIS OF GODAVARI RIVER FLOW DATA AT POLAVARAM - ANDHRA PRADESH –RABI SEASON

in TMC

MONTH	NO. OF DAYS REQUIRED	YEARLY MEAN FLOW	IRRIGATION DEMAND	MAXIMUM SURPLUS	65% DEPENDABILITY	75% DEPENDABILITY	90% DEPENDABILITY	MINIMUM SURPLUS	DISTRIBUTION	R2	EQUATION
DECEMBER	31	47.74	10.08	92.00	26.18	23.14	19.26	8.54	EXPONENTIAL	0.98	$y = 2.2248\ e^{(-0.047\ x)}$
JANUARY	31	33.58	13.92	52.93	12.44	9.49	5.48	-0.97	POLYNOMIAL	0.96	$y = \{ 0.0005x^2 - 0.0449x + 1.1311\}$
FEBRUARY	28	26.29	18.62	28.20	1.92	-0.60	-4.05	-8.75	POLYNOMIAL	0.97	$y = \{ 0.0006x^2 - 0.0406x + 0.7257\}$
MARCH	31	24.86	16.12	27.37	3.13	0.82	-2.36	-6.82	POLYNOMIAL	0.97	$y = \{ 0.0007x^2 - 0.0461x + 0.7873\}$
APRIL	30	19.59	13.53	29.80	0.75	-1.24	-3.98	-6.45	POLYNOMIAL	0.98	$y = \{ 0.001x^2 - 0.0496x + 0.6868\}$
TOTAL	**151**	**152.06**	**72.27**	**230.30**	**44.42**	**31.61**	**14.35**	**-14.44**	x – Surplus flow in TMC		y - % of Exceedence

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సమకాలికం - అధునాతన దిశలో

సాంకేతిక విద్య

ప్రపంచీకరణతో అనూహ్యరీతిలో మారుతున్న సాంకేతిక రంగం విద్యావ్యవస్థను ప్రధానంగా సాంకేతిక విద్యను అత్యంత ప్రభావితం చేస్తున్నది. నూతన సవాళ్ళను సమర్థవంతంగా ఎదుర్కొనేందుకు ఆంధ్రప్రదేశ్ సాంకేతిక విద్య సర్వసన్నద్ధమైంది. పరిశ్రమలు, ఉపాధి అవకాశాలు, పరిశ్రమ రంగాలకు ధీటుగా విద్యార్థులను అత్యంత సమర్థులుగా చేసేందుకై రూపాంతరం చెందింది.

సాంకేతిక విద్యాశాఖ ప్రత్యేకతలు

- పేద, మధ్య తరగతి విద్యార్థులకు అందుబాటులో ఉండేలా భారతదేశంలోనే అతి తక్కువ ఫీజుతో డిప్లొమా కోర్సులు పూర్తి చేసే అవకాశం.
- కోర్సు ముగిసిన పిమ్మట ఉద్యోగ అవకాశం, ఎడ్యుకేషన్ కెరీర్ డెవలప్‌మెంట్ చేసుకొనే విధంగా సాంకేతిక విద్యాశాఖ వివిధ కోర్సులను రూపొందించడం జరిగింది.
- జాతీయ స్థాయిలో జరుగుతున్న 'గేట్' లాంటి ఉన్నత శ్రేణి ప్రవేశ పరీక్షల్లో డిప్లొమా సాంకేతిక విద్య నేపథ్యంగా కలిగిన విద్యార్థులు 'టాపర్లు'గా నిలుస్తున్నారు.
- ప్రతి సంవత్సరం జరుగుతున్న రాష్ట్రస్థాయి, జాతీయ స్థాయిలో జరిగే పలు ప్రవేశ పరీక్షలలో 'డిప్లొమా సాంకేతిక విద్య' విద్యార్థుల ర్యాంకులే అధికంగా ఉంటున్నాయి.

ప్రస్తుతం ఉన్న వివిధ కోర్సులను అభివృద్ధి చేసి పాఠ్యాంశాలలో నూతనత్వాన్ని పొందుపరచి పరిశ్రమలు, నూతన ఆర్థిక వ్యవస్థ అందిస్తున్న ఉపాధి అవకాశాలను వినియోగించుకొనే రీతిలో నూతన కోర్సులను ప్రవేశపెట్టడం జరిగింది.

