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Agricultural Sustainability by Cultivation of Medicinal and Aromatic Plant

ASCMAP 2017

Supported and funded by Department of Science and Technology

Editors

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ON

AGRICULTURAL SUSTAINABILITY BY CULTIVATION OF MEDICINAL & AROMATIC PLANTS

18TH DECEMBER, 2017

HEALTH, SAFETY AND ENVIRONMENT DEPARTMENT

UNIVERSITY OF PETROLEUM & ENERGY STUDIES (UPES)

SUPPORTED BY

DEPARTMENT OF SCIENCE & TECHNOLOGY, SEED DIVISION, GOVERNMENT OF INDIA, NEWDELHI,

WOMEN TECHNOLOGY PARK PROJECT

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Preface

Since time immemorial India has lead the world by demonstrating the use of herbal drugs in curing ailments. Most of the *jadi buti(s)* (medicinal herbs) used in Ayurveda, Siddha, Unani and Homoeopathy systems of medicines come from natural forests - which are fast disappearing. Disappearance of forests has been accelerated by the conversion of forests into agricultural fields, to feed the growing population, and the climate change triggered by global warming.

Medicinal plants are very sensitive to climate change and therefore there is an immediate need for conservation and sustainable use of medicinal plants. While efforts should be made to conserve the natural sources of *jadi buti(s)*, cultivation of medicinal plants should be encouraged with participation of all the stake holders - growers, collectors, traders, manufacturers, exporters, etc. This objective to ensure availability of medicinal plants in a sustainable way requires steps to acquire and develop know-how of growing medicinal plants and understand various factors that affect growth of such plants.

In order to cater to this need University of Petroleum and Energy Studies (UPES), with support from Department of Science & Technology, seed division, Government of India, New Delhi, has organized a one day National Conference on *Agricultural Sustainability by Cultivation of Medicinal and Aromatic Plants* (ASCMAP 2017), December 18, 2017. The conference aims to provide an interdisciplinary forum to researchers, consultants, industries, academicians, entrepreneurs and professionals for dissemination of information, results, innovations and improvisations in the broad area of environment based on agricultural diversification, conservation and sustainable development through cultivation of Medicinal & Aromatic Plants.

Dr. Kanchan Deoli Bahukhandi
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DENSITY FUNCTIONAL THEORY (DFT) STUDY OF STRUCTURAL AND ELECTRONIC PROPERTIES OF CRYSTALLINE 2,3-BENZANTHRACENE

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Abstract

We have carried out first principles calculations to investigate various ground state properties, e.g. the structural, electronic band structure, density of states, the projected density of states and dispersion forces of the title molecule. Our first principles calculations reveal that the title molecule exhibits promising high charge carrier mobility nature. The calculated structural lattice parameters are in excellent agreement with available experimental data. The band structure calculations reveal that the direct and indirect band gaps are 2.00981 eV and 2.10785 eV respectively in perfect agreement with experimental values.

Keywords:

Density Functional Theory (DFT) calculations;
Benzanthracene;
Dispersion correction.

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1. Introduction

It is well known that organic semiconductors have great potential as active materials in optoelectronic devices. Among these materials, molecular semiconductors of the oligomers of the acene family have attracted attention due to their promising high charge carrier mobilities, which enable them to be incorporated in functional devices such as

light-emitting diodes [**1**, **2**], field effect transistors [**3**–**8**] and photovoltaic cells [**9**–**12**]. The molecules within the oligomer crystals are bound together by van der Waals (vdW) dispersion forces. Therefore, the crystal is compliant, in that the application of a small external perturbations such as pressure, temperature, can significantly alter structural, vibrational and electronic properties whilst preserving the chemical structure of the molecule. The interest in molecular crystals along with the temperature and pressure dependence of their properties dictate the need to correctly predict the properties of the crystal under ambient temperature and pressure conditions and when subjected to external conditions.

Density-functional theory (DFT) is by far the most popular method for performing first-principles quantum-mechanical simulations of materials because it balances a sufficiently accurate treatment of exchange and correlation for many purposes with a moderate computational cost. However, the usual approximations employed to describe exchange and correlation—the generalized gradient approximations (GGAs)— lack any account of vdW dispersion forces that play an important role in carbon-based conjugated semiconductors. A recent DFT study performed on other molecular crystals containing a correction for the vdW interactions correctly predicts the structural, vibrational, electronic and optical properties of the crystals [**13**, **14**]. In the present study, using Quantum Espresso Modelling Techniques and applying the dispersion correction term as implemented in the Quantum Espresso suite which is important in such a study, we will present a detailed first-principles study of the 2,3-benzanthracene molecular crystal under ambient temperature and pressure conditions.

Among the oligomers of the acene crystals, 2,3-benzanthracene is a good choice for such a study due to the availability in the literature of experimental results under ambient and external conditions.

2. Our Method and Computational Details

The first principles calculations were performed within density functional theory approach using the plane wave basis sets implemented in Quantum Espresso code [**15**]. The exchange correlation functional is approximated with generalized gradient approximation parameterized by the Perdew-Burke-Ernzerhof (PBE) scheme [**16**]. The plane wave ultra-soft pseudo potential method is adopted to describe the interaction between electrons and ions. The Monkhorst-Pack has been adopted to generate special **k**-points within **6x6x6** grid throughout the Brillouin zone. The calculations are done with a plane wave function and charge density cut-offs of 60 Ryd and 600 Ryd, respectively and obtained quite accurate values of in-plane and out-of-plane lattice constant *a* and *c*, respectively by the process of the total energy minimization. A Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm was used to relax electrons, ions and cell parameters in the unit cell with full degree of freedom. The atomic positions and cell parameters were fully relaxed in all cases, until an energy convergence of 10^{-7} eV and a force convergence of 0.04 eV/˚A is reached.

After getting the relaxed structures, we performed self-consistent calculations with a Monkhorst-Pack [**17**] 8×8×8 k-mesh followed by the non-self-consistent calculations for band structures, DOS/PDOS and charge density separately. We have used **12×12×12 k**-points mesh along the path Γ−H−X−Γ in the irreducible Brillouin zone to obtain the band structure with very fine mesh points.

Tables and Figures are presented center, as shown below and cited in the manuscript.

Table: Optimized Lattice Parameters of Title Molecule

Title Molecule	Lattice Constant a(Å)	Lattice Constant b(Å)	Lattice Constant c(Å)
Present Work	7.372	8.752	11.866
Experimental	6.055	7.872	13.420

(a) (b)

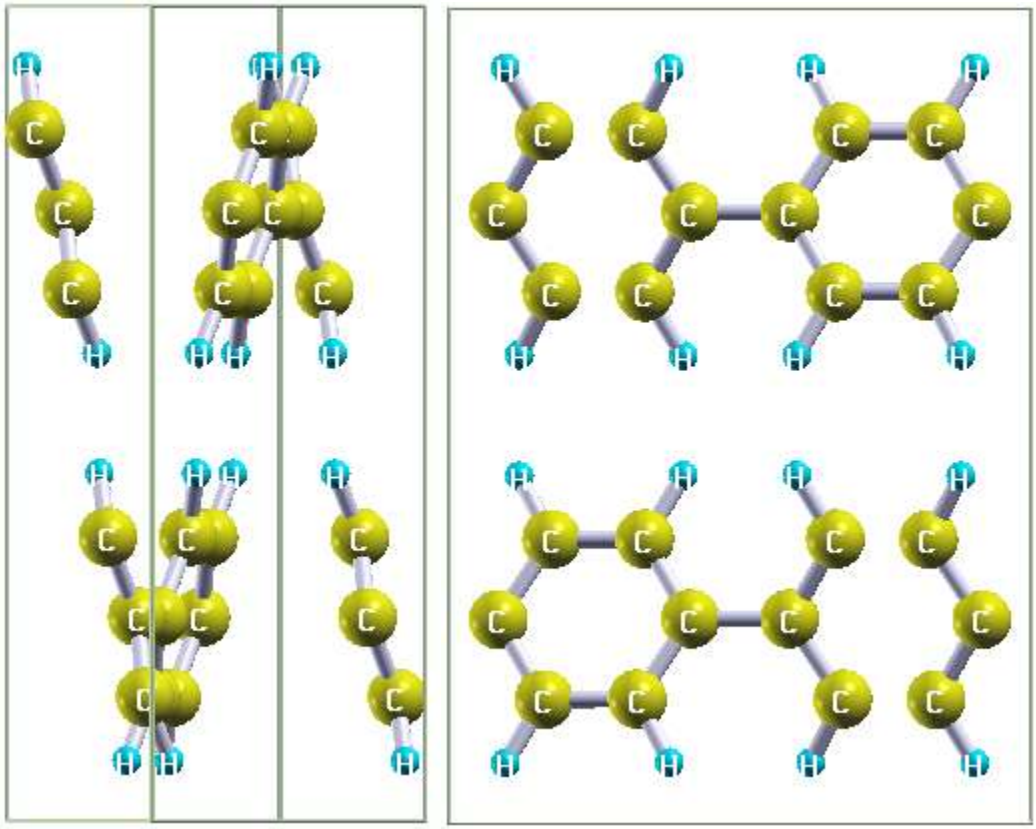

Fig.1 The super cell structure of title molecule: (a) front view, (b) side view.

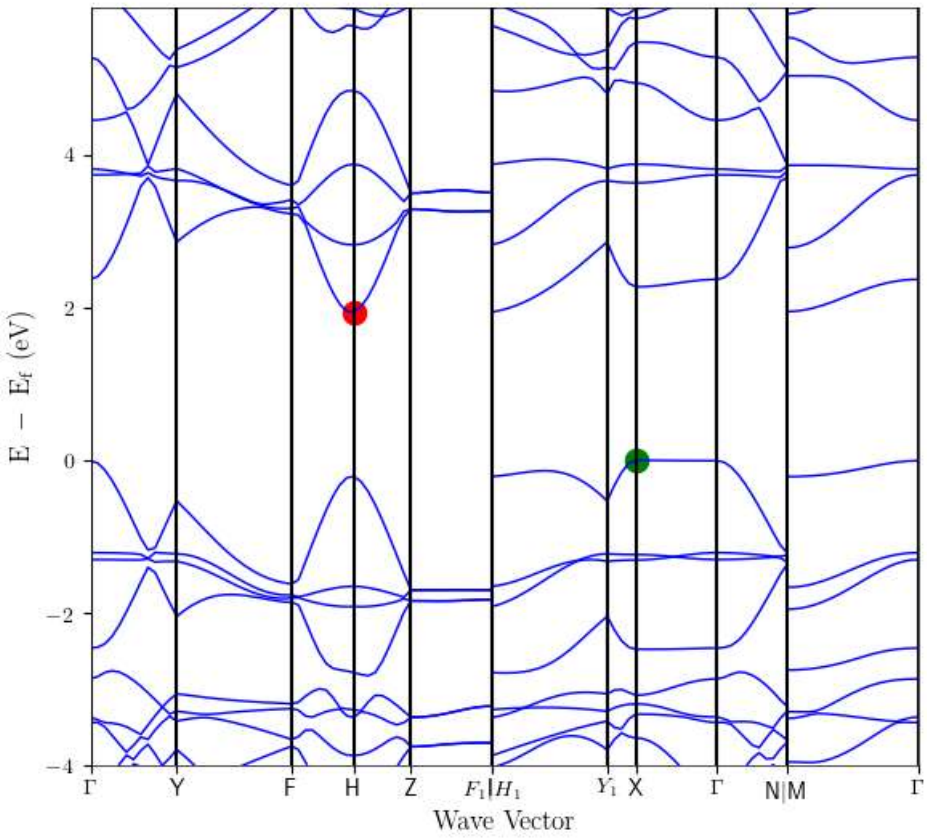

Fig. 2 Electronic band structure.

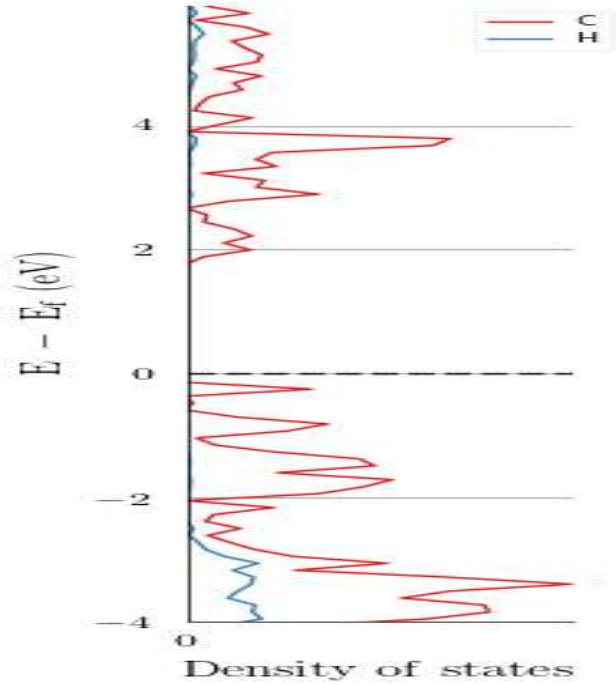

Fig. 3 Electronic Density of States.

3. Results and Discussions

Applying the dispersion correction term as implemented in the Quantum Espresso suite which is important in our study, there is a good agreement between our calculated cell volume and the experimental value. The geometries were fully optimized (Fig. 1(a & b)). The optimized cell parameters a, b and c are presented in the table along with the available experimental data [**18**, **19**]. There is in general an excellent agreement between the present calculated values and experimental data. The C-C, C-H, bond lengths are 1.5145 Å, 1.101 Å respectively which are also in agreement with literature [**19**].

To understand the electronic property of title molecule, we have calculated the electronic dispersion curves with partial density of states and total density of states as shown below. In the range of -10 to 0 eV (below Fermi level), energy bands are least flat and there is much dispersion along Γ-Y-F-Z directions. However, the energy bands in Z-X-Γ directions are less dispersive. The conduction region is highly dispersive. It has direct energy band gap value 2.00981 eV and indirect energy band gap value equal to 2.10785 eV which is in agreement with experimentally measured band gap values of 1.945eV and 1.965eV respectively [**20**, **21**].

The calculated projected density of states clearly reveals that the title molecule is a narrow gap semiconductor and the higher peak below the Fermi level corresponds to the C and H elements contribute significantly to the total electronic density of states.

4. Conclusions

Accounting for vdW dispersion forces in our DFT-LDA calculations, we have found that our calculated lattice parameters, cell volume, bond lengths and electronic band structure are in good agreement with experimental values. Using density functional theory, we demonstrated that the topic molecule exhibits promising high charge carrier mobility characteristics. The projected density of states reveals the significant contributions of C and H elements to the total density of states below the Fermi level in the valence band.

Acknowledgments
The authors, VWE and AKM acknowledge the use of University of Petroleum and Energy Studies (UPES) High Performance Computing Service and the computational resources. VWE thanks the Ministry of Science and Technology for the grant of FICCI of New Delhi for C V Raman fellowship.

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WORKPLACE HAZARDS AND ITS MANAGEMENT: A REVIEW PAPER ON ANALYSIS OF RISKS AND ITS CONTROL MEASURES

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Ashish Maindolia[**]
Akshi Kunwar Singh[***]

Abstract

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Working in industry is not safe as it sounds. Every single work activity is associated with some major health hazards. Occupational health hazards are major concern nowadays and many studies has been done to analyze and manage the risks associated with work. In spite of the fact that many technologies and techniques have evolved to resolve the issue, still some of the major issues stays in the workplace environment. Noise, being the major issue, creates permanent Noise Induced Hearing Loss (NIHL), heat stress cause heat cramps, exhaustion and heat stroke, vibration cause hand arm vibration syndrome and chemicals like silica, asbestos and chromium cause major lung and heart diseases. Ergonomics hazards are also a topic of concern as wrong posture causes musculoskeletal disorders. In today's scenario, owner of the workplace is focused on generating profits and employees are focused on their salaries and this attitude gives rise to workplace accidents and health hazards. Workers negligence on their health results in rise of occupational diseases like NIHL, HAVS, asthma, cancer, lungs disorder etc. This paper focuses on the major hazards which results in various occupational diseases and also some of the management methods to reduce the hazards and make the workplace much less hazardous.

Keywords:

Musculoskeleton disorder;
NIHL;
HAVS;

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1. Introduction

In the past years many researchers have studied and identified various occupational and workplace hazards. They have categorized the occupational hazards as follows:

1. Physical hazards which includes noise, vibration, heat stress and radiation
2. Chemical hazards which includes fumes, dusts, metals, chemicals
3. Biological hazards which includes fungus, algae etc
4. Ergonomic hazards such as musculoskeletal disorder
5. Psychological hazards leading mental stress, lack of motivation. [5]

These hazards have led to many occupational accidents and injuries. Working in unsafe workplace leads to danger to life to workers and staff turnover happens. Occupation accidents and injuries not only hamper the workers faith in workplace but also the reputation of industry.

The major workplace problem includes noise, vibration, heat stress, chromium toxicity, musculoskeletal disorder, dust, fumes, asbestos and silica. Noise being the top issue of concern as one in six adults are suffering from physiological hearing impairment. [1] Vibration causes hand arm vibration syndrome to those workers involved in drilling activities. Working in wrong or lifting heavy load manually leads to musculoskeletal disorders. [2] Exposure to silica and asbestos dusts leads to lung disorders, asthma, silicosis and asbestosis. [3][4]

Categorization of each hazard and their consequences is very important as it helps in assessment of risk related to any activity. Assessment of risk is an effective technique in workplace which helps in control of workplace hazards and accidents at very initial stage.
Assessment of risk is performed as:

1. Identification of hazards related to activity.
2. Identification of workers at risk.
3. Evaluation of risk and assigning control measures.
4. Recording the findings.
5. Reviewing the control measures. [5]

This paper reviews the workplace related hazards and their management along with some standard values assigned with each parameter.

2. Literature Review

NOISE
Noise is workplace is of prime concern as it damages the cochlea. Acute effects are ringing of ear, tingling effect, less concentration, threshold shift and irritation. Due to irreversible damage to sensory hair cells of the cochlea NIHL causes the reduction of a progressive, sensorineural, hearing deficit. [1] Worldwide, the disability percentage occurred due to noise has reached to 16% and raging 7-21% in various sub regions. The assigned value of safe sound level at workplace is 85dB. [13]
Noise can be reduced by the following methods:

1) Sound proofing of the work zone.
2) Providing job rotation.
3) Providing rest between the tasks.
4) By providing the ear muffs and ear plugs.
5) By medical check-ups.
6) Providing training and knowledge about the occupational noise induced disease.

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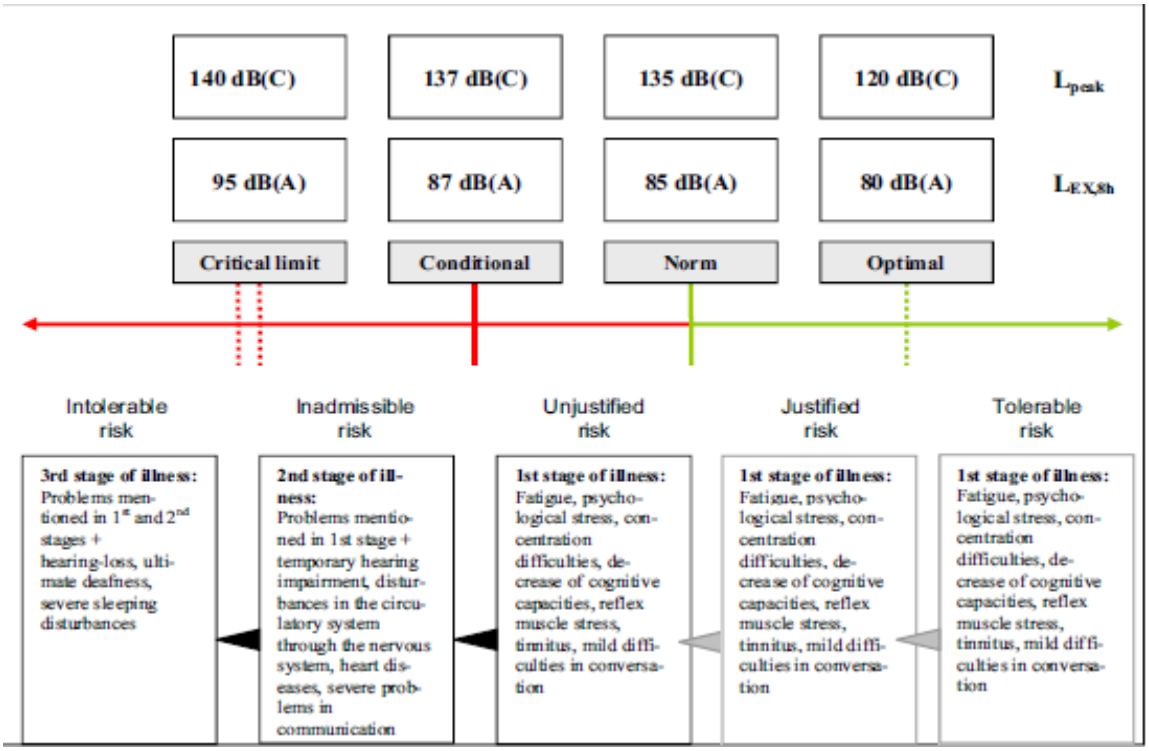

Fig-1: Noise and risk criteria. [5]

Muscoskeletal Disorder

While lifting a load of weight more than the worker's capability or doing any physical work with wrong posture can lead to ergonomic injury. Musculoskeletal disorder and upper limb disorder are main disorders related to ergonomic injuries. Musculoskeletal disorder is associated with back bone and spinal cord effecting muscles, spine, and ligaments, joint and supporting blood vessels causing inflammatory and degenerative conditions. [2]

Chemical Exposure

Chemical exposures like exposure to dust, fumes and metallic particles lead to severe issues to lungs, hearts and brains. Respiratory diseases like silicosis, asbestosis, pulmonary oedema, asthma and lung cancer can occur due to inhalation of metal dusts.

Chromium toxicity is one issue as the hexavalent chromium is carcinogenic. Chromium enter the cells through anionic transport system. Once the chromium is entered in cells, it reduces various intercellular reductants and due to cellular activities the hexavalent chromium is converted into trivalent chromium which reacts with proteins to produce toxicity. [6] The trivalent chromium is also lethal when exposed to it directly. Exposure to chromium fumes can occur due to hot works like welding, forging, melting of aluminum.

Silica dust is another issue at workplace since it can cause silicosis, pulmonary oedema and other lung related diseases. Silica is found in crystalline form mainly in crytobalite or quartz form which have tendency to cause cancer. Silica dusts are mostly generated from blast activities, molding, and cement industries and even in paint industries. [4]

Third most toxic and generally used material is Asbestos as it is also carcinogenic and causes asbestosis. The most toxic form of asbestos is chrysotile which causes lung, larynx and gastrointestinal cancer and pleura malignant mesothelioma. [3]

Vibration and heat stress

Vibration is rapid reciprocating motion of any device which leads to interaction of low frequencies with blood vessels. Work activities like drilling, chipping, grinding leads to vibration exposure to worker. Exposure to vibration causes Hand Arm Vibration Syndrome. Hand Arm Vibration Syndrome is caused by the activities which involves low frequency vibration and refers to signs and symptoms of vascular, neurological and musculoskeletal. [9]
The people who are exposed to HAVS are drillers, grinders, moulders, electric welders, forklift operators, polishers, sheet metal operators, chainsaw operators, power tools operators, etc. can suffer from cold intolerance, blanched finger, tingling of fingers, pain and swelling in fingers and forearms, etc.

Heat stress is another main concern which has causes many fatalities at the workplace. The temperature at which humans can work safely is 37^0c above this temperature dehydration causes which leads to heat stress.
Heat stress is classified into heat cramps (loss of body fluids), heat exhaustion (depletion of body fluids) and heat stroke (damage to the temperature regulatory functioning of body). Occupational heat stress is calculates as Wet Bulb Globe Temperature.

Workplace Hazards Management
Workplace hazards which were stated earlier needs to be monitored, assessed and controlled. The hazards are managed in a systematic way.
1) Firstly all the hazards and activities are identified along with the people who are involved in that activity.

The identification is done by three approaches:

- The work area
- The workers involved
- The process performed.

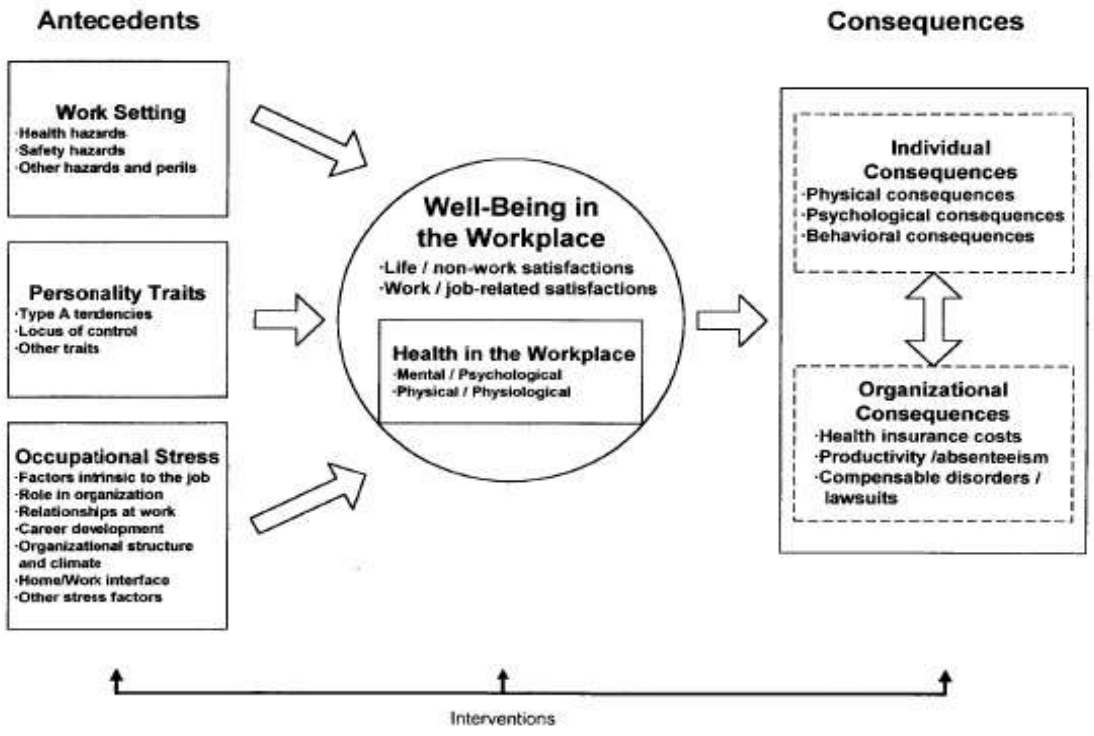

Fig-2: A Framework for Organizing and Directing Future Theory, Research, and Practice Regarding Health and Well-Being in the Workplace. [7]

2) Risk assessment is another tool to reduce the risk involved with workplace. Assessment of risk is performed as:

- Identification of hazards related to activity.
- Identification of workers at risk.
- Evaluation of risk and assigning control measures.
- Recording the findings.
- Reviewing the control measures. [5]

3) The hierarchy of controls which are assigned as per risk assessment are:
   - Elimination of the hazards by either stopping the process or by removing the element which causes harm.
   - Isolating the process by creating partitions or shifting of the process machineries to separate section.
   - By the application of engineering techniques such as local exhaust systems, fan, sound proofing, etc.
   - Application of administrative controls like job rotation, jobs in shifts, rest etc.
   - The last resort is the application of personal protective equipments. Although they are not that effective but they provide protection up to some level.

4) Monitor and reviewing of the whole process for better control measures and its sustainable application. [11]

Along with these management techniques, some advanced tools are also used to reduce and identify the hazards at initial and in running phase of any work. These techniques are as follows:

- Hazard Identification and Risk Assessment
- Hazard Operability Studies
- Failure Mode Effect Analysis
- Fault Tress Analysis
- Event Tree Analysis
- Bowtie Analysis
- What-if Analysis
- Brain storming
- Use of models and software like CFD, ALOHA, PHAST which do simulations. [12]

Proper training and awareness should also be provided to each and every employee especially at the time of joining. Premedical checkups should be performed and records should be kept at the workplace.

3. Conclusion

Occupational health hazards are increasing with the increase of technology as not a single process or machinery is completely safe. Machines are working with electricity or fuels which give rise to fumes and electrocution along with noisy environment which increases threat to life to workers. According to HAZAWA act it is the duty of the employer to take care of his employee's ad it is the duty of employees to take care of themselves as well as their subordinates. Occupational diseases might not be identified soon in the workers as they take 15-20 years of time after the worker has started working to be diagnosed. The worker is affected slowly but the effect is permanent and cannot be reversed. Even though workers are aware of the fact that workplace is full on dangers, still they have negligence in their attitude which needs to be changed. Proper training and awareness should also be provided to each and every employee especially at the time of joining. Premedical checkups should be performed and records should be kept at the workplace.

Advanced techniques are now available which helps in identifying the hazards in every early stages and the government is banning the use of most of the toxic substances like asbestos which again is the good approach

towards enhancing the workplace's safety culture. But one thing that should be remembered all the time is that safety comes from inside and one should consider safety as value not as priority.

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DEVELOPING MECHANISM FOR AWARENESS & MONITORING HEALTH & SAFETY IN FARMING SECTOR

Bhaskar Tichkule

Keywords:

India;
Physical Factors;
Chemical & toxicological hazards;
Occupational Safety & Health;
Survey for Data Collection;
Prevention & Control.

Abstract

India, a growing economy and world's largest democracy, has population exceeding 1.2 billion. More than 90% work in the informal economy, mainly agriculture and services. Less than 10% work in the organized sector; mainly industry, mining and some services. Agricultural works are associated with a variety of unique occupational health and safety hazards in the form of physical factors like extreme weather conditions, sunrays, etc; chemical and toxicological hazards in the form of pesticides/fertilizers, etc, including different forms of biological and mechanical hazards. But unluckily there is no mechanism with government to establish the required data about health and safety in forming sector where, our 70 % countrymen working on daily basis.

The focus of the project was developing a mechanism for regular monitoring of accidents and occupational health issues in farming through the involvement of various government admistrative bodies. Also as a beginning in farm sector, let realize some system to spread awareness about hazards to the rural large population for their welfare and financial benefits and health. The data collected by choosing a zone of one taluka in Maharashtra to identify hazards, activities, their effects on health, any existing system to collect data through farmers, government administration on village level; through survey, checklists, interviews and by other means.

The survey conducted for data collection of health and safety problems reached on conclusion that it required awareness about OSH risks among all farm workers and farmers. The very important finding which needs immediate attention that, there is no system for any data collection from government side for agricultural safety injuries and health related problems. Present situation demand in OSH needed to acquire National policy, legislation; awareness program and development of OHS infrastructure in farming sector.

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1. INTRODUCTION:

Agriculture is one of the most hazardous occupations worldwide. In several countries the fatal accident rate in agriculture is double the average for all other industries. According to ILO estimates, workers suffer 250 million accidents every year. Out of a total of 335,000 fatal workplace accidents worldwide, there are some 170,000 deaths among agricultural workers. The intensive use of machinery and of pesticides and other agrochemicals has raised the risks. Machinery such as tractors and harvesters has the highest frequency and fatality rates of injury. Available data from developing countries shows that there has been an increase in the accident rate in agriculture.

If we see the demographical area of India, it covers 328 million hectors total area. Out of this figure, 140 million hector is net cultivated land. Average size of land holding is 1.16 ha for land holders. In India 263 million agriculture workers depends on the land. It is also important to quote here that 37 % are female workers contribution of human power to the total power used in agriculture is about 5%. It is estimated that out of total farmers, about 84 % are small and marginal farmers (having less than 2 hector land). There are different cropping patterns with different practices vary depending on the crops. Also level of mechanization, we can see in varied levels.
The use of variety of equipments, fertilizers, pesticides, terrains, atmospheric conditions creates various types of safety and health hazards for the farmers and farm workers. Some of them like excessive vibration dose, noise exposure, respiratory problems due to dust, chemical exposure ill effect due to pesticides spray, musculoskeletal disorders, extreme weather conditions etc.

1.1 Aim:

The aim of the project is developing a mechanism for regular monitoring of accidents and occupational health issues in agriculture through the involvement of various government administrative bodies. Also as a beginning in farm sector, let realize some system to spread awareness about hazards of farm sector to the rural large population for their welfare and financial benefits and their health.

1.2 Objective of Study:

- Objective of the project is to identify level of awareness in rural area farming sector.
- To know the existing system for health and safety in place for farming sector.
- To know the legal system or code of conducts for best practices to minimize the farm risks in farming sector.
- To find the different means for spreading awareness about health and safety in rural sector farming to spread all over the country.
- To develop a constructive mechanism for collection of useful incident/ injury data from the rural farming area.

1.3 Case Study Area:

It is obvious to select a rural area where farming is a main business. I have selected a block where farming is 80 % people business and the main cultivation is paddy. For interviews and checklist and survey, the study has provided in depth of problems and the obvious health and safety hazards. Also it helps to identify any system available to notification of incident or injury related with agriculture sector. The known farmers enthusiastically participated in whole study and provided the required data for study.

1.4 Significance of Study:

- Study is significant to locate the existing system of collecting data which was very poorly found.
- To develop the mechanism which can benefit for collection of health and safety data for future.
- To identify the hazards in farming sector.
- What can be the means for dissipation of awareness about health and safety in rural area?
- Government lagging behind the code of practices, acts, rules with refers to farming sector.

2. RESEARCH METHOD:

As we see our rural area in India is wide spread, survey and observation is suitable method by selecting certain area. Our large population is depending on agriculture sector, we can choose a part of it only for survey and observation. It is known that many type of farm machines and tools, equipments, various types of fertilizers, pesticides used in agriculture sector which generate some obvious hazards. The methodology used here by conducting interviews, talk in groups, collecting data which little available on internet, talk with various organizations, associations and government entities. This subject is wide spread which allow taking samples easy.

2.1 Targeted Population and Sample Size:

Obviously target population is the cluster of farmers which cultivating paddy fields on block level. We have taken 200 farmers samples for collecting relevant information and data for this study. Its inclusion is located with farmers, gramsewaks, NGO's, PHC physicians, Village Talathi, Agriculture Supervisor & officer, Police station Authorities, Various farmers associations head, etc.

- Quistionnaire used for Farmers
- Interview with PHC physician
- Interview with Local Police station Authority
- Interview with Gramsewak in village Grampanchayat
- Interview with NGO in Agriculture sector
- Interview with Agriculture Supervisors
- Interview with Private Physician in that Area

Data collection from Internet from various website internationally and nationally also. It is difficult to get data about health and safety in agriculture on National level. Our government have no policy about the farming sector health and safety. Secondly it came to picture, very few people has done research in this subject about data collection as there no existing system. In such a vast country, and 60% dependency on agriculture, people are not looking for their welfare and health and safety, it is very sorry state for our country.

3. RESULTS AND DICUSSIONS:

The evaluation of agriculture hazards is important based on that anybody can design various awareness planning and program about health and safety for farmers. Based on the observations, collection of farm hazards are prescribed as further:

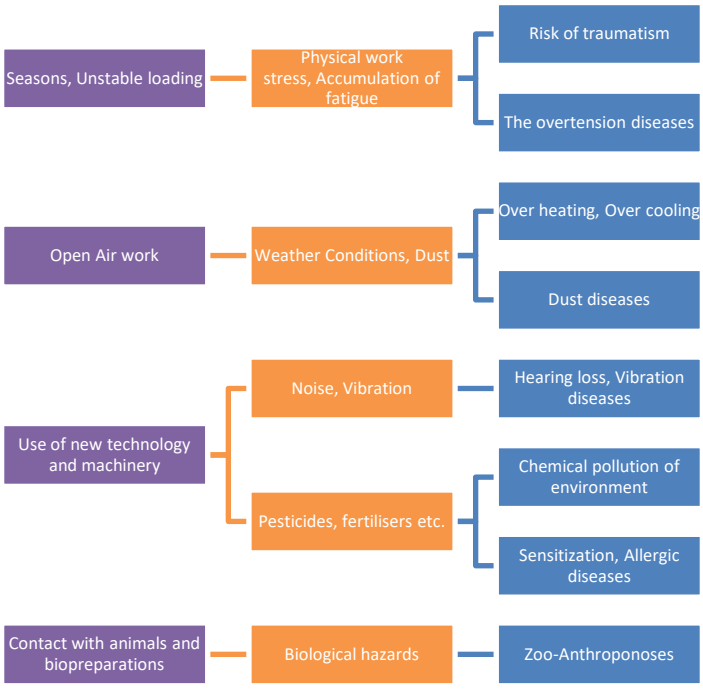
Mechanical, chemical and environmental hazards may increase the risk of accidents for agricultural workers. The principle risks to the health and safety of agricultural workers stem from the nature of the work, the condition of tools or equipment and exposure to chemicals.

3.1 Stresses Associated with Agriculture:

- **Chemical stresses associated with agriculture:**

Farmers and farm workers suffer from increased incidence of respiratory diseases, noise-induced hearing loss, skin disorders, and certain types of cancers, chemical toxicity, and heat-related illnesses.

The use of chemicals in the work environment (including pesticides, herbicides insecticides and fungicides) is regarded as a chemical stressor. Agricultural workers are exposed to, excluding those found in the natural environment, additional chemicals on a daily basis. If they do not observe proper precautions, illness or even death may ensure.