సాంకేతిక విద్యాశాఖ మరియు SBTET అందిస్తున్న డిప్లొమా కోర్సుల వివరాలు

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మెకానికల్ ఇంజనీరింగ్	సిరామిక్ టెక్నాలజి	గార్మెంట్ టెక్నాలజి
ఆటోమొబైల్ ఇంజనీరింగ్	కెమికల్ ఇంజనీరింగ్	హోటల్ మ్యానేజ్‌మెంట్ & క్యాటరింగ్ టెక్నాలజి
ప్యాకేజింగ్ టెక్నాలజీ	కెమికల్ (షుగర్ టెక్నాలజి) ఇంజనీరింగ్	లెదర్ టెక్నాలజి
ఎలక్ట్రానిక్స్ & కమ్యూనికేషన్స్ ఇంజనీరింగ్	కెమికల్ (పెట్రోకెమికల్స్) ఇంజనీరింగ్	ఫుట్‌వేర్ టెక్నాలజి
బయో-మెడికల్ ఎలక్ట్రానిక్స్ ఇంజనీరింగ్	కెమికల్ (ప్లాస్టిక్స్ & పాలిమర్స్) ఇంజనీరింగ్	కమర్షియల్ & కంప్యూటర్ ప్రాక్టీస్
కంప్యూటర్ ఇంజనీరింగ్	కెమికల్ (ఆయిల్ టెక్నాలజి) ఇంజనీరింగ్	హోమ్ సైన్స్
ఇన్‌ఫర్మేషన్ టెక్నాలజి		క్రాఫ్ట్ టెక్నాలజి

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బి.ఆర్.కె.ఆర్. భవన్, హైదరాబాద్ - 63

నేటి ఆలోచనాసరళికి తగ్గట్టుగా సాంకేతిక విద్యనభ్యసించిన విద్యార్థులను తయారు చేయడమే కాకుండా పరిశ్రమల అవసరాలకు అనుగుణంగా తీర్చిదిద్దడం సాంకేతిక విద్యాశాఖ లక్ష్యం.

STEWARDSHIP IN ENERGY AND ENVIRONMENTAL SUSTAINABILITY

SCCL - An Engine of Economic Growth

Synonymous for coal in the Deccan, Singareni symbolizes the face of modern mining in the country. It all started when some pilgrims bound to the temple town of Bhadrachalam unexpectedly witnessed a burning stone at Singareni village in Khammam District in Andhra Pradesh. That was in 1870, and it led to the discovery of huge coal deposits in the Godavari valley by Dr. William King, the enterprising Geologist. The rest is history, the history of man's quest to exploit mineral wealth to enrich his life. Sequel to this discovery, Coal Mining operations began at Yellandu in 1889 by the Hyderabad Deccan Company and gradually began to acquire operational breadth & depth under the renamed Singareni Collieries Company Limited. Singareni Colliers Company Ltd., popularly known as SCCL, today accounts for nearly 9% country's total coal production with 7% of nation's coal reserves. SCCL supplies coal to more than 2500 medium and small industries including cement, paper, textiles, tobacco, ceramic, pharmaceutical and brick units, apart from major power plants in Andhra Pradesh, Karnataka and Maharashtra.

Our Technology - OpenCast

Surface Miner | Dragline | Shovel & Dumper | Inpit crusher-Conveyor-Spreader | Highwall

Operation Profile

16 Mines | Coal: 39.92 million tonnes; OB: 170 million cubic metres | Stripping Ratio: upto 1:6 | Gradients operated: upto 180 | Depths operated: 170m | Depths Planned: 400m

Our Technology - Underground

Conventional Mining | Side Discharge Loader | Load Haul Dumper |

Road Header | Longwall | Blasting Gallery | Continuous Miner

Operation Profile

32 Mines | Coal: 10.55 million tones | Depths operated: 400m | Depths Planned: 650m

The Sole coal producer in South India and a key partner in the country's economic and industrial progress, Singareni Collieries Company Ltd. (SCCL) is more than committed to caring for the environment.

Company's mission statement aptly reflects the emphasis given to protection of environment and ecology. Company has established benchmark practices and internationally accepted soil conservation, Overburden bio-engineering measures in its Open Cast mines. Mine plans include development of Siltation ponds, timely back filling and regeneration of original species on the back filled areas etc. Company has raised plantations in 5600 Ha.