Occupational H & S hazards and risks in Agriculture

- **Physical stresses associated with agriculture:**

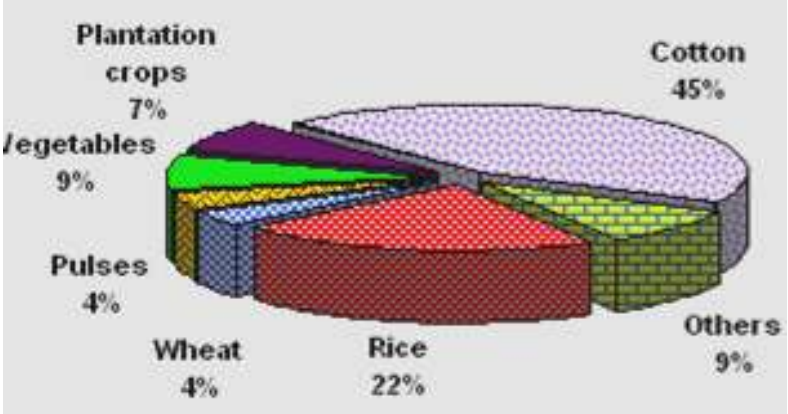
The open air work environment exposes the agricultural worker to environmental temperature extremes. Heat stress occurs when the body builds up more heat than it can handle. High temperatures, high humidity, sunlight, air movement and heavy workloads increase the likelihood of heat stress. Heat stroke, a rare condition, is when sweating stops and the body temperature rises. This is a life-threatening condition and requires immediate medical attention.

Agricultural workers have a high risk of developing skin cancers, as their work can expose them to long periods of ultraviolet radiation. The back of the neck may be especially vulnerable to the rays of the sun and therefore is an area of particular concern. Ninety percent of all skin cancers occur on parts of the body usually not covered by clothing.

Agricultural noise is another common health hazard on the farm. The agricultural worker is continuously exposed to high levels of noise. The exposure to noise may cause noise-induced hearing loss and a permanent threshold shift.

3.2 Types of Safety Risks to Farm Workers:

- **High health and safety risks of farm workers**
  - Inhalation of inorganic dust
  - Inhalation of organic dust
  - Inhalation of ammonium nitrate
  - Exposure to excessive noise
  - Exposure to whole body vibration
  - Inhalation of exhaust gases
  - Tractor roll-overs
  - Caught in or between objects
  - Inhalation of organophosphates
  - Ingestion of organophosphates
  - Skin absorption of organophosphates



Pesticide Consumption by different Crops in India.

- **Moderate health and safety risks of farm workers:**
  - Exposure to high temperatures
  - Exposure to ultraviolet radiation
  - Skin contact with fertilizers
  - Skin burns from fertilisers
  - Poor ergonomic design
  - Trips and slips
  - Contact dermatitis

- **Low health and safety risks of farm workers**

Farmers exposed to arsenic pesticides are at risk of skin cancer, multiple cell carcinomas and squamous cell carcinoma.

3.3 Analysis of Collected Data:

Following is the analysis based on the various interviews:

- 90 % of farmers not aware about the health and safety hazards from their job
- It is difficult for farmers to guess the hazards related with health or illness from their work.
- 25 % educated farmers are able to tell few hazards which come out of tools and equipment which they used.

- Out off 200 people interview, 165 farmers were educated up to 5th standard. Education is important requirement for farmers which enable them to think about their job.
- As age old procedure they are following for farming, their think is "show must go on at any cost".
- But it is glad to say all 100 % farmers were agreeing to take part in health and safety programs as it is related with them.
- They were very keen to know safety and health hazards for them from their farm land.
- They want me to teach them how to identify the hazards from the job.
- As observed, if government or other parties plan to implement health and safety program, they are excited to participate in that than any educated one.
- In Interview with Gramsewak, he was not aware about health and safety and hazards in farm land.
- Gramsewak agreed for participation in awareness program and maintaining a data for future health and safety plans.
- Gramsewak suggested, if government instruct to all villager to notify the small injuries and illnecess in grampanchayayt, it is easy to prepare a record for the year on village level.
- At presents, there is some existing NGO's working in farming sector. They are doing best also. But they don't have any program for health and safety for farming sector.
- No government instruction has been provided to them to prepare the plans for health and safety of farmers.
- NGO's don't have any communications with HSE specialists.
- But we can say, if government plan for the new small awareness program, NGO's can help immensely.
- Local Police stations were not aware about the health and safety incidents in particular.
- Police authority does not keep any record separately for farm incidents or injuries.
- Agriculture associations don't have any role about health and safety of farmers.
- Government still today don't have any health and safety policy for farmers and farm workers.
- Trade Unions are not formed yet for farmers which can play important role in health and safety of farmers.
- Agriculture universities don't play much role in relation with health and safety subject.
- Even manufacturers of machines do not care about the farmers who is doing near about 50000 crore rs business every year in India.
- Fatality rate for farmers due poor health problems, nobody care them. No policy for occupational health which emerge from farming work.
- PHC (Public Health Centres) which located for village service, do not participate for collection of any data with refer to health and safety in agriculture sector.
- Private physicians don't have any role for producing any record for farm injuries and ill heaths from farming sector.
- Very poor treatment for farmers gets for their health problems year on year.
- Repetitive occupational health problems are coming on often basis but no arrangement to record it.

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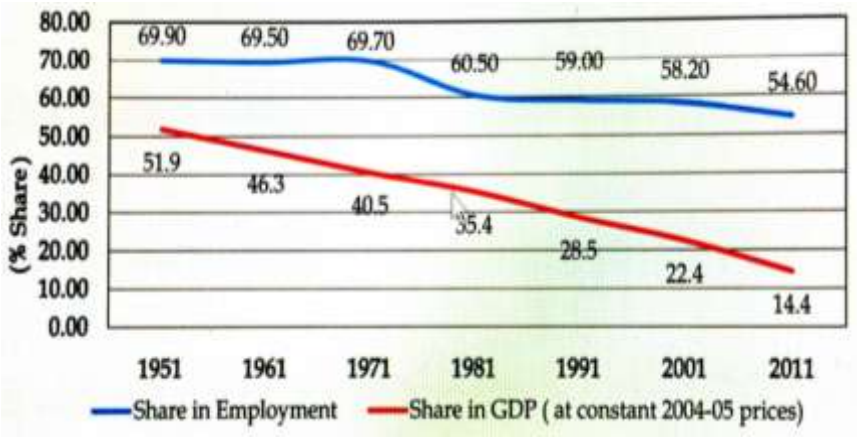
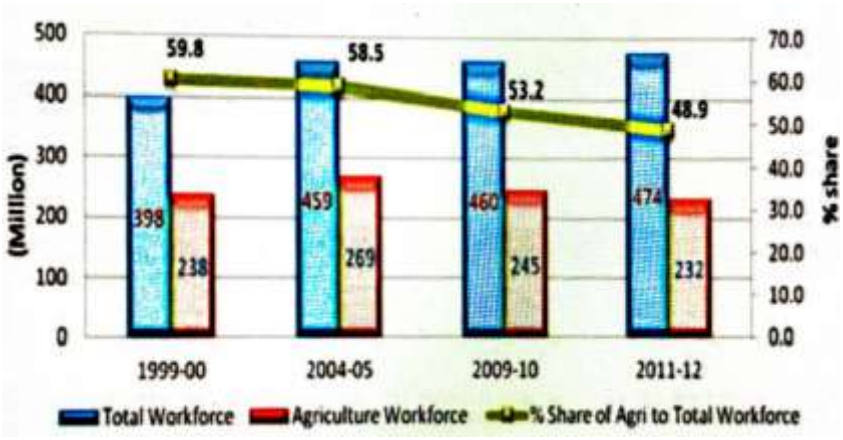


Share of Agriculture & allied sector in Employment & GDP



Workforce Engaged in Forming Sector in India.

4. CONCLUSIONS:

First cluster of findings:

- Farming, a neglected sector for health and safety:
- Farm Environment which leads to more prone to hazards to Farmers and farm workers:
- Environmental Stressors for Safety Risks:
- Government negligence as compared to other industries for Agricultural sector.
- Unavailability of notification system for Health and Safety incidents or Injuries:
- No Awareness program for any safety hazard basically from machines:
- No Awareness program about the health hazards:
- Long Hours and Intensity of Work
- Absence of Farmer Unions or Trade Unions:

Second cluster of findings:

- Poor Hygiene and Sanitation Finding:
- Lack of Protective Equipment Finding:

- Poor Housing Finding:
- Lack of adequate health and safety training:
- Rural Location and lack of availability and quality medical assistance:
- Cost of Medical Treatment:

4.1 Recommendations:

4.1.1 Developing Mechanisam for Health and Safety:

Throughout the study, it is found that there is no health and safety culture in Farming sector where we can go ahead and say improvement. In very first place, we are lacking for the mechanism for health and safety implementation. Mechanism is the important base on which we can expect implementation like a vast country of us.

- **International**

ILO Convention No. 184 concerning safety & Health in Agriculture Recommendations of DGFASLI to take care of this convention, it was suggested to rename The Plantation Labour Act, 1951 as the Agriculture Workers (Safety, Health and Welfare) Act.

- **Central Government:**

Central government still doesn't have policy for farming sector health and safety. It is need of hour to welfare, health and safety of our farmers who feed the complete nation.The Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187), and its accompanying Recommendation (No. 197), also promote such broader approaches.

- **State government:**

Actually main role of state government should be for implementation of the various health and safety programs in all the over the state through various administrative branches. State Government can establish a Directorate General for the state to administer the various health and safety programs all over the state. Safety Inspectors can do the pertinent role if their strength increases district wise. If a District collector has given some responsibility of health and safety of farmers and farm workers, he can collect a necessary data from the available resources on district level which can be analyse further for the reviewing the health and safety policies and programs.

- **Block level Agricultural Administration Department:**

During our survey it is found that agriculture assistance and officers having a better communication and direct coming in contact with the farmers. It's a valuable source which can used as implementation of various health and safety programs in rural farm work areas.

- **Public Health Centre (PHC):**

Usually in India, we can find one PHC among the 7-8 villages. Whenever farmers or farm workers get ill or any other medical help, they are visiting to PHC. Recommendation is that, Health Ministry should insist them to keep the record of farm injuries and illness caused due to farming for the year. PHC is a very valuable source to gather the exact information occupational health diseases. They can help to do occupational health surveillance in rural areas farmers which can use as a data to consider various factors for health and safety programs.

- **Local Police Stations:**

Suppose any tractor incident happened, department notifying it as a tractor incident only. But if a record notify it as a Farm related tractor fatality, then it will help to get exact data for incidents in farming sector. State government should utilize this small concept for collection of genuine data to prepare the policy and programs for health and safety.

- **NGO (Non Governmental Organizations):**

In our country many nongovernmental organizations are working in agricultural sector but no one has yet taken interest in health and safety of farmers. NGO can be utilized for the health and safety programs in a fruitful way. They can easily establish and implement health and safety programs in large extent.

- **Trade Unions or Farmers Associations:**

In our country trade unions are found in factory side only and more political involvement diminishes their values also. It is the need of hour that farmers also should gather under the trade unions. Trade unions can be more valuable for taking care of farmer's welfare by providing health and safety shelter to them in rural areas.

- **Registered Farmers Associations**

They should be directed with health and safety initiatives for its implementation throughout their members during meetings. They can keep collect some information about the hazards and risks what their members are facing during cultivation and suggest some remedies to avoid them or reduces them.

- **State Agriculture Universities:**

The agriculture universities can develop a program for health and safety in agriculture and study it well through students throughout the curricular for its future implementations. They can play important role in coming future. Even we can say, why not include one separate subject for hazards and risk treatments for agriculture out comings as they are having knowledge of pesticides and inorganic fertilizers. Because most of the hazards are related with them which affects the health and safety of farmers.

- **Private Physicians practicing in rural areas:**

It is necessary of government directives to educate and enforce them to keep the record of patients who are coming from farmers families with refer to farming hazards and ill health.

- **Manufactures ofFarm Machines:**

As we all aware, most of the incidents happened due to farm machines utilized in farming sector, Make necessary for manufacturers to provide the training to farmers how to operate machine safely. Let manufacturer prepare a gadgets how to operate their machines in safe manner to avoid the injury/incidents.

- **Gramsewaks:**

Gramsewaks are deployed in every grampanchayat in India at village level who helps to keep the record of spending on various works, agricultural data, mediator for communication between government and village administration. Government can utilize him for distribution of various safety related matters on village level. Even it is possible that the system can generate to notify incidents or accidents or ill health of villagers in village grampanchayat with him. He can play a detailed role to collect useful data of safety and health which emerge in relation with farming.

- **Talathi(Village Revenue Officer):**

Talathi is appointed by land revenue department to keep the record of lands on village level basis. Most of the farmers are visiting him often for their land problems. He is having the authority to issue various required documents with refer to land owners. He can be the focal point for notification of various hazards which realized in farm sectors. Talathi can become a reality collector of genuine problems of the farmers in relation with health and safety.

4.1.2 Awareness about Hazards and Health Problems in Farming Sector:

We can a say there is no awareness about health and safety in farming sector at all. It is immense requirement to spread awareness about health and safety in farming sector. Government and various sources can help to create the atmosphere of health and safety culture among the farmers and farm workers. National programmes for agriculture should seek to promote a preventive OSH culture that addresses the particular needs of men and women and to progressively improve OSH throughout the sector.

- There should be time-bound and have clear targets and indicators.
- target OSH risks that concern small family farms, the self employed and seasonal and migrant workers; and

- Involve a range of different activities at both national and local levels, including high-level conferences, seminars and meetings to maintain focus on the issues, targeted inspection and enforcement, educational and promotional activities, media coverage, widespread publicity and information through websites, etc.
- TV and radio programs may be targeted at specific types of farms, the self-employed and/or vulnerable workers, including seasonal and migrant workers, highlighting any safety and health risks they may face.
- Provide workers with language suitable resources concerning the details of their healthcare and insurance coverage as well as guidelines to any registration requirements in accessible formats such as radio spots, photo novellas, etc.
- Fund community organizations and agencies that are active in working with farm workers. These groups will play an important role in supporting farm workers, have extensive ties to their communities
- Provide training courses for medical professionals practicing in areas of high farm worker concentration to ensure that they have a proper understanding of immigrant and migrant worker issues,
- Include interviews with farm workers in workplace health and safety assessments to obtain a comprehensive understanding workplace conditions
- Provide first aid training to workers in relation with small health problems and small injuries.
- Developing safety guidelines/ good practices documentation for various operations/ areas in agriculture.
- Manufacturers of machinery, equipment, chemicals and other products intended for use in agriculture should as far as reasonably practicable, ensure that their products are designed and manufactured so that they present minimal OSH risks to those who use them correctly and provide instructions in the language of the user for the safe installation, storage, use and maintenance of those products.
- Competent authorities should consider how to engage other partners, such as farmers' associations, agricultural development organizations, financial institutions, insurance companies, NGOs, community-based organizations and others in promoting OSH more widely within the agricultural sector.
- Competent authorities and Safety inspectors should consider how to make best use of agricultural trade fairs and exhibitions, through displays of information and promotional material, film shows and other activities
- On primary school level, various types of farming hazards competition may help to teach the parents about the unknown hazards as kids or innovative always in their ideas.

4.2 Future Research:

This report has opened a number of avenues for future research on form worker health and safety. It would be useful to extend the study for other agricultural sectors like animal husbandry, chicken form etc. or to conduct in depth comparative research on particular crop and / or commodities. However my suggestion is for further paddy field farmers and farm workers study with refer to health and safety issue. The way observe data said, and the population involved in farming sector in India, it is the need of hour to participate in health and safety program enhancement for our poor and always neglected farmers.

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LOCK OUT TAG OUT - A STEP TOWARDS PROACTIVE CULTURE

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Deepak Mamgain***

Abstract

This paper gives an overview of the entire safe LOTO Procedure for Transformer maintenance. The main purpose for doing the research was rectifying the shortcomings and problem faced by workers and employees while performing LOTO. This paper tells you the exact and practical procedure, which is a path forward towards "Zero Incident". The problems faced while performing LOTO are that all the persons, who are working inside, under or above the equipment, which has been isolated, are not providing locks. It means that those persons are not taken in to consideration. That means if no one told them about completion of job and unintentionally de-isolate the equipment their life will come in danger. Another problem, which they face while applying LOTO, occurs when the keys transfer in shift changes and making an LOTO for more than one day. This paper discusses about the solution of these problems for achieving safe LOTO.

Keywords:

LOTO;
PDB;
PCC;
MCC;

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1. Introduction

In an organization, two workers were clearing jam in the de-dusting suction of pipe at Shuttle Conveyor platform, Conveyor started accidently and one worker fell to his death from 15-20 meters height. In an another incident which happened during maintenance while starting Control Board 1, a flash over happened resulting in 60%-70% burns to one of the workers and minor burns to the two others. The probable cause are the lack of awareness regarding the isolation procedures and isolation sources. It becomes necessary to ensure a formal approach for managing risk to personnel from hazardous energy. It is required as to reduce the number and frequency of incidents related to hazardous energy. These key elements have been subsequently further modified and developed into a series of practices or procedures. These practices or procedures shown below are equally applicable across all locations in an Industry whatever type it may be. This would help in bringing out a consistency in the process throughout the industry location.

What can happen without LOTO [4]?

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Th Electrocution has been discussed in the p Arc Flashover Fire

i) To achieve and maintain safely the isolation made and

ii) Releasing the equipment from lockout.

As to achieve and maintain safely the isolation separate Isolation procedures have to be made for separate equipments with Isolation points and mechanism.
Second points deals with the releasinf of the equipment from the Lock Out safely.

2. Methodology & Artwork

The basic requiremnet for performing a Lock out & Tag out is described below ,the following steps are to be followed for safe operation.

Lock out Tag out Procedure for Electrical Isolation of Transformers Step Down/Step Up

-Persons authorized to lock must be an Employee or Associate Employee fulfilling the following criterion:

i) Qualified and trained in the Lockout and Tag out.

ii) Should have minimum of 2 year experience in Power Distribution equipment

Steps to follow while doing Lock Out /Tag Out for the working of the personnel's.

First to identify the type & intensity of the energy that the machine or equipment uses. (By Authorized Person) Prior to starting any defined job. All possible sources of electrical energy must be determined (33/11/6.6/0.690/0.433 kV) using up-to-date information such as drawings and diagrams. All electrical circuits, conductors and other live parts are in energized state until the LOTO [4] procedure is completed.

Hazards:

- Electric shock leading to severe burn injury / fatality.
- While working in Circuit Breaker [10] mechanism, care taken for De-Energizing the springs as to avoid injury to fingers and hands.

Personal Protecting Equipment

- Insulated Hand Gloves
- Face Shield,
- Arc Flash suit

Second is too aware all affected Employees (Persons who are going to work in that equipment) and associate employees about the machine or equipment, which will be down and locked out for service or maintenance.

-Third step is to cut off power of the machine or equipment

LV (Secondary) Side Isolation

The responsible qualified person should ensure un-interrupted power to connected loads prior to switching off the LV (Secondary) side breaker by complying with the following procedure:

- Switch ON Bus-coupler [9]
- Switch OFF the identified Incomer
- Switch OFF Control supply of LT [11]Circuit Breaker [10]
- Drawing Out LT [11] Circuit Breaker [10]
- Place Isolation Tag

Fourth step is to make machine or equipment to be isolated from energy sources, by means of appropriate energy-isolating devices.

HV (Primary) Side Isolation

- Switch OFF the identified Circuit Breaker [10]
- Switch OFF Control supply
- Draw Out HT [11] Circuit Breaker [10]
- Place Isolation Tag

Cordon Off the area, and then Switch On the isolation of the equipment by doing the following:

1. If the circuit breaker [10] is in Test position, try to energize the transformer by switching ON the breaker (as per procedure). The circuit breaker should not close in such circumstances.