- Monitoring of air/water/noise/ambient pollution at each mine on a regular basis. Establishment of 18 effluent treatment plants (Oil and Grease traps) at mines/stores/workshops
- Constructed 7 Sewerage Treatment Plants
- Introduced LPG to its staff for cooking in lieu of the supply of 20,000 tonnes of coal per month
- Rehabilitation of minesites/over dumps with a due emphasis on biological engineering. This has been done through protective and mechanical engineering works like gabions, cribs, rock fill dams, toe walls, garland canals, siltation ponds and contour stretches along with plantation of sapling of local suitable species

- Adoption of environment friendly technologies like Input Crusher, Conveyors for reducing consumption of diesel and oil. Replacement of timber supports in mines with steel supports resulting in a 20% reduction in usage of wood and protection of natural resources

THE SINGARENI COLLIERIES COMPANY LIMITED

(A Government Company)

Registered Office: Kothagudem Collieries - 507 101.

One Family. One Vision.. One Mission... - The Spirit of Singareni


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SWACHH SOCH SWACHH BOL

METRO INDIA

THE SPIRIT OF HYDERABAD

The English Daily

PURE THOUGHT, PURE TALK

India is facing several challenges that come along with development and progress – over-population, corruption, lack of sanitation, sex-related crimes, child-labour, socio-economic anomalies, to name a few. Everybody blames the government and politicians for the maladies plaguing the nation, forgetting that every citizen has a responsibility to eradicate the same.

METRO INDIA, the fastest growing English daily of Hyderabad, wants to contribute whatever little it can in inspiring the young minds and reminding them of their responsibility towards society. As part of it, it is now launching a campaign – **"SWACHH SOCH –SWACHH BOL"** (Pure Thought, Pure Talk). It is a concept of cleansing your mind from within, so that you can be part of the change that wakes up India from its slumber.

So, get ready to take up the challenge and be the change that you wish to see

CL Rajam
Chairman
METRO INDIA
clrajam@netscape.net

THE WATER AND LAND MANAGEMENT TRAINING & RESEARCH INSTITUTE (WALAMTARI)

The Water and Land Management Training & Research Institute (WALAMTARI) was established in the year 1983. It was registered as a Society in the year 1992, under the Societies Registration Act. The Institute is recognized as one of the best institutes in India and outside for the activities under Irrigation and Agriculture. The Institute has faculty from all major streams connected with Irrigated Agriculture and Climate Change. Capacity Building and Research are the two main focused activities of the Institute.

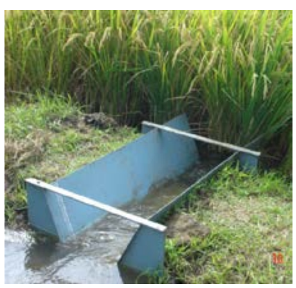
ClimaAdapt : Adaptation through innovation

WALAMTARI is implementing ClimaAdapt Project funded by the Ministry of Foreign Affairs, Norway / The Royal Norwegian Embassy, New Delhi. WALAMTARI, IWMI, MSSRF, TNAU are the lead partners for implementing ClimaAdapt Project (2012-2016) in collaboration with BIOFORSK-Norway. The project is being implemented in the Nagarjuna Sagar Project area of Krishna Basin and Cauvery Basin. One of the main objectives was to integrate science-stakeholder-policy makers and to develop adaptation framework for Water and Agriculture sectors in Andhra Pradesh, Telangana and Tamil Nadu states of India.

Significant achievements:

Formation of State Level Supervisory Committees for Andhra Pradesh and Telangana.

Established: Climate Cell at WALAMTARI; Canal Network Flow Monitoring System (CNFMS); and Climate Water Forum

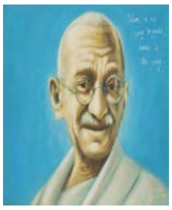


Organised: A.P. Water Week , 2013 and 2014; National Workshop : Climate Change and Water, 13-14, Nov.2014; and AQUACROP training by FAO;

Participation: World Agricultural Forum Congress, Nov., ’13; and 22nd ICID Congress, Gwangju, South Korea Sept 2014;

Capacity Building to School children: Awareness on Climate Change; Water Use Efficiency studies using sensors.

Contact: WALAMTARI, Rajendranagar, Hyderabad, Ranga Reddy District, Andhra Pradesh, India Pin: 500030
phone: 040-24006217 /24006202 Fax No. 24006222 | **e-mail:** dg.walamtari@gmail.com | website: http://tswalamtari.org/



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The Mahatma Gandhi Institute of Technology (MGIT) is offering the following courses in UG & PG Programs: from the Academic Year 2014-15

S.No	Name of the Branch	Intake
UNDER GRADUATE (UG) Courses		
1	B.Tech. Electronics and Communication Engineering (ECE)	180
2	B.Tech. Computer Science and Engineering (CSE)	180
3	B.Tech. Electrical and Electronics Engineering (EEE)	120
4	B.Tech. Information Technology (INF)	60
5	B.Tech. Mechanical (Mechatronics) Engineering (MCT)	60
6	B.Tech. Metallurgical and Materials Engineering (MMT)	60
7	B.Tech. Civil Engineering (CIV)	120
8	B.Tech. Mechanical Engineering (MEC)	120
	Total	900

S.No	Name of the Specialization	Intake
POST GRADUATE (PG) Courses		
1	M.Tech. Computer Networks and Information Security	18
2	M.Tech. Mechatronics	18
3	M.Tech. Digital Electronics and Communication Engineering	18
4	M.Tech. Power Electronics and Electrical Drives	18
5	M.Tech. Computer Aided Structural Engineering	18
6	M.Tech. Software Engineering	18
	Total	108

ACHIEVEMENTS

- Six UG Programmes of MGIT Accredited for the second time by NBA from 01-07-2014 to 30-06-2016.
- UGC granted 2(f) and 12 (B) Status to MGIT.
- Ministry of Steel, GOI awarded Chair Professorship & Scholarship@10,000/-PM to Five MME Students for 24 Months from 2013 to 2018.
- Received ISTE – BEST STUDENT CHAPTER Award for A.P. Section-2014.
- Received ISTE AP Section Best Engineering College Principal Award – 2012.
- Received ISTE BEST CHAPTER Award at the 42nd National Annual Convention on 20-12-2012.
- Accredited by TCS for Campus Placements. Campus Placements provided for 75% eligible candidates during the last Three Years.
- Achieved Certificate of Excellence at All India Level "Business and Management Chronicle" Survey-2014.
- Achieved 90th Rank among All India Ranking of Engineering Colleges 2014 "EduTech RAND".
- Achieved 32nd Rank among Top Engineering Institutions in South India (Deccan Chronicle) and Rated among top 100 Premier Engineering Institutions in the Country (THE WEEK Magazine).

With Best Wishes from

*****

Sri D Kamalakar Reddy *Secretary & Correspondent*	*Dr. V. Malakonda Reddy* *Chairman*	*Dr G Chandra Mohan Reddy* *Principal*

The success of Jeedimetla Effluent Treatment Ltd. (JETL) lies in the total and continued commitment of the participating units, not only to comply with the requirements of the Regulatory Agency, but also to strive to achieve what is technologically feasible with optimum utilization of resources and establishment of excellent laboratory facilities at the CWWTP and the continued search for newer treatment technologies and setting up of effective environmental monitoring system. In this commitment and its physical translation to reality, JETL is unparalleled among all the CETPs.

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- Deploy state of the art equipment like a Combined Wastewater Treatment Plant, Multiple Effect Evaporation and Spray Dryer System for wastewater treatment & preserve the quality of our environment and prevent degradation.
- Installed On-line TOC Analyzer, pH & Conductivity Meters for monitoring the quality of treated wastewater and On-line VOC Meter to monitor the Ambient Air Quality
- Installed Outdoor day & night visible True colour Led Ticker Display Board for showing daily results of Environmental discharges (Air, Water & Stack).
- **Conversion of Sludge to manure an Eco-friendly process – a result of continuous R&D.**
- An Environmental Training Institute for future generation.
- Develop Clean & Green Environment by planting trees in the Industrial / residential areas of Jeedimetla, Hyderabad.
- Provide community development facilities like constructing public toilets, being maintained by "Sulabh" a voluntary agency
- Laying and developing parks in the surrounding areas involving the local community to maintain Clean & Green Environment.
- **First ever CWWTP Laboratory to get recognition from Ministry of Environment & Forests, Govt. of India.**
- **Recycling of treated wastewater to Boiler and supplying to industries using RO Technology**
- Rendering technical assistance to Industries on Environmental Management Issues.