2. If the circuit breaker [10] is indrawn out position, the above-mentioned step not required.

Drain the stored energy, like in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, using methods such as grounding, blocking or bleeding down.
Residual energy from the HT [11] cable has to be dis charged and properly earthed as mentioned below:

Procedure for discharging:

1. Open the back cover using suitable tools
2. Use HV Tester [1] to ensure absence of voltage. (HV Tester [1] tested periodically for its healthiness.)
3. Open the grill (if provided).
4. Discharge the stored energy of the cable by using a Discharge Rod[12] as per the following steps:
    - Fix the Earthing [3] clamp of the Discharge Rod [12] rigidly to the nearby earth point/bus.
    - Stand on a rubber mat [7]
    - Use the Discharge Rod [12] one after the other in all the three phases till the residual energy is completely discharged

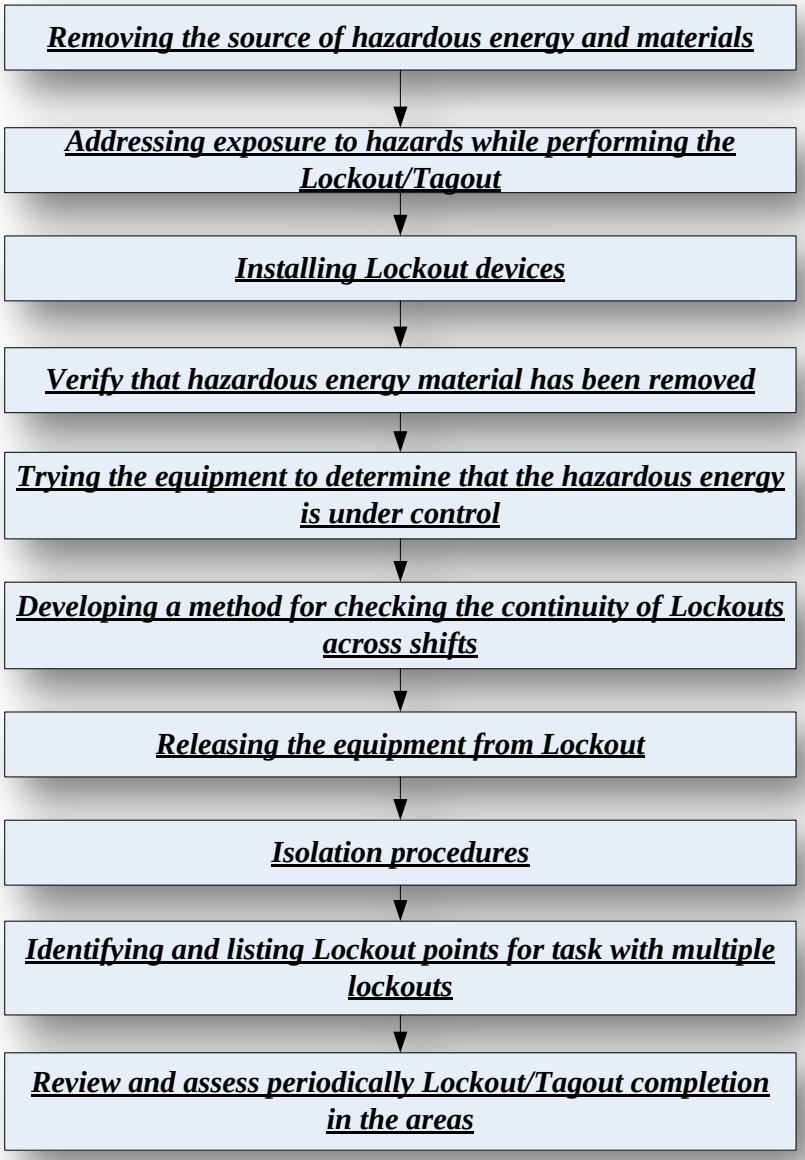
Procedure for Earthing [5] outgoing cables using Earthing [5] clamps:
Earth the cables as per the following steps:

- The Earthing [5] cable and clamps should be designed such so as to handle the system fault [6] current
- Stand on a rubber mat [7].
- Fix the earth lead of the Earthing [5] clamp rigidly to the nearby earth point/bus.

- With the Discharge Rod [12] connected to the R-phase, connect one of the Earthing [5] leads of the Earthing [5] clamp on to the R-phase [8].
- Repeat the same procedure for Y and B phases [8].
- Remove the Discharge Rod [12].

Earthing [5] should remain intact until end of work
Procedure of Earthing [5] outgoing cable using Earthing [5] Truck-
Draw out the Circuit breaker [10]

1. Identify the cable chamber Earthing [5] truck



3. Clean Earth Truck and connect the earth bus of the Earthing [5] truck in its specified location.
4. Rack In Earth Truck to Service position

-LOCK OUT the energy isolating devices with assigned individual locks and tags.
Apply Lockout device along with Lock out Tag at the following isolation points:

- LT Circuit Breaker [10]
- HT Circuit Breaker [10]

Note: A Tag without the use of lock can be use in a place where the equipment does not have the facility to provide a lock. In that case, the LOTO [4] Keeper should ensure enhanced monitoring.
-Check that no employees is or are subjected towards the hazardous energy, "VERIFY" [2] the isolation of the equipment through the following methods:

Equipment is isolated from its energy sources.

CONTINUITY OF LOCKOUTS ACROSS SHIFTS

It is essential that a method for helping ensure the continuity of lockouts across shifts be developed and made clear to all affected persons. Provide and maintain a register in which the transactions of Lockout devices keys interchanged with next shift in charges with mentioning of date, time etc.

Conclusion

The above article states about the relevance of safe workplace practice i.e. lock out Tag out and the importance of it in our day-to-day life. The procedure for making an isolation for Mechanical, Electrical and Operation as well. Therefore, the main objective is to follow these practices in your respective fields. By following these procedures and practices, it is certain that some improvement will sure happen.

Acknowledgement

I want to thank all the officials and staff of Steel industry, with their help and support the research was completed. Thank you very much all the officials and Staff Electrical Department.

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SEED OUTPUT AND SEED PROTEIN CONTENT – QUANTITATIVE ANALYSIS

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Abstract (10pt)

Man being rich in protein content mainly consumes the seeds of legumes. The name pulse is derived from the Latin word "puls" meaning thick soup or potage. Quantitative analysis of seed output and seed protein content of *vigna radiata* and *Vigna mungo* was done on per plant basis by treating the plants with two pesticides rogor and nuvan. Pods of the plants were collected and carefully the seeds were separated from pods, weighed and then protein content analysis was done. Protein estimation was done by the method of Bradford (1976). The data are recorded as mg/gm fresh weight of seeds. It has been observed that in pesticide treated plants, the seed output and protein contents show variability as against the control plants.

Seed output and protein content of the seed is the measure of plant yield and its food value and in the present investigation, seed output and protein content of the seeds of *Vigna radiata* and *Vigna mungo* were analyzed at different concentrations of rogor and nuvan to find the effect of these chemical pesticides on legume plants. The data showed that at low concentration, i.e., 0.5% and 1.0%, the effect of these chemical pesticides was very less on seed yield and protein content but when the concentration of pesticide is increased, there was gradual decrease in seed yield and protein content and at higher concentration and at 10.0% pesticide concentration and above no results were obtaine

Key words:
Vigna , Pesticides , Rogor , Nuvan.

1. Introduction (10pt)

The seeds of legumes are mainly consumed by man being rich in protein content. The name pulse is derived from the Latin word "puls" meaning thick soup or potage. The edible seeds of legumes are "pulses", e.g. lentils, bean, pea, chick pea, mung bean and urd bean. Each of these pulse crops has wide range of colors and sizes. Pulse crops are grown for food and feed in countries around the world and hold significant cultural and historical importance too. In addition to their food value, pulses also play an important role in cropping system because of their ability to fix nitrogen and biologically enrich the soil. Pulses contain proteins, including essential amino acids (18-25%) much higher than cereals.

Review of Literature:

Maguire, J. D in the year 1973 studied the Physiological disorders in germination of seeds induced by the environment.Mehta A R and Johri S N (1985) Studied the tolerance of saline water irrigation on germination of oilseed crops. Singh, Tejbir and Kumar, Y in the year 1988 carried out qualitative and quantitative analysis of soluble nodular proteins under influence of growth hormones in mung bean (*Vigna radiata* L).

2. Research Method (10pt)

Quantitative analysis of seed output and seed protein content was done on per plant basis in control as well as treated plant. Pods of the plants were collected and carefully the seeds were separated from pods, weighed and then protein content analysis was done.Protein estimation was done by the method of Bradford (1976). The data are recorded as mg/gm fresh weight of seeds.

3. Results and Analysis (10pt)

It has been observed that in pesticide treated plants, the seed output and protein contents show variability as against the control plants. The data for these parameters as observed in *Vigna radiata* and *Vigna mungo* are shown in table 9.1 to 9.8 for sample I and II respectively.

The results (table 1 and figure 1 A and B) for *Vigna radiata* show that the seed output was 3.50, 3.48, 3.15 gm, and 2.66, 2.25, 1.99 gm, and 1.64, 1.26 gm while protein content was 249, 231, 215 mg/gm, and 198, 172, 124 mg/gm, and 82, 52 mg/gm for different increasing concentrations of rogor, i.e., 0.0%, 0.5%, 1.0%, 1.5%, 2.0%, 2.5%, 5.0% and 7.5% respectively. No results were obtained at 10.0% rogor concentration.

The results for the effect of nuvan on seed output and protein content of *Vigna radiata* are shown in table 2 and figure 2A, B). The result showed that the seed output was 3.20, 2.98, 2.65 gm, and 2.15, 1.91, 1.54 gm, and 1.42, 1.05 gm/plant and protein content was 247.00, 227.00, 215.00 mg/gm, and 189.00, 162.00, 121.00 mg/gm, and 78.00, 48.00 mg/gm of fresh weight of seed.

The result for the effect of Rogor on seed output and protein content of *Vigna mungo* are shown in table 3 and fig. 3A, B). The results indicated that the seed output were 3.80, 3.40, 2.88 gm, and 2.78, 2.53, 1.95 gm, and 1.81, 1.42 gm and protein content were 231.00, 214.00, 187.00 mg/gm, and 161.00, 143.00, 114.00 mg/gm, and 65.00, 38.00 mg/gm for 0.0%, 0.5%, 1.0%, 1.5%, 2.0%, 2.5%, 5.0% and 7.5% rogor concentration respectively. No results were obtained for 10.0% rogor concentration.

Table 4 and fig. 4 A, B shows the results for the effect of various concentrations of nuvan on seed output and protein content of *Vigna mungo* (sample I). The result showed that the seed output was 3.42, 3.15, 2.88 gm, and 2.51, 2.26, 1.77 gm, and 1.26, 1.05 gm per plant and the protein content was 248.00, 230.00, 214.00, and 197.00, 174.00, 125.00, and 84.00, 53.00 mg/gm for increasing concentration of nuvan, i.e., 0.5%, 1.0%, 1.5%, 2.0%, 2.5%, 5.0%, 7.5%, respectively. No results were obtained at 10.0% nuvan concentration.

Table 1 Effect of various concentration of Rogor on Seed output and protein content of *Vigna radiata* .

S/N	Treatment	Seed output (gm)	Protein content (mg/gm)
1	0.0%	3.50±0.17	249.00 ± 3.97
2	0.5%	3.48±0.16	231.00±3.57
3	1.0%	3.15±0.14	215.00±3.40
4	1.5%	2.66±0.12	198.00±3.17
5	2.0%	2.25±0.12	172.00±3.04
6	2.5%	1.99±0.10	124.00±2.15
7	5.0%	1.64±0.08	82.00±2.11
8	7.5%	1.26±0..06	52.00±2.08
9	10.0%	0.00	0.00

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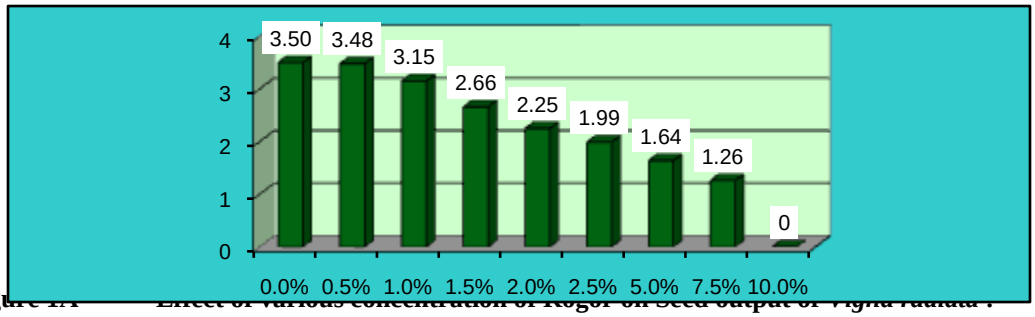

Figure 1A Effect of various concentration of Rogor on Seed output of *Vigna radiata* .

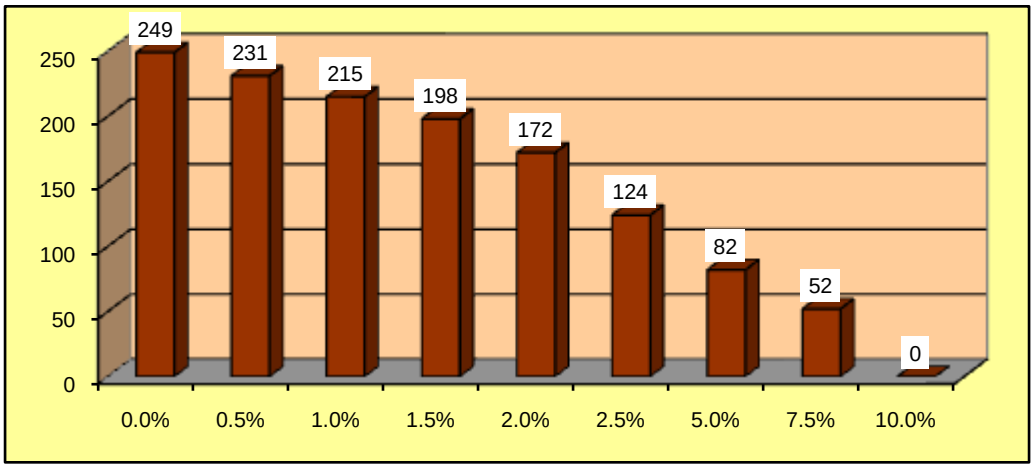

Figure 1B Effect of various concentration of Rogor on Protein Content of *Vigna radiata* .

Table 2 Effect of various concentration of Nuvan on Seed output and protein content of *Vigna radiata* .

S/N	Treatment	Seed output (gm)	Protein content (mg/gm)
1	0.0%	3.20 ±0.17	247.00±3.45
2	0.5%	2.98±0.0.16	227.00±4.05
3	1.0%	2.65±0.15	215.00±4.06
4	1.5%	2.15±0.15	189.00±3.47
5	2.0%	1.91±0.12	162.00±2.97
6	2.5%	1.54±0.12	121.00±2.15
7	5.0%	1.42±0.10	78.00±1.54
8	7.5%	1.05±0.11	48.00±2.14
9	10.0%	0.00	0.00

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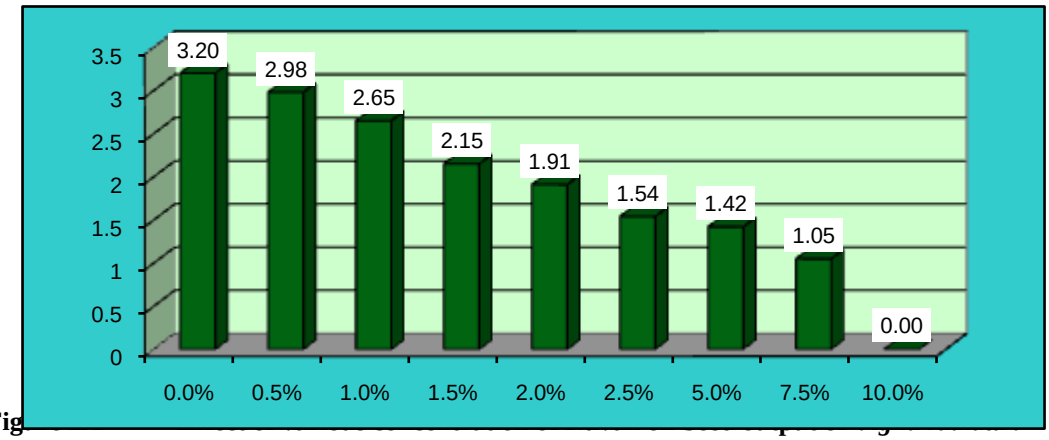

Fig

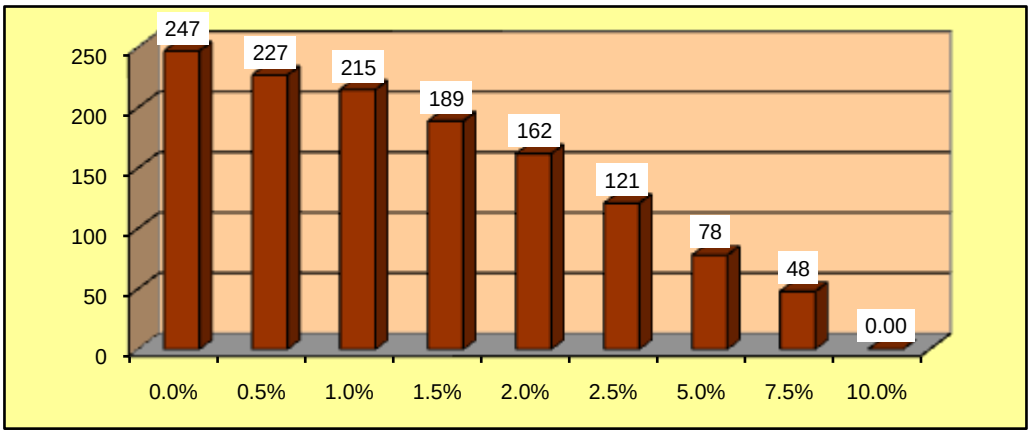

Figure2B Effect of various concentration of Nuvan on Protein Content of *Vigna radiata* .

Table 3 Effect of various concentration of Rogor on Seed output and protein content of *Vigna mungo* .