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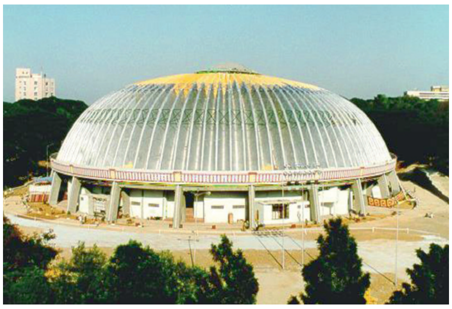

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ANDHRA PRADESH STATE COUNCIL OF SCIENCE & TECHNOLOGY (APCOST)

Department of Environment, Forests, Science & Technology
Government of Andhra Pradesh

APCOST, established in the year 1986 by the Government of Andhra Pradesh with the catalytic role played by the Department of Science and Technology, Government of India, is progressing with focused attention for pursuing the objectives

- **To formulate measures to foster the spirit of Science at all levels of society especially among the youth.**
- **To evaluate scientific and technological options available to aid and improve the planning process and to improve the efficiency of investment in the State**
- **To evolve methods of promoting applied S&T research which will stimulate the optimal utilisation of State's potential including all natural, human and material resources and**
- **To serve as a liaison with the National Committee on S&T in formulating S&T policy and plan operation at the State's level**


Regional Science Centre, Vijayawada

FOCUS AREAS

1. **Regional Science Centers & Popularization of Science**
2. **Integrated Rural Energy Program**
3. **Agriculture & Traditional Sciences and Technologies**
4. **Science & Technology Communication Projects/ Programs**
5. **Natural Resources and Disaster Management**
6. **Science & Technology Information Systems**
7. **Rural Development**
8. **R&D and Special Projects on Societal Needs**
9. **Intellectual Property Rights**
10. **Resource-based, Area-based, Location-specific S&T interventions (with support from DST, MoES, DSIR – Govt. of India)**

Current Programs for Students, Researchers and Scientific & Academic Community in Andhra Pradesh

- **National Children's Science Congress (NCSC) – Students of 10 to 17 years age**
- **Andhra Pradesh Scientist Awards & Engineer's Awards – Scientific & Academic Community**
- **Regional Science Centers - for the benefit of students, academicians and general public**
- **National Science Day Celebrations, National Mathematical Day Celebrations – for organizing theme based science communication campaigns**
- **Edu-Sat programs in Regional Science Centres.**
- **Partial financial support for Research Projects (Mini/ Micro-level) / S&T seminars/ workshops/ symposia etc. and Partial financial support for Travel Grants for presenting research papers in International Conferences/ Seminars etc, for the benefit of academicians/ scientists / Institutions**

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Andhra Pradesh State Centre

Andhra Pradesh State Centre - New Building

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- M tech- Power Systems
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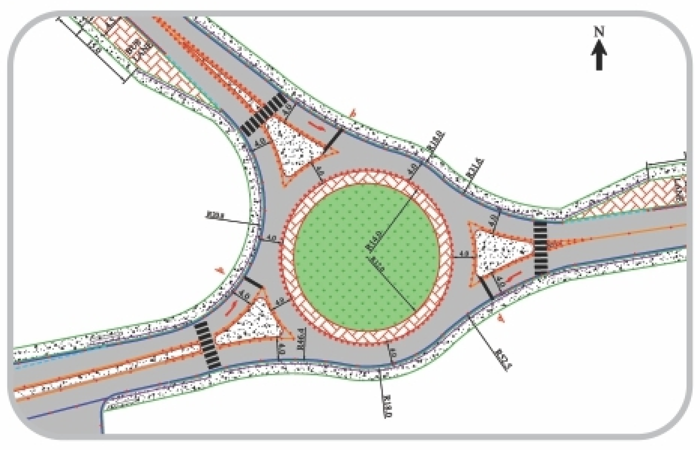
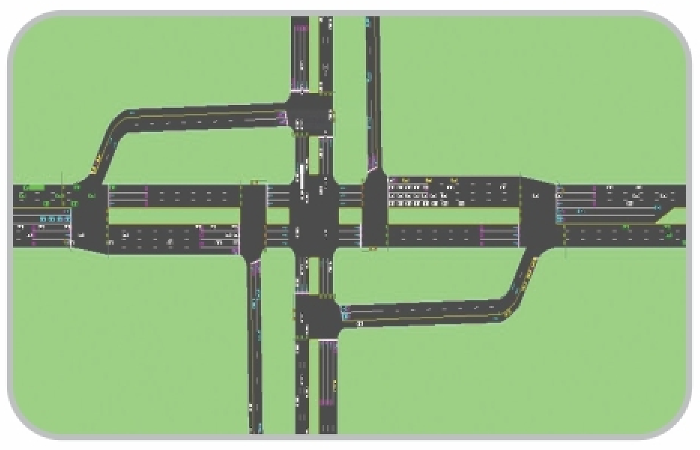


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