S/N	Treatment	Seed output (gm)	Protein content (mg/gm)
1	0.0%	3.80±0.14	231.00±3.82
2	0.5%	3.40±0.12	214.00±3.65
3	1.0%	2.88±0.13	187.00±3.76
4	1.5%	2.78±0.09	161.00±3.46
5	2.0%	2.53±0.08	143.00±2.99
6	2.5%	1.95±0.06	114.00±2.13
7	5.0%	1.81±0.04	65.00±2.11
8	7.5%	1.42±0.04	38.00±1.98
9	10.0%	0.00	0.00

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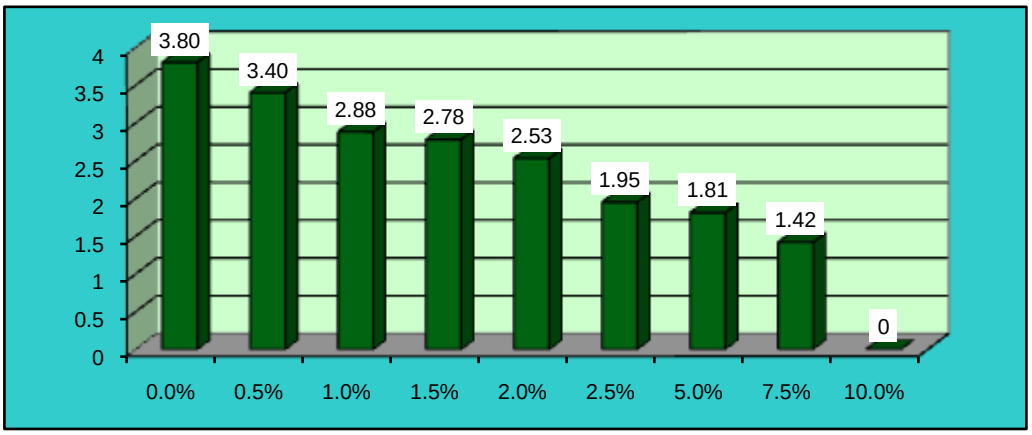

Figure 3A **Effect of various concentration of Rogor on Seed output of *Vigna mungo* .**

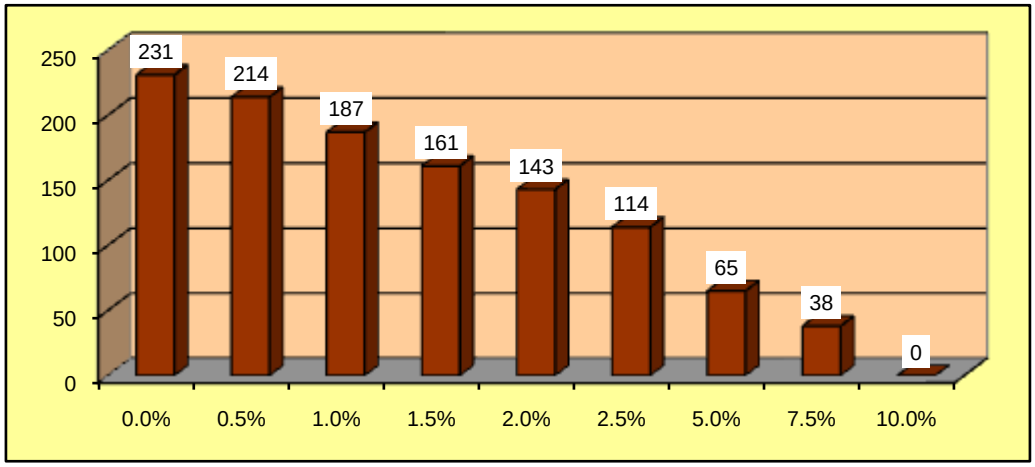

Figure 3B **Effect of various concentration of Rogor on Protein Content of *Vigna mungo***

Table 4 **Effect of various concentration of Nuvan on Seed output and protein content of *Vigna mungo* .**

S/N	Treatment	Seed output (gm)	Protein content (mg/gm)
1	0.0%	3.42 ±0.11	248.00±3.36
2	0.5%	3.15±0.10	230.00±3.84

3	1.0%	2.88±0.09	214.00±3.79
4	1.5%	2.51±0.07	197.00±3.81
5	2.0%	2.26±0.06	174.00±3.43
6	2.5%	1.77±0.04	125.00±2.65
7	5.0%	1.26±0.05	84.00±2.56
8	7.5%	1.05±0.03	53.00±2.48
9	10.0%	0.00	0.00

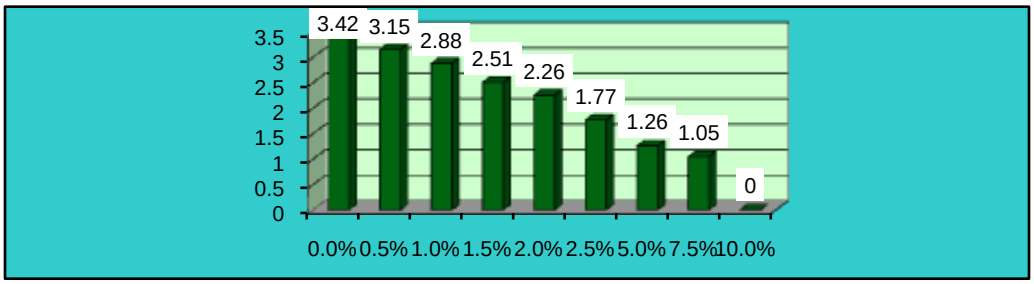

Figure 4A Effect of various concentration of Nuvan on Seed output of *Vigna mungo*.

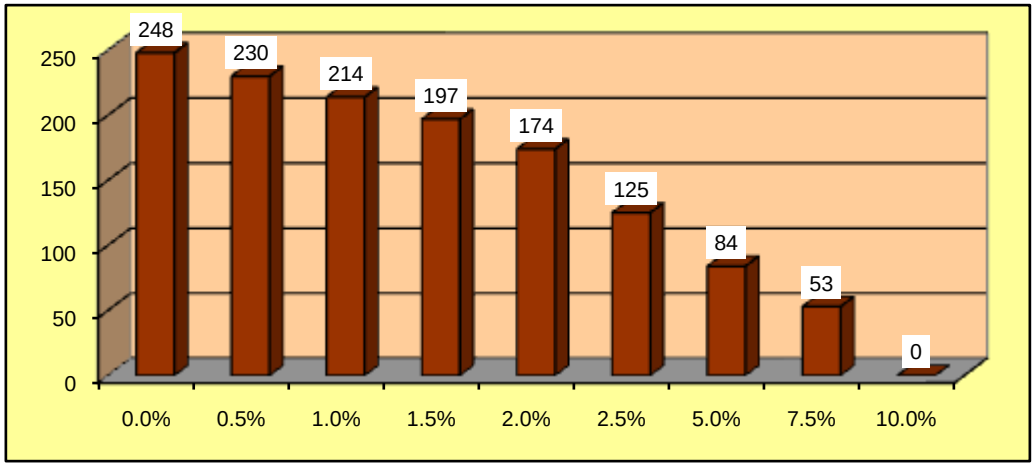

Figure 4B Effect of various concentration of Nuvan on Protein Content of *Vigna mungo* .

4. Conclusion (10pt)

Seed output and protein content of the seed is the measure of plant yield and its food value and in the present investigation, seed output and protein content of the seeds of *Vigna radiata* and *Vigna mungo* were analyzed at different concentrations of rogor and nuvan to find the effect of these chemical pesticides on legume plants. The data showed that at low concentration, i.e., 0.5% and 1.0%, the effect of these chemical pesticides was very less on seed yield and protein content but when the concentration of pesticide is increased, there was gradual decrease in seed yield and protein content and at higher concentration and at 10.0% pesticide concentration and above no results were obtained. The present results coincide with the observations made by Asgar Ali et al. (2006).

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HORIZONTAL WELL PLUGGING AND ABANDONMENT

Mohammed Junaid Khan*

Keywords:

Horizontal, P&A;
mD; TOC;HSE,
OISD-STD.

Abstract

Plugging and abandoning of oil and gas wells those are no longer economically viable or reached to final phase of production. Dry wells and other wells which have wellbore issue need to close and abandoned. In oil and gas industries a number of wells drilled, the average ratio of exploratory and drive well in proved region is 1:3. Production wells when passed their production stage require more maintenance/investment and are rapidly approaching their end of life. This final stage of well is cessation and next step is to plug and abandoned the wells. It is also necessary in order to protect the environment, fresh water aquifer, rivers ecosystem and minerals deposition bed from contamination of hydrocarbons.

This paper focused on general review of abandoning, feasible methods and techniques of horizontal well plugging and abandoning and addressed the economic challenges related to it and challenges of protection of environment and rehabilitation of land. Technically sound abandoning practices are essential for long term environment protections and rehabilitation of land to return it owner.

The regulatory bodies' involvement in plugging and abandoning are given for just as a reference. Rigless techniques of plugging and abandonment are discussed which are most optimal and effective methods especially for onshoar

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hydrocarbon fields. Offsoare field plugging and abandonment is also briefly discussed. Howevre, either permanent or temporary plugging and

abandonment would be suitable for oil and gas field is discussed too.
Some tables and figures are mentioned for purpose of easy comprehension and source from which these are taken are also mentioned along with.

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1. Introduction

The plugging and abndonment of oil and gas wells is a big challenge for the servicing companies because of the P&A phase is not for yielding money but it's performed mainly for environment protection desires. As the cost of P&A in onshoare field is much lesser than the cost of P&A of offshoare wells so the P&A phase has big care and costwise must be optimum. The 1956, "oil gas and coal mining act required", 'wells to be permitted' and upon completion and abandonment, wells has to be placed on record with the department of the environment resources. Because there were no previous requirements, there are problems with locating the abandoned oil and gas wells drilled before January 30, 1956(D.G. Calvert et. al). Before implementing this act in Pennsylvania alone there may be thousands of unplugged abandoned wells since the industries drilled without regularity requirement.

The drack well, drill in Pennsylvania in 1859 is acknowledged start of drilling industries in the United States. Drilling equipment began with hand digging tools, followed by spring pole, cable-tools and rotary rig equipment in the late of 1800s. Early "Churn" drilling used a cable or flexible line so that holes were mainly vertical.By earlier methods all well are drilled vertically downward. Directional drilling evolved from the need to drill the hole in other direction. Special drilling tool and procedure are used to change the direction of the well bore from vertical to directional or horizontal in order to penetrate the target location or zone where can't be reached by conventional vertical drilling. Directional and vertical drilling serves mainly for the drilling of exploration and development wells. Horizontal drilling creates the development wells with increase sometimes very high production rate. There are various well patterns under directional and horizontal classifications depending upon types of wells.

The purpose of horizontal well is to increase the productivity by increasing drainage area at the well bore. Horizontal well can be defined as extension of highly deviated well or drilling a well parallel to horizontal bed plane or drilling in order to increase the length of completion zone through the reservoir borehole inclination approaching 90 degree from vertical.

By passing the time a stage comes when all types of wells has lost their productivity and use required partially or permanently, to plug and abandon the well following guidelines assigned by existing regulatory body in that particular state or country. The regulation body has described what standard has to maintain during closing the wells in their guidelines.it may be different area to area on the basis of formations zone and stratigraphic records. Whatever situation is existing we have to follow guidelines according to that particular norms.
Table 1: Petroleum Field Regulatory Authorities' Names

S/N	Country's Name	Regulatory body guidelines.
1	India	OISD-STD-175, OMR 1984/others
2	USA	Texas Railroad commission
3	Canada	AER(Alberta Energy Regulation)
4	Norway	"Act 29 November 1996 No. 72 relating to petroleum activities"

General Review:
Holes or wells have been dug and drilled for various purposes.
Table 2: Drilling scope and purposes.

Industrial Purposes	Domestic purposes	Others
• Industrial and Municipal application • Oil and Gas • Mine drainage • Testing • Seismic purpose • Solution mining • Measurment of physiacal roperties of downholes	• Drinking water wells • Irrigation purose	• Specific purpose

Plugging and Abandonment

Plugging

The principal technique applied to prevent cross flow between permeable formations is plugging of the well, creating an impermeable barrier between two zones. Beside this the Well plugs are being used for several different operations in oil and gas industry, such as lost circulation control, formation testing, directional/sidetrack drilling, zonal isolation and well abandonment. The scope of this study is restricted to the latter two applications. Well plugs can be either cement or mechanical plugs. Specifications of well plugs and abandonment are prescribed by regulatory authorities.

In the oil and gas industry the most common material used for plugging wells is Portland cement, which is placed in the well as slurry that hardens under influence of the in-situ temperature and pressure. A cement plug consists of a

volume of cement that fills a certain length of casing or open hole to prevent vertical migration of fluids. Cement satisfies the essential criteria of an adequate plug; it is durable, low-permeable (mD) and relatively inexpensive. API has set the specific stander of cement to be used for specific depth interes zon and working conditions. Single cement could not be used for all intrest depth and temperature. Generally the cement s are used in P&A because, it is easy to pump in place, has a reasonable setting time and is capable of tight bonding to the formation and well casing surface preventing fluid flow along these interfaces.

Abandonment

The purpose of permanent well abandonment is to isolate permeable and hydrocarbon bearing formation from fresh water aquifers and minerals deposition, protecting underground resources and gas seepage from thin zone into aquifer and lateral migration. The intention of abandonment is to restore the natural integrity of the formation that was penetrated by the wellbore. Abandonment procedures were developed in the oil and gas industry where several techniques were designed to prevent inter-zonal communication and fluid migration. If a well is not properly abandoned, it may provide pathways for brines, hydrocarbons or other fluids to migrate up the well and into shallow drinking water aquifers or to surface. Identify the well to be abandoning and plug is the primary task for abandoned processes and defining the each zone which need to plug, identified its characteristics and physical and chemical behavior of formation zone. A whole study of wells which to be plugged is thoroughly completed then we go to further for planning of well abandonment

Classification of Abandonment

There are two types of well abandonment (1) Temporary Abandonment (2) Permanent Abandonment

Temporary Abandonment: temporary abandonment is applied to that wells of field which need to be reintered into the well for reprodusing the well. Temporary abandonment need to apply where the wells can't be used for production prospects but wells can be used water injection wells or disposals or other such porposes, due to uncontrolled flow of fluids could leed to the well integrity failure and environmental hazards, indication of irrepareble the well intigrity failures' and the production and other activities can not possible to environmental reasons. In the oil and gas field many wells rest as dummy and subsquentlyapplicable niether for production nor for injection or other's purposes that's need to be closed temporarly so the pressure of wells are controlled and stable as per requairments, the decision of abandon or shut the well is taken by the Field Head Quarter (FHQ) levels, While approval of permanent abandonment the wells is granted by Corporate office.

Permanent Abandonment: when the wells has no fruther prospects and completely got dry no indication of producing hydrocarbons, and can't be used as water injection wells, identifies as permanent abandonment. Now a days the most effective and optimal techniques are requaire to plugging and abandonment because of liablity to environment protection such as to protect fresh water aquifer, minerals depositions and biogradients etc. CO2 gas is very hamful for the natural resourses and the water aquifer. Substitutes of cement or best quality of cement to abandoning especially horizontal wells are need to introduse. A large scope of research is exists herebacausemostaly companies are intreste in the production of oil and gas but gives less attention to plugginf and abandonment of wells.

Plans to wells Plugging and Abandonment

Any work has their effectiveness and acceptance as much how smartly and perfectly as planned it.

Because the abandonment and plugging segment has no economical add in production plan so the expenditure for abandoning and adapted techniques should be planned prior to drilling or can say it is the course of action under initial plans.

Initial plan of plugging and abandoning of horizontal well is to define the well first and identify the zone of interest

and designing the well abandoning course of area as well as total capital cost, techniques and procedure is required for this course of action. After planning defining and designing the course of horizontal wells follows the guidelines of state or country regulatory bodies whose has written guidelines and procedure has to be adapted by abandoning service providing companies.Final plan of abandonment is to check durability and inspection of work and desire.

Activities Involved in Plugging and Abandonment:

General Steps in abandoning

- Remove salvageable equipment,
- Isolation of open hole,
- Isolation of perforations,
- Isolation of lap joints or liner tops,
- Finding and replacing channels in cements
- Identification the channels in cement sheath.
- Repair of channels-cement squeeze. Cement slurries.

Materials used

- Gelled pills (Betonites and others).
- Portland cement.
- Spacers to protect cement slurries.
- Mechanical plug (incl. cement retainers).
- Inflatable plug.

Pre Abandon Activities

1. **Disassembled and remove all well equipment:**

   Before abandoning and plugging the well drilling rig and work- over tools are utilized to pull out of all down-hole's equipment previously used in production by operators, such as production tubing, down-hole pumps and packers. Casing is also removed if it would be possible. If the tools removal is not possible to come out due to stuck and lost equipment the whole abandonment strategies have to revised and approved by concerned authorities.

2. **Cleaning the well:**

   After the removal all bore hole's equipment and completing the operation, the wellbore needs to be cleaned from fill, scale and other debris. To this purpose the wellbore is flushed by a circulation fluid with sufficient density to control pressure and with the physical properties that enable the removal of debris. Air with high pressure is circulated to clean the well less accessible corners. Dependent on the specific conditions additional tools or additives may be required to successfully clean the hole.

Currently Plugs Practices

Licensee must use the log from the well to determine the exact plug positions through the well. All leaking and interested zone must be identified which to be plugged. P&A has different processors to different country base on local and state regulation imposed by regulatory authorities.

The plugging and abandoning (P&A) has different methods, there are four methods for well plugging and abandonment are discussed, these are the balanced plug method, the dump bailer method, the two-plug method and rigless method. API recommends the abandonment to be chosen after an analysis of the well for probable risks and potential problems with respect to the different abandonment techniques. However, in reality ideal practices are not always successfully achieved. Here only rigless technique is explained**.**

Rig less method

The key fact of this rig less abandonment program would be the coordination of the all well services to maximize efficiency.

There are five main performance criteria-

Super-mobile, all equipment, including *a* mobile camp should be mounted on the wheel so it can be transported to new location quickly.

Self-supporting, as the name implies that the contract can take care of nearly all activities likes, material supply, transport and sub conductor service with minimal operator involvement. The main hydrocarbon producing companies need only to provide programming, air transport, communication facilities, some mud and chemicals and site representatives.

Dry location concept, well site is dry because water or fluid would not be drain near the working site. This eliminates the necessity of the repairing and rebuilding the waste pits near the abandonment location. Although the circulation and dumping is inevitable during the job process, all fluid is stored into a tank. Dry locations speed up abandonment and restoration job by approximately about ten days per well because no time is spent in cleaning the waste pit or waiting for the location to dry. In previous techniques this required several months.

One-stop job, each well-site is visited once and entire abandonment process must complete at this time. Any return to the site subsequently delays the operations and increases the logistical costs and associated HSE exposers.

Minimum mileage, the total process is optimized to reduce move time by unit moves and optimized transport too. HSE concern need to be also maintained and limited the night driving to an absolute minimum (12/12 hr.) working schedule to optimize camp moves.

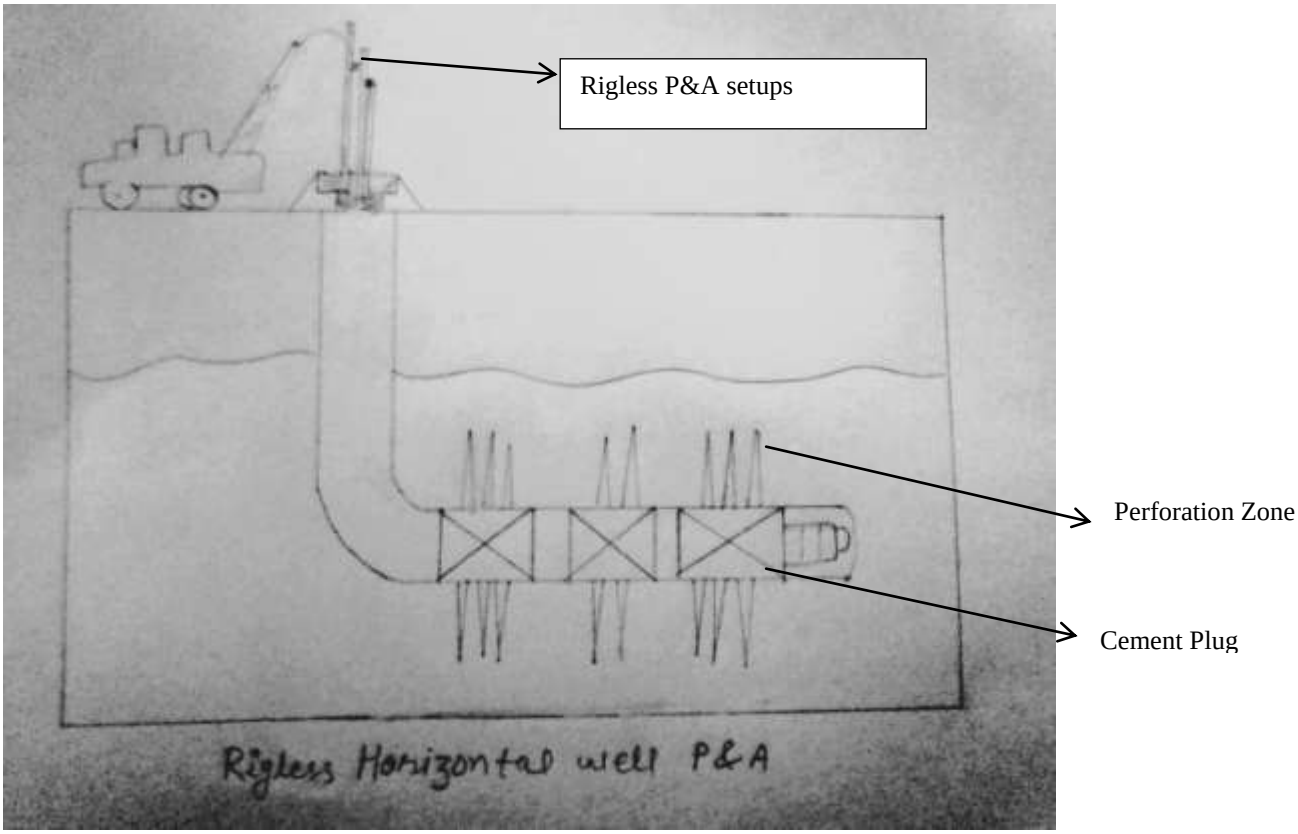

Figure 2.*Rig lessHorizontal well Plugging and Abandonment (Self-made)*

Cement plug evaluation

After the well is plugged, testing is required to ensure that the plug is a placed at the proper level and provides zonal isolation. The plug can be verified by tagging its top, pump pressure testing or swab testing.

Tagging the top of cement (TOC) can be done through the employment of a drill pipe, wire line, work string or tubing. The procedure, recommended by API, is a very straightforward operation with the benefit that no additional pressure needs to be put on the wellbore. It enables exact determination of the top of the plug. Tagging the plug with open-ended pipe can also be applied for testing the cement plug's integrity. However, disadvantages of this method comprise the concentration of the load on the area where the pipe hits the cement, the required incorporation of corrections for buoyancy and friction when using the pipe weight, and potential weight insufficiency for shallow plugs.

Secoundly, pressure test can be executed using pump pressure. In this case the pressure is exerted uniformly on the plug and no corrections are required. The application of pump pressure provides more accurate data on the pressure, which could also be monitored over time. However, the associated changes in pressure itself could initiate casing integrity problems if the well cannot sustain the enforced pressure changes.due to this, it could lead to loss of wellbore control.Another pressure testing method is swab testing or swabbing. This technique involves running of a swabbing tool that reduces the pressure in the wellbore above the plug to levels below the pressure gradient from the

isolated reservoir below the plug.Subsequently fluid levels and pressure are monitored to ensure adequate isolation. Swabbing is more time-consuming relative to the other methods.By evaluating the cement plugs through these methods it could be assure to safe plugging of wells.

HSE- Health, Safety and Environment

Environment and natural resources protection such as (soil, greenery and water aquifer) is primary concern of any firm or industries. HSE subject has become most important to world nowadays. Many international conventions are organized by UN and different observatory institute time to time on international platform.As oil and gas exploration field consume a large amount of natural resources and land, subsequently have effect on the natural resource as discussed very beginning at this chapter. OSHA the international regulatory authority and other local and national regulatory bodies release advisory to companies about HSE.

As horizontal oil and gas well can affect the environment is shown in the above figure. How oil and gas seepages and leakages could affect the nearby soil and water aquifer bed through passage in form of fractures, faults and permeable channels into amongst different subsurface strata. In order to develop a comprehensive overview of applied well abandonment techniques, common practice of well drilling, plugging and abandonment needs to be evaluated in different regions throughout the world. To this purpose, a questionnaire was developed and distributed amongst experts active in operating and service companies, consultancies, regulator bodies and research institutes involved in oil well drilling and abandonment activities worldwide. This section comprises a concise description of the results of the well abandonment survey. However, the collected amount of data proved to be insufficient to extrapolate and investigate regional differences.

Rehabilitation of land: after completing the plugging and abandoning the wells of exploration field by the licensee the producer company has to rehabilitate the field as much possible as was before and returned to that person(s) who is the real owner of the land.Rehabiliation is done only when it has been confermedthat the hydrocarbon field will not be going to fruther production in future. No bypassed oil are there, no infill drilling could be possible there. After rehabilitation the land it can be converting into farm land for agricultural purpose or others.

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ASSESSMENT OF MAJOR HAZARDS IN PLASTIC INDSUTRY AND THE SAFETY ASSESSEMENT OF INJECTION MOULDING MACHINE USING FMEA

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Abstract

Safety at work is one of the very esstential part for which commitment isrequired from both the site management as well as from employees site. In order to implement the safety at workstations, it must be measured and this measurement can be achieved by an appropriate safety indices. This study used Failure Mode Effective Analysis (FMEA) concepts and proposed a new safety index. This new index is a general index and can be used in all fields of industries. The FMEA standard tables were changed and safety can be measured based on three criteria: severity, occurrence, and detection. These three criteria led us to do final calculation risk priority number (RPN)

This paper will give an awareness to the plastics workers (men and women) to understand the nature and extent of toxic exposures in the production of plastics and required measures which should be taken for a cleaner and healthier workplace. The assessment of the injection moulding machine using FMEA(Failure Mode Effective Analysis) has been carried out to identify various hazards and risk associated with plastic products manufacturing equipments and measures which were required to reduce the level of risk. FMEA had also helped in assessing various control measures. An index has been developed using FMEA (Failure Mode Effective Analysis). The methodology consists of collection of primary data to find out the severity, occurence and detection number, which enabled to develop RPN(Risk Priority Number) number.The tool is implemented on injection moulding machine. It was found that with the help of various RPN numbers the identification of various risks and recommended methods to reduce the risk, a proper assessment of major hazards in the plastic industry can be obtained. The result indicated that majority 47% comes under moderate level of occurence.

(9 pt).

Keywords:

Hazards and Risk associated with plastic products; FMEA(Failure Mode Effective Analysis) ; Safety, Safety Index; RPN(Risk Priority Number)

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1. Introdcition

The hazard assessment will help the plastics workers to understand the nature and extent of toxic exposures during various process of plastics manufacturing in plastic industry. Plastics are extremely diverse in terms of chemical composition, properties and possible applications, and are widely distributed in the society and the environment. [1](Lithner Delilah 2001). In the last 20 years the global annual production has doubled, reaching 345 million tons in 2015. Most of the chemicals which are used to produce plastics are hazardous for human health and for other living organism in our environment. The plastic polymers are not considered as toxic, but in plastic products there may be non-bound residual monomers, polymerization chemicals, degradation products, and additives which have toxic properties.

Different FMEA calculations are defined in different fields such as industries [2] [3] [4] [5] [6] [7] [8]. Different methodologies such as reliability and FMEA (Failure mode and effects analysis) were cpndcuted by number of researchers in the past [9] [10][11] [12]. FMEA is one of the most well-known techniques to assess the failure of a process or a product. FMEA has been used in safety topics to increase the safety at work [13]. This index has been useful for predicting the safety of foods. Husain et al used FMEA and probabilistic counter examples for airbag system. Moreover FMEA can be used to increase the safety of patients in hospitals. Chiozza and Ponzetti [14] have been used FMEA to reduce the medical errors. They showed a significant reduction of the risk priority number (RPN). Adachi and Lodolce [15] [16].

2. Research Method

The methodology includes literature survey about the various steps involving in the plastic product manufacturing. Various steps involved in the manufacturing of plastic products are Injection moulding , Extrusion, Blow moulding , Compression moulding, Calendering, Finishing process and purging. FMEA is a systematic tool that has been used in industries to analyze the reliability. The performance of a production in the point of view of risk can be measured using FMEA. By the by the risk and the probability of getting accident can be reduced and analyzed. The initial step is to find out the failure modes. Any kind of errors or defects in a process or design is called failure modes. Here 45 failure modes are identified. In next step all the failure modes are ranked with the help of Severity table, Occurrence Table and Detection table.

At last the risk priority number (RPN) is identified based on the above estimation of the severity, occurrence, and detection. This index is the main index which shows the priority of corrective action on the failure modes. Based on Equation 1, the RPN is calculated by multiplying the severity (1–10), occurrence (1–10) and detection ranking (1–10) levels resulting in a scale from 1 to 1000.

RPN = Severity ×Occurrence × Detection.

3. Results and Analysis (10pt)

3.1.Assessment for plastic injection molding machine using FMEA

The ranking of FMEA was based on three main criteria: severity, probability, and detection. In this study also we use these three criteria**.** Severity,Occurrence,Detection. Table 1 shows the ranking of different accidents in workstations in the point of view of severity. The next item to the ranking of accidents is based on the occurrence of ranking. Occurrence criteria for classification as indicated is the probability of a failure during the expected life of the system. In this part also means occurrence probability of an accident of a worker. Therefore , the occurrence of description is similar , only the rank is formed vice versa. Detection classification criteria is the last criteria to be evaluated for classification of accidents in jobs. As detection ranking said it helps to sort based on an assessment of the probability of failure . Similar to previous parts detection classification criteria is also formed by an accident on workstations. Tables 1, 2, and 3 develops to assess the safety of plastic injection molding machine. These tables have been derived from the original FMEA concepts and with some modifications they are used for assessing the safety of plastic injection moulding machine.

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3.2. Assessing the safety ofplastic injection molding machine at ESS PLAST PVT LTD

Manufacturing processes which have two cases thermoplastic and thermosetting is called injection moulding. Raw materials are inserted into a heated barrel, mixed and forced into a mold cavity where it cools and hardens to the configuration of the mould cavity. ESS PLAST PVT LTD. is a factory producing plastic products in Kerala, India. This product has 2 main parts, First is the body and Second is the cap. Each part is produced by an injection process and in each process there is a specific rate of rejection. Finally in last process these two parts will be assembled. ESS PLAST PVT LTD wants to increase the safety at workstations. Therefore the proposed method was implemented in this organization and the results were mentioned using FMEA (Table 4). All failures are categorized in 3 categories: - Appearance, Dimensional, and Performance.

In order to increase the safe level of working in injectionmoulding machines Failure Mode Effects Analysis has been carried out with several potential failure modes based on performance, appearance and dimension. Based on Tables 1. (severity), Table 2. (occurrence), and Table 3.(detection,) the problems were detected and then RPN has been calculated. By referring the RPN chart the various recommend measures are identified. RPN interpretation indicated that **47% failure category comes under RPN** between 451-650 that shows moderate probability that the defect will be detected. **31%failure category comes under RPN** between 301-450 that shows low probability of occurrence.

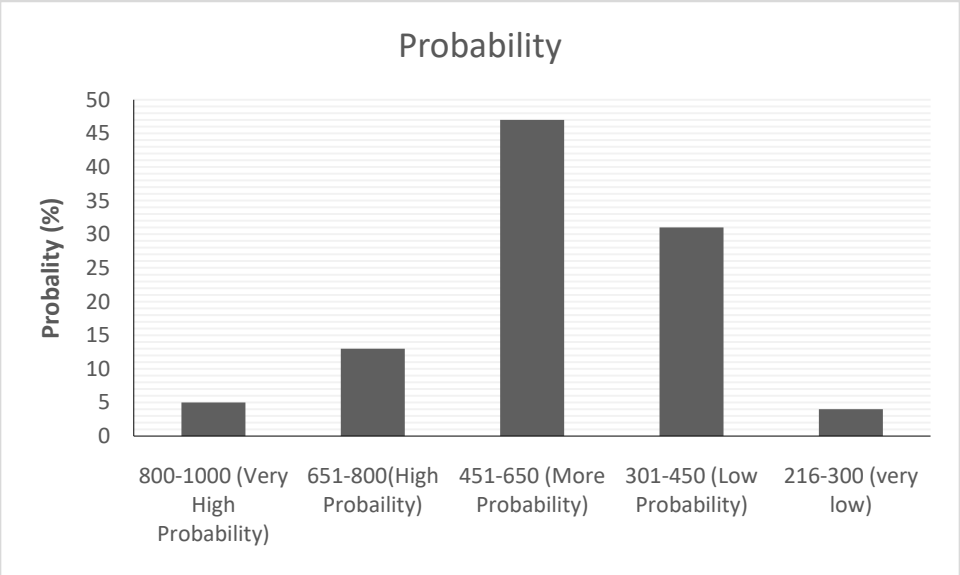

Figure 1 RPN interpretation chart

Table 1 Severity Ranking Criteria

Rank	Title	Description
10	Lethal	The injuries are non-survivable even with immediate medical attention.

9	Serious	The injuries pose a serious threat to the individuals life and require immediate medical attention.
8	Severe	Those are dangerous in life term periods such as high volume for Hearing system.
7	Moderate	Injuries are survivable,but may require medical attention. Without medical attention the injuries could be come severe.
6	Mild	Fatigues or injuries pose no serious threat to life if complications are prevented (such as infection of wounds)

Source (Rakesh R, Bobin Cherian Jos, George Mathew March 2013)

Table 2 Occurrence ranking criteria

Rank	Probability of Failure	Description
10	Very High,	An unlikely probability of occurrence during the item operating.
9	Highly repeated	A remote probability of occurrence during the item operating time.
8	Moderate failures	An occasional probability of occurrence during the item operating.
7	Few failures	A moderate probability of occurrence during the item operating.
6	Very less	A high probability of occurrence during the item operating time.

Source (Rakesh R, Bobin Cherian Jos, George Mathew March 2013)

Table 3 Detection ranking criteria

Rank	Description
10	Very high probability that the defect is detected
9	High probability that the defect will be detected.
8	Moderate probability that the defect will be detected.
7	Low probability that the defect will be detected.
6	Very low (or zero) probability that the defect will be detected.

Source (Rakesh R, Bobin Cherian Jos, George Mathew March 2013)

Table 4 Assessment for plastic injection molding machine using FMEA

4. Conclusion

The assessment carried out by FMEA consist of 45 failure category out of 45 % lies in moderate occurrence 31% lies is low occurrence 13 % high probability of occurrence and 5 % very high occurrence so proper measures have to be taken to reduce the probability of occurrence to very low in between 215 to 350. Controlling at the source, Substitution, Isolation, Re- engineering controlling along the path should be implemented

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ESTEMATES OF VARIABILITY, HERIITABILITY AND GENETIC ADVANCE IN GARLIC. *(ALLIUM SATIVUM L.)*GENOTYPES

NIRMALA KORANGA*

Abstract

The Spice Garlic is an important leading medicinal and remunerative crop in our economy. Garlic (Allium sativum L.) is an important condiment which is a most remunerative crop is an indian agriculture. It is a perinial bulbs crops. Generally grown as annual crop. Its grown in moderate temperature winter and summer are suitable for its cultivation. It is also used for getting relief from gastric troubles, paralysis etc.. The paper cover heritability and genetic advance amount traits of 15 diverse genotypes for two seasons. Objectives of the paper are Evaluative variability in garlic genotypes and to find out heritability and genetic advance in garlic genotype.

Keywords:

Genotype;
Heritability;
Variability;
Remunerative;
Condiment;
Allicium.

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1. Introduction

The spices crops have an important role in our economy. Garlic (allium sativum) is an important condiment which is a perennial bulbs crop, generally grown as annual corp. it grows well in moderate temperature, winter and summer are suitable for its cultivation. The chemical substance all in present in garlic gives antibiotic allicium which is obtained by an enzymatic dehydration process. Garlic is also used for getting relief from gastric troubles, headache, flatulence paralysis etc.

In spices garlic is an important leading medicinal and most remunerative crop in Indian Agriculture. Its importance is a long-felt need. Information on estimates of heritability and genetic advance expected after selection indicates the feasibility and extent to which improvement is possible for increasing production. Keeping this view and attempt was made to generate information and genetic variability, heritability and genetic advance among various traits of garlic. Fifteen diverse genotypes were evaluated for two seasons in 2002-2003 and 2003-04.

2. Research Method

Experiments were laid out in Randomized block design with their replications of 15 varieties of Garlic at C.S. University of Agriculture & Technology, Kanpur during 2002-03 and 2003-04. All plants were provided uniform cultural and plant protection measures. All morphological, growth, yield etc. parameters were Studied for deriving the results in 10 plants of each plot. Total bulb weight was measured in Kg and the statistical analysis was done for assessing the association ship of various qualitative and quantitative characters.

The material comprised of varieties under cultivation were, Kanpur local white globe, Krojovy-86, Patna white, R-2, Varanasi, Krajovy Recambal, Meeruty, while majesty, Pusa-1, white long, Kannaujia, Kurawali, White skinned and Faizabad. The experiments were laid out in randomized block design with three replications. Data recorded for 14 characters namely plant height, stren diameter, leaf diameter, leaf diameter, bulb length, bulb diameter.

3. Results and Analysis

Maximum diameter of bulb was found interlacement Kurawali Local (4.333 cm) in 2001-02 and 4.283 cm. in Meerut Local during 2003-04. In all promising results of these aspects, treatments Kurawali Local, Meerut Local, Mainpuri, Varanasi showed significant results. Number of cloves was found to be maximum 31.700 in Varanasi and 37.407 in IC 42891 treatment during first and second year of investigation respectively. The present findings are in conformity for the results obtained. Similar results have also been obtained by Das et atl. (1985) Maximum clove length was recorded 4.40 cm. in Varanasi and 4.417cm in IC 49381 during 2002-03 and 2003-04 respectively.

Maximum weight of clove was recorded in IC 49381 (3.567g.) and (3.500g) in 2002-03 and 2003-04, respectively. The minimum weight of clove was found 2 it 2.450g. Etawah Red skin during 2002-03. Whereas it was 2.867 g in Kalyanpur local during 2003-04. These findings are in accordance with results of Mehta and Patil (1985) Bhatal and Thakur (1988). Among all the treatments Varansi and kurawali local showed highly significant bulb yield during both the years of investigations. These results are in accordance with the findings of gations. The results are in accordance with the findings of Subrayandu et al. (1976) and Tr. Ippel and Chubrikovea (1976).

Table 1.1 Performances of Garlic Parameters

Varieties	Blub	Length (Cm)	Blub	dia (cm)	No. of cloves	Bulb
Bithoor Culture	**3.467**	**3.517**	**3.333**	**3.367**	**26.517**	**28.663**
IC-35265	**3.350**	**3.650**	**3.267**	**3.250**	**26.467**	**30.917**
IC- 35295	**3.517**	**3.537**	**3.317**	**3.183**	**28.733**	**29.550**
Taral Bold	**4.400**	**4.437**	**4.200**	**4.200**	**27.987**	**28.833**
Bagpat Red Skin	**3.883**	**3.550**	**3.250**	**3.317**	**23.000**	**23.450**
Etawah Red Skin	**3.507**	**3.333**	**3.317**	**3.167**	**20.837**	**21.767**
Basti-I	**3.133**	**2.830**	**2.760**	**1.667**	**19.74**	**17.700**
Kalyanpur Local	**4.057**	**3.567**	**3.617**	**3.483**	**21.457**	**21.990**
Meerut Local	**4.383**	**4.420**	**4.133**	**4.283**	**23.550**	**23.783**
Manpuri	**4.600**	**4.450**	**4.217**	**6.233**	**25.800**	**26.317**
Kurawali Local	**5.223**	**3.983**	**4.333**	**4.133**	**28.620**	**28.483**

Varanashi	**4.783**	**5.200**	**4.193**	**4.200**	**31.700**	**31.260**
IC-42891	**4.400**	**4.433**	**3.967**	**3.867**	**30.880**	**31.467**
IC-49381	**4.183**	**4.767**	**3.873**	**4.067**	**28.2873**	**30.583**
Local White	**4.933**	**4.350**	**4.033**	**3.873**	**30.553**	**29.703**

Table 1.2 Performances of Garlic Parameters

Clove	Length (Cm)	Clove	Dia (Cm)	Clove wt.	Blub	Yeld/ha
3.350	**3.267**	**0.447**	**0.483**	**3.517**	**28.767**	**28.717**
3.400	**3.150**	**0.460**	**0.483**	**3.387**	**27.500**	**28.450**
3.283	**3.383**	**0.433**	**0.400**	**3.067**	**26.833**	**28.883**
4.217	**4.057**	**0.350**	**0.443**	**0.033**	**26.200**	**26.850**
3.517	**3.250**	**0.367**	**0.407**	**2.833**	**24.467**	**23.837**
3.440	**3.183**	**0.340**	**0.320**	**2.450**	**25.447**	**23.940**
2.867	**2.433**	**0.333**	**0.340**	**2.387**	**27.067**	**21.450**
3.367	**3.300**	**0.340**	**0.343**	**2.563**	**27.067**	**21.490**
3.367	**3.110**	**0.333**	**0.397**	**2.800**	**28.417**	**28.500**
3.467	**3.517**	**0.336**	**0.383**	**3.217**	**29.217**	**29.517**
4.153	**4.183**	**0.451**	**0.437**	**3.083**	**31.233**	**31.677**
4.400	**4.267**	**0.453**	**4.450**	**3.403**	**31.417**	**31.533**
3.383	**3.920**	**0.450**	**0.513**	**3.450**	**30.833**	**29.617**
4.193	**4.417**	**0.473**	**0.533**	**3.567**	**30.200**	**28.117**
3.917	**3.617**	**0.550**	**0.497**	**3.383**	**29.533**	**29.767**

4. Conclusion

No. of cloves/bulb, clove length, diameter, weight, bulb yield/ha and time taken for clove, germination, revealed that stem diameter and bulb diameter showed highest heritability 97.975 and 97.548 per cent in 2002-03 and 2003-04 respectively. Leaf length and plant height revealed minimum heritability. Genetic advance was found maximum in number of cloves/bulb (70.207) and leaf length (7.542) and minimum in clove diameter (0.068, 0.067) during both years of investigations, respectively. The genotypic and phenotypic covariance ranged from 2.892-19.861 and 4,502-20.065 in stem diameter and leaf length, respectively.

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INSIGHT INTO THE STRUCTURAL ANALYSIS OF THE MAP KINASE PROTEIN FAMILY IN *ARABIDOPSIS THALIANA* (LINN.) HEYNH.

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B. Vibha**
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Abstract

Mitogen-activated protein kinases are important signaling tools in all eukaryotes, and function in mediating an enormous variety of external signals to appropriate cellular responses. In the present study, ten full-length amino acid sequences of MAP kinase from

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Keywords:

Mitogen-activated protein kinases;
Homology modeling;
Ramachandran plot;

Arabidopsis thaliana were collected and subjected to multiple sequence alignment (MSA), protein family identification, domain identification, and construct protein three-dimensional structures of the protein molecule. PFAM and Prosite scan studies define these proteins belongs to the protein kinase family and found protein kinase domain, and this domain belongs nucleotide binding domain family, Multiple Sequence Alignment and MEME software construct a regular expression of these proteins. We developed the structural molecular model of the MAP kinase proteins from *Arabidopsis thaliana* by homology modeling using the SWISS-MODEL online software. The energy of constructing models was minimized and the quality of the models was evaluated by PROCHECK and VERRIFY-3D. Resulted Ramachandran plot analysis showed that confirmations for 100.00% amino acids residues are within the most favored regions. These structures are finally submitted to Protein Model Database.

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1. Introduction

Plants have integrated signaling networks that mediate the concepts and reactions of hormones, nutrients and environmental stresses and which control the growth and development of plants (Gray, 2004). The current knowledge of our plant signal transduction routes came from the identification of sensors and receptors, which coordinate the signal, and transcription factors and reaction of the target gene (Kacperska, 2004). In the last few studies, it has become clear that mitogen active protein kinase (MAPK) cascades plays the most important role in plant signal transduction pathways from cell division to cell death (Taj et al., 2010).

MAPK cascades are evolutionary conserved signaling modules with vital regulatory functions, which include fungi, plants and animals. The recent rapture of plant MAPK cascade is supported by many studies, which show that the plant MAPKs are activated by pathogens and pathogen-derived elicitors, abiotic stresses, hormones and are also active in specialized phases during the cell cycle (Jonak et al., 2002). Recent studies of MAPK cascades studies in plants were centered on cDNA cloning and used a MAPK in-gel assay, MAPK and tyrosine-phosphate antibodies, and kinase inhibitors to connecting signal to MAPKs (Zhang et al., 2006). The *Arabidopsis thaliana* (At) genome sequence gives a new opportunity to identify and isolate the large gene families encoding MAPKs and their immediate upstream regulators (Ausubel et al., 2002). A mitogen activated protein kinase cascade minimally consists of three kinases such as MAPKKK, MAPKK and MAPK. These proteins perform their functions by protein-protein interaction and post translational modifications. Signalling through MAPK is a fundamental and conserved process in eukaryotes and transduce external signals through protein phosphorylation (Nakagami et al., 2006). The prediction of protein-protein interactions is an important step toward the elucidation of protein functions and the understanding of the molecular mechanisms inside the cell. MAPKs are protein Ser/Thr kinases that convert

extracellular stimuli into a wide range of cellular responses (Cargnello and Roux, 2011). Earlier studies suggested that, MAPKs regulate different types of processes including abscission, stomatal and ovuled evelopment, signals for various abiotic stresses, and defense responses against bacterial and fungal pathogens (Pitzschke et al., 2009).

2. Research Method

Sequences of MAP kinase proteins of *Arabidopsis thaliana* were retrieved from the SWISSPROT, a public domain protein database (Bairoch, 2000). Table 1 shows the protein sequences considered in this study. The MAP kinase amino acid sequences were retrieved in FASTA format and used for further analysis.

Table 1. Protein sequences considered for the study

S.No.	Accession no.	MAP Kinase	Length
1	Q39021	MAPK-1	370
2	Q39022	MAPK-2	376
3	Q39023	MAPK-3	370
4	Q39024	MAPK-4	376
5	Q39025	MAPK-5	376
6	Q39026	MAPK-6	395
7	Q39027	MAPK-7	368
8	Q9LM33	MAPK-8	589
9	Q9LV37	MAPK-9	510
10	Q9M1Z5	MAPK-10	393

Sequence analysis of the considered protein sequences

A set of ten potential protein sequences from *Arabidopsis thaliana* was used as the preliminary data. An initial alignment generated by CLUSTRAL W and functional characterization was of all ten protein was done through PFAM and PROSITE Scan.

Comparative Modeling:

The method of comparative modeling requires for the identification of homologous sequences with known structure. The first step of comparative modeling is scanning and selection of template protein structure using the target sequence as query (Berman et al., 2000). BLASTp is generally used for template selection procedure (Johnson et al., 2008). The output of BLASTp for potential templates was showing in **Table 2**. Ten models were constructed through MODELLER 9v10 (John and Sali, 2003) for each protein sequence. MODELLER implements comparative protein modeling by satisfaction of spatial restraints.

Analysis of the model:

The several models generated through Modeller for the same target and the best model selected for further analysis. We evaluated the model with the lowest value of the Modeller objective function and PROCHECK statistics (Laskowski et al., 1993). The overall stereo-chemical quality of the models for MAP kinase checked through Ramachandran's map calculation it was computed through the Structure Analysis and Verification Server (PROCHECK and VERIFY-3D) program that is available on National Institute of Health (NIH) server (http://services.mbi.ucla.edu/SAVES/) (Eisenberg et al., 1997).

Table 2: Summary of the best template sequence profile that was generated through BLASTp

S.No	Name of Protein	PDB ID	Identities	E. Value	Score
1	MPK-1	pdb|3TEI|A	172/341(50%)	3e-114	341bits(857)
2	MPK-2	pdb|3TEI|A	173/336(51%)	2e-114	341bits(857)
3	MPK-3	pdb|4IC7|A	179/343(52%)	7e-119	355bits(912)
4	MPK-4	pdb|4IC7|A	188/366(51%)	1e-124	370bits(951)
5	MPK-5	pdb|3TEI|A	177/346(51%)	3e-117	349bits(895)
6	MPK-6	pdb|289F|A	167/304(55%)	7e-117	333bits(854)
7	MPK-7	pdb|3TEI|A	163/341(48%)	7e-117	332bits(852)
8	MPK-8	pdb|4IC7|A	169/348(49%)	3e-106	331bits(848)
9	MPK-9	pdb|4IC7|A	165/348(47%)	1e-103	322bits(824)
10	MPK-10	pdb|3TEI|A	177/346(51%)	1e-115	345bits(886)

Visualization and structural analysis

Visualization and Structural analysis of the final protein model was carried out through PyMol software (DeLano, 2002). 3dSS (Sumathi et al., 2006) and CHIMERA (Pettersen et al., 2004) were used for the structural alignment and RMSD calculation with model and template protein structure.

Table 3: Ramachandran Plot Results

Regions	MAPK-1	MAPK-2	MAPK-3	MAPK-4	MAPK-5	MAPK-6	MAPK-7	MAPK-8	MAPK-9	MAPK-10
Fully Allowed Region	81.52%	80.48%	77.99%	77.01%	80.48%	79.64%	81.42%	72.40%	67.72%	81.33%
Additionally Allowed Region	14.13%	13.64%	15.76%	16.84%	14.44%	15.27%	13.66%	18.23%	20.08%	14.07%
Generously Allowed Region	3.26%	4.28%	4.08%	3.74%	3.21%	03.56%	03.28%	6.67%	6.50%	02.30%
Outside Region	1.09%	1.60%	02.17%	2.41%	1.87%	01.53%	01.64%	2.90%	5.71%	02.30%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 4: Comparison of model validation from different server

	MAPK-1	MAPK-2	MAPK-3	MAPK-4	MAPK-5	MAPK-6	MAPK-7	MAPK-8	MAPK-9	MAPK-10
Prosa (z-score)	-7.77	-7.93	-8.7	-8.26	-8.40	-7.95	-7.91	-6.64	-5.02	-8.59
Verify 3D	82.70%	84.04%	82.70%	87.23%	82.98%	70.00%	72.55%	69.61%	74.71%	84.22%

Physico-chemical characterization

For physio-chemical characterization theoretical pI (isoelectric point), molecular weight, -R and +R (total number of

positive and negative residue), EI (extinction coefficient) (Gill and von Hippel, 1989), II (instability index) (Guruprasad et al., 1990), AI (aliphatic index) (Ikai, 1980), and GRAVY (grand average hydropathy) (Lesh et al., 2012) were computed using the Expasy's ProtParam server (Gasteiger et al., 2005) for set of proteins (http://us.expasy.org./tools/protparam.html), and the results are shown in **Table 5**.

Table 5: Physio-chemical properties of MAP kinase proteins in *Arabidopsis thaliana* by protparam tool

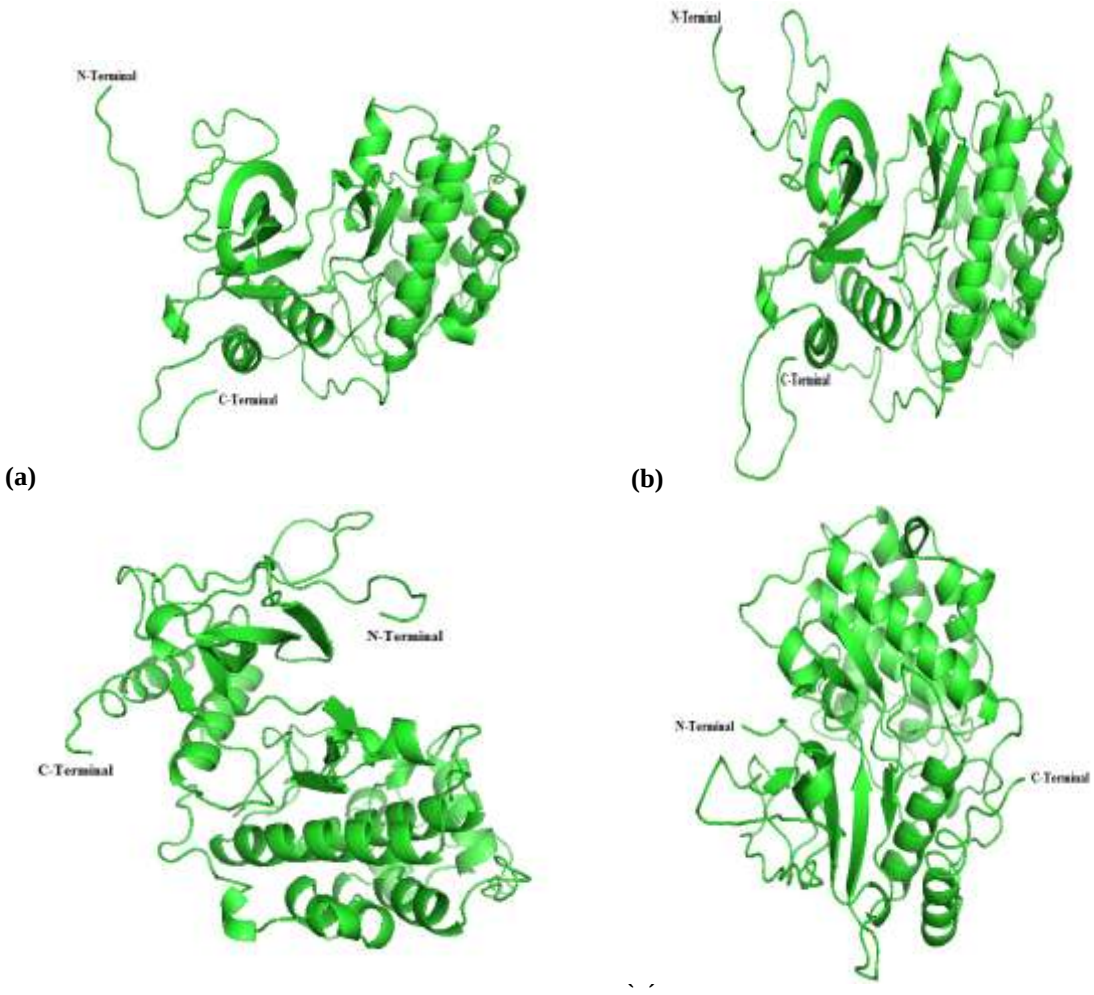
Protein	Seq. Len	MW	pI	+(R)	-(R)	EC	II	AI	Gravy
MAPK-1	370	42644.4	6.50	41	44	47330	43.02	98.27	-0.215
MAPK-2	376	43124.7	6.19	47	47	46340	41.46	97.47	-0.233
MAPK-3	370	42716.8	5.61	37	49	33725	36.92	89.89	-0.349
MAPK-4	376	42851.7	5.74	42	50	36830	42.13	88.40	-0.333
MAPK-5	376	43207.4	5.61	43	54	42205	39.79	94.60	-0.248
MAPK-6	395	45057.5	5.28	38	54	35215	49.19	90.20	-0.282
MAPK-7	368	42298.9	6.86	41	42	46340	38.00	97.47	-0.211
MAPK-8	589	66231.4	6.09	74	84	47580	43.98	77.35	-0.541
MAPK-9	510	58394.5	8.54	71	67	46550	37.49	80.53	-0.527
MAPK-10	393	45174.4	4.93	40	61	39225	43.31	90.81	-0.323

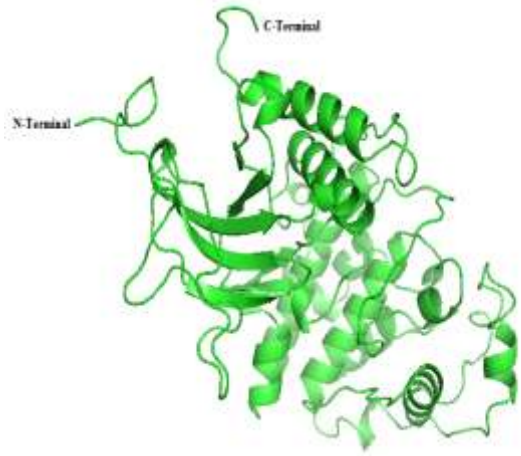
3. Results and Analysis

The primary structure analysis of different flavor of MAP kinase enzyme was calculated in Table 5 since the isoelectric point (pI), solubility is minimized and mobility in an electro focusing system is zero that's why calculated pI will be useful. Isoelectric point (pI) is the pH at which the surface of the protein is covered by the charge, but the net charge of the protein is zero. At pI, protein is stable and dense. For processing buffer system for purification by isoelectric focusing method, the computed isoelectric point (pI) will be valuable. While Expasy's Protparam computes the extinction coefficient of 276, 278, 279, 280 and 282 nm wavelengths, 280 nm has been elected since protein absorb light strongly. Extinction coefficient of MAP kinase enzyme of *Arabidopsis thaliana* at 280 nm was 47330, 46340, 33725, 36830, 42205, 35215, 46340, 47580, 46550 and 39225 $M^{-1}cm^{-1}$. The computed extinction coefficient can help in the quantitative study of protein-protein and protein-ligand interaction in solution. The instability index provides and determine of the stability of protein in a test-tube. There are definite dipeptides, the occurrence of which is particularly divergent in the unstable protein compared with those in the stable once. This method assigned a weight value of instability, which is feasible to compute an instability index (II). A protein whose instability index is slighter than 40 is estimated as stable, a value above 40 estimates that the protein may be unstable. The instability index of MAPK-1, 2, 4, 6, 8 and 10 was found above than 40 such as 43.02, 41.46, 42.13, 49.19, 43.98 and 43.31, which indicates that the protein is unstable and MAPK-3, MAPK-5, MAPK-7 and MAPK-9 was found less than 40 such as 36.92, 39.79, 38.00 and 37.49, which indicates that the protein is stable. The aliphatic index (AI) is elucidated as the relative volume of a protein occupied by aliphatic side chains (A, V, I and L) is estimated as a positive factor for the increase of the thermal stability of globular proteins. Aliphatic index (AI) for the MAPK enzyme was 98.27, 97.47, 89.89, 88.40, 94.60, 90.20, 97.47, 77.35, 80.53 and 90.81. A very high aliphatic index of the protein sequence indicates that the protein may be stable for a vast temperature range. The minimal thermal stability of protein was indicative of a more flexible structure when compared to other protein. The

Grand Average hydropathy (GRAVY) value for a peptide or protein is calculated as the sum of hydropathy values of all the amino acids, divided by the number of residues in the sequence. A GRAVY index of different MAPK enzyme was calculated such as -0.215, -0.233, -0.349, -0.333, -0.248, -0.282, -0.211, -0.541, -0.527 and -0.323. This low value shows the probability of better interaction with water.

Comparative Modeling is a very effective method of generating the 3D structure of a protein for which experimental (X-rays crystallographic or NMR) structure is not available but the crystal structure of homologue is available. Then by making use of this template the 3D structure of the protein of interest was generated through homology modeling based method (Kumar Verma et al., 2013). For homology modeling of MAPK from *Arabidopsis thaliana*, BLAST (Basic Local Alignment Search Tool) scanning results had revealed identical with crystallographic structure showing in Table 2, while the template was determined based on higher sequence identity. Comparative modeling predicts the three dimensional structure of hypothetical model of a given protein sequence (target), based primarily on this alignment to the template. The resulting 3-D structure of MAP kinase was sorted according to the score calculated from discrete optimization, protein (DOPE) scoring function. The final model, which has lowest root mean square deviation (RMSD), relative to the trace of the crystal structure, was selected for further study.

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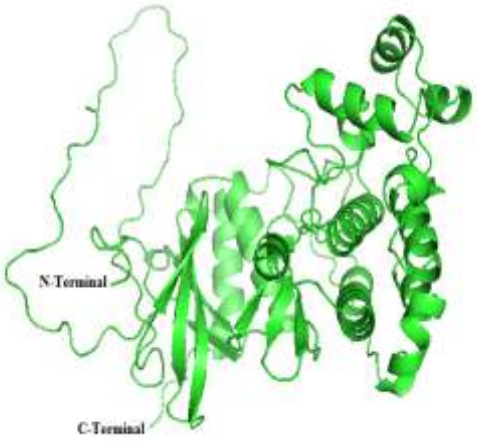
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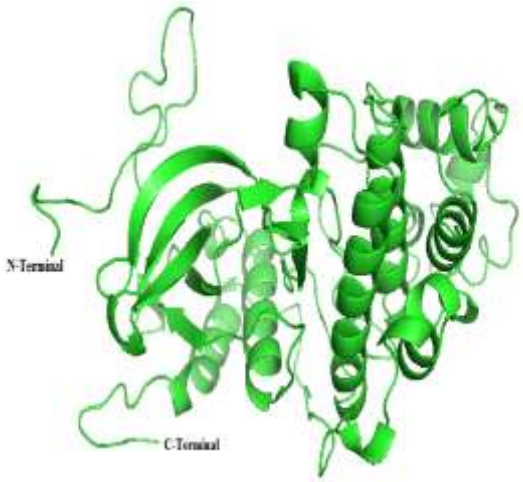
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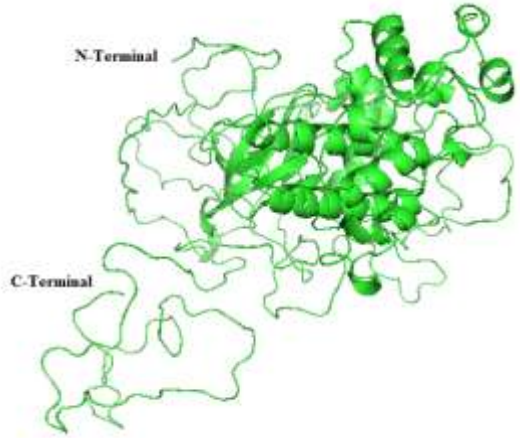
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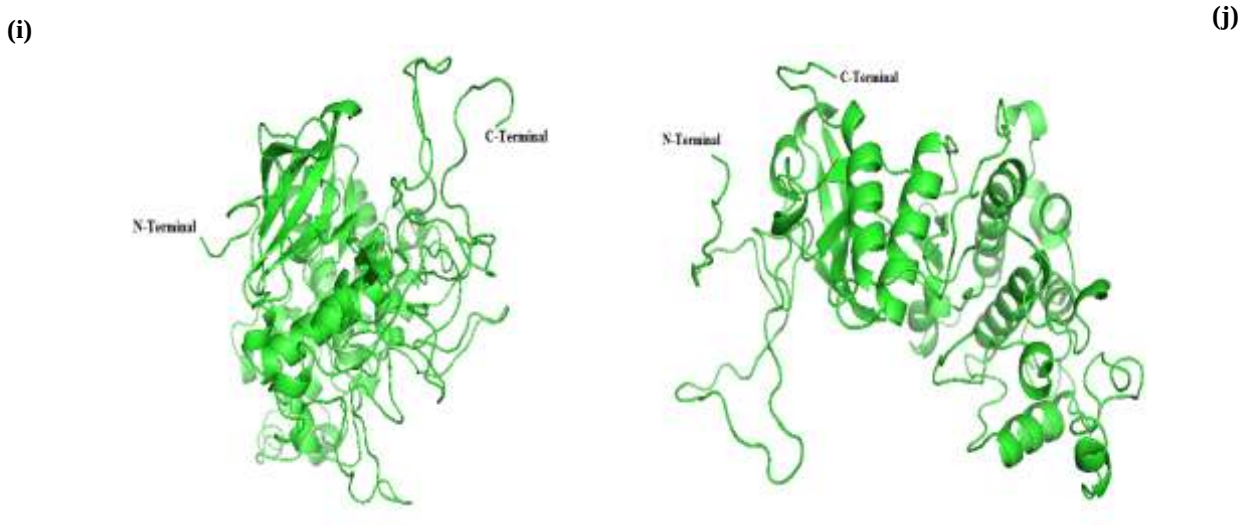

Figure: Homology model of MAP Kinase enzyme (a) Model structure of MAPK-1 (b) Model structure of MAPK-2 (c) Model structure of MAPK-3 (d) Model structure of MAPK-4 (e) Model structure of MAPK-5 (f) Model structure of MAPK-6 (g) Model structure of MAPK-7 (h) Model structure of MAPK-8 (i) Model structure of MAPK-9 and (j) Model structure of MAPK-10

The model quality assessment was done using procheck, prosa and verify-3d tool. The Ramachandran plot (figure) using procheck tool evaluated the detailed residue-by-residue stereo-chemical quality of the modeled protein structure. The reliability of the backbone torsion angle Φ and Ψ distribution of the protein and the template was evaluated by the Ramachandran plot in Procheck tool. The receive Ramachandran plot calculation for all three-dimensional structures were showing in Table 3. The packing quality of each residue of the model was assessed by Verify-3D program where the compatibility of the model residue with their environment is assessed by score function. Residue with a 3D-1D score of >0.2 should be considered reliable. As shown in Table 4; the score of the refined model is 82.70%, 84.04%, 82.70%, 87.23%, 82.98%, 70.00%, 72.55%, 69.61%, 74.71% and 84.22% of the residues had an averaged 3D-1D score. ProrSA revealed a Z-score of -7.77, -7.93, -8.7, -8.26, -8.40, -7.95, -7.91, -6.64, -5.02 and -8.59 for modeled protein.

The functional characterization of the protein includes protein domain and family, prediction of MAP kinase by Pfam and prosite scan, revealed one protein family protein kinase Table 6. A prosite scan search of MAPK protein revealed which domain, NP binding site, binding site and active site Table 7.

Table 6: Identification of protein family

S.No	UID	Protein	PFAM		
			Family Description	Envelop	
				Start	End
1	Q39021	MAPK-1	Protien kinase domain	32	319
2	Q39022	MAPK-2	Protien kinase domain	50	335
3	Q39023	MAPK-3	Protien kinase domain	41	324
4	Q39024	MAPK-4	Protien kinase domain	44	329
5	Q39025	MAPK-5	Protien kinase domain	44	329
6	Q39026	MAPK-6	Protien kinase domain	100	383

7	Q39027	MAPK-7	Protien kinase domain	32	319
8	Q9LM33	MAPK-8	Protien kinase domain	104	395
9	Q9LV37	MAPK-9	Protien kinase domain	23	314
10	Q9M1Z5	MAPK-10	Protien kinase domain	42	325

Table 7: **Functional Characterization of MAP kinase protein in *Arabidopsis thaliana* at Prosite**

S.No	UID	Protein	Prosite Scan			
			Domain	NP Binding	Binding site	Active site
1	Q39021	MAPK-1	IGRGAYGVV(32-319)	IGRGAYGVV(38-46)	K(61)	D(158)
2	Q39022	MAPK-2	IGRGAYGVV(32-319)	IGRGAYGVV(38-46)	K(61)	D(158)
3	Q39023	MAPK-3	IGRGAYGIV(38-324)	IGRGAYGIV(44-52)	K(67)	D(164)
4	Q39024	MAPK-4	IGRGAYGIV (43-329)	IGRGAYGIV(49-57)	K(72)	D(169)
5	Q39025	MAPK-5	IGRGAYGFV(43-329)	IGRGAYGFV(49-57)	K(72)	D(169)
6	Q39026	MAPK-6	IGKGAYGIV(63-348)	IGKGAYGIV(69-77)	K(92)	D(189)
7	Q39027	MAPK-7	IGRGAYGVV(32-319)	IGRGAYGVV(38-46)	K(61)	D(158)
8	Q9LM33	MAPK-8	VGKGSYGVV(104-395)	VGKGSYGVV(110-118)	K(133)	D(230)
9	Q9LV37	MAPK-9	IGKGSYGVV(23-314)	IGKGSYGVV(29-37)	K(52)	D(149)
10	Q9M1Z5	MAPK-10	IGRGACGIV(60-345)	IGRGACGIV(69-74)	K(89)	D(186)

4. Conclusion

In this study, we have evaluated structural analysis of MAP kinase enzyme through homology modeling. First, we construct three-dimenssional structure of different flavor of MAP kinase protein using the comparative modeling approach. Secondaly, we determined their physiochemical characteristics of protein by different parameter like as isoelectric point, molecular weight, total number of positive and negative residue, extinction coefficient, instability index, aliphatic index and grand average hydropathy (GRAVY). This study will be helpful to investigate the hormonal distruption studies.

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CONVERSION OF WASTE PLASTICS TO VALUABLE HYDROCARBON PRODUCTS

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Mohammed, S.[***]
Mandal, C.[****]

Abstract

Plastics have though entwined their way into our everyday lives nonetheless posing a tremendous threat to the environment. The MoEF and Climate Change report of 2016 stresses that in India 15000 tons of plastic waste is engendered every year. This paper emphasizes the conversion of waste plastic into value added fuels,

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Keywords:

Cracking;
HDPE;
LDPE;
Pyrolysis;
Economic development.

which is being elucidated as a practical solution for reutilizing of plastics. Under anaerobic cracking process, plastic can be decomposed into 3 fractions: gas, liquid & solid residue. The present paper describes the pyrolysis method for conversion of plastic waste into useful gasoline and gas-oil range hydrocarbons containing more of olefins, aromatics and naphthenes than paraffins. The products obtained from catalytic cracking resulted better overall yields, characteristics & more stability than the products by thermal cracking. The waste plastic feed mixture consisting of High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE) was cracked for the study. The conversion of plastic waste to liquid hydrocarbons can be used as a source of energy and/or as a feedstock for petrochemicals. The present work will also play a significant role in enhancing social, environment & health benefits and also in economic development in the energy sector of 21st century.

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1. INTRODUCTION

Pyrolysis is a chemical reaction involving molecular breakdown of larger molecules into smaller molecules in the presence of high temperature. Pyrolysis has been derived from two Greek words "pyro" meaning fire and "lysis" meaning separating. Pyrolysis, a type of thermolysis, is a high temperature reaction that involves irreversible simultaneous change of chemical composition and physical phase of organic material. It is one of the processes involved in charring wood, in absence of oxygen for the synthesis of coal, starting at 200–300°C (390–570°F).[1][3]
The synthetic plastic made from a wide range of organic polymers such as polyethylene, poly vinyl chloride, nylon, etc., can be precast into various shapes, in softer state, and then set into a rigid or slightly elastic state. An important property attributed to plastics is plasticity, which is the general property of the materials to irreversibly deform without breaking. Polymers of plastic are often made up of carbon and hydrogen and sometimes of oxygen, nitrogen, sulfur, chlorine, fluorine, phosphorous, or silicon. [2]

Thermoplastics, thermosets and bio-plastics are the 3 forms of plastic, among which thermoplastic gets soften when heated and harden on cooling. Greater than 80 % of plastics are thermoplastics that include: High density polyethylene (HDPE), Low density polyethylene (LDPE), Polyethylene terephthalate (PET), Polypropylene (PP), Polyvinyl chloride (PVC). [2] Thermosets are hardened through curing process and cannot be re-melted or re-molded. Thermosets includes: Polyurethane (PU), Epoxy, Phenolics and Unsaturated polyesters. [2] Bio-plastics can be produced by conversion of plant sugar and from plastics grown in micro-organisms, corn and other crops [2]

Central Pollution Control Board (CPCB) in 2016 reported that the packaging and polyvinyl chloride (PVC) pipe industry is growing at the rate of 16-18% per year. We use different kind of plastics goods in our daily life and its demand is rapidly increasing from domestic to industrial use. The demand for the plastic goods is rising at the rate of 22% per year. According to the plastic production data of 2014-15, 6533.157 thousand metric tons was produced.

The National consumption of plastic is as shown in Table 1 from the year 1996 to 2007. The domestic consumption is expected to touch 20 million Metric tons by 2020. [5], [8]

Table 1

S. No.	Year	Consumption (Tons)
1.	1996	61,000
2.	2000	3,00,000
3.	2001	4,00,000
4.	2007	8,500,000

Source: Central Pollution Control Board

According to plastic and polymers industry, the per capita consumption of plastic in India doubled from 4 kg in 2006 to 8 kg in 2008 and 12 kg in 2016, and globally it would touch an average of 27 kg per person by 2020. Among the factors driving the consumption growth of plastics is increasing in packaging, infrastructure, agriculture, automotive, healthcare and FMCG segments. [6], [8]

Although plastics have become increadible commodities in our daily life providing enormous economic benefits to the society, the non-biodegradability of it has made their disposal a serious environmental concern. The littering of these wastes has resulted in a general deterioration of hygiene in urban areas as well as threat to the biodiversity both on land and marine region.

The present paper highlights the method by which waste plastics like polyethylene and polypropylene accounting 60 % of the plastics being consumed can be converted into gasoline, diesel or aromatics. The method is totally environment friendly as there is no formation of toxic substances. The method has the potential of supplementing the high value petroleum products as well as providing an environment friendly disposal method and the adoption of this method can help in keeping the urban and semi-urban areas free from plastics. [7]

2. EXPERIMENTAL PROCEDURE

Figure 1: Fabricated Reactor (Photo Captured In Lab)

Firstly, the reactor was assembled, insulated properly with asbestos sheets and insulation ropes to minimize the heat losses as shown in Figure 1. Initially, the temperatures profile was worked out to set the maximum temperature of the reactor to 500°C by regulating the voltage from the dimmer stat at 160 V. Thus, the maximum temperature of reactor under different conditions of voltage and time was obtained. The data obtained during this calibration was utilized for controlling the reactor temperature and maintaining it during the actual operation run. The reactor was then subjected to trial runs for optimizing the process parameters.

Three sets of experiments were performed at 480^0C temperature with mixed plastic feed consisting of HDPE and LDPE as shown in Figure 5. The first set was carried out without any catalyst, the second set was carried in the presence of porcelain beads as shown in Figure 6 and the third set with copper mesh as shown in Figure 7. It was observed that the condenser did not require low temperature cooling, as the vapours started solidifying at room temperature by itself in the first two experimental sets except the third experimental set. As a result, water condensers were used for cooling the vapour products from the third set of experiment. The 1^{st} air condenser was maintained at higher temperature while the 2^{nd} condenser was maintained at room temperature which was followed by an optional water condenser. This type of cooling arrangement helps in collecting the products properly. The experimental setup is as shown in Figure 2.

Figure 2: Reactor assembly

Inference:

The experiment took 45 minutes on an average to reach the reaction temperature of 480°C once the heater was started. The product was collected from the condenser line. The operation continued until an appreciable amount of product was collected. When the vapors stopped coming out of the reactor, the heating was stopped.
It was observed that very high pour point products were obtained. Even at the room temperature this product appeared to be waxy in nature.
The products obtained from all the three experiments were waxy in nature and were then subjected to simple distillation while closely monitoring the distillation temperatures and appearance of the material in the distillation flask. When the material in the distillation flask appeared little darker and thicker, the heating was stopped, and the flask was allowed to cool. The distillate collected was clean yellowish liquid product and the material left in the flask looked like grease. The distillate was also subjected to fractional distillation to recover gasoline range and gas-oil range hydrocarbons.
The simple distillation assembly arranged is as shown in the Figure 3:

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Figure 3: Simple distillation assembly (photo captured in lab

The difference in the appearance of the raw product, distilled product and greasy residue is as shown in Figure 4.

Figure 4: Product before and after distillation and greasy residue obtained

The distilled products obtained from the fractional distillation of all three sets of experiments were subjected to tests such as ASTM distillation, Aniline point, Pour point, Conradson Carbon Residue, Redwood and Kinematic viscosity, API gravity, Flash and Fire point, Bromine number, etc, for determining the characteristics of the products obtained as depicted in Table 2 for Cracked Product, Table 3 for Gasoline fraction and Table 4 for Gas oil fraction and were compared with the ASTM standards as shown in Table 5 and 6 for Gasoline and Gas oil fractions respectively.

3. RESULTS AND DISCUSSION

A. First set of experiment - Thermal Cracking:
Material Balance (Overall weight basis):

Feed: 350 gm HDPE flakes + 50 gm LDPE flakes
Total recovery in ml - 370 ml from 400 gm feed
Total recovery in gm - 352 gm liquid product from 400 gm feed
FEED = LIQUID PRODUCT + (VAPOUR LOSSES + RESIDUE)
400 gm = 352 gm + 48 gm
The distillate obtained had boiling range (44- 372^{o}C) in ASTM distillation.

Figure 5: Raw Feed (HDPE + LDPE)

Temperature (^{o}C)	% Distillate
44	IBP
105	10
125	20
160	30
194	40

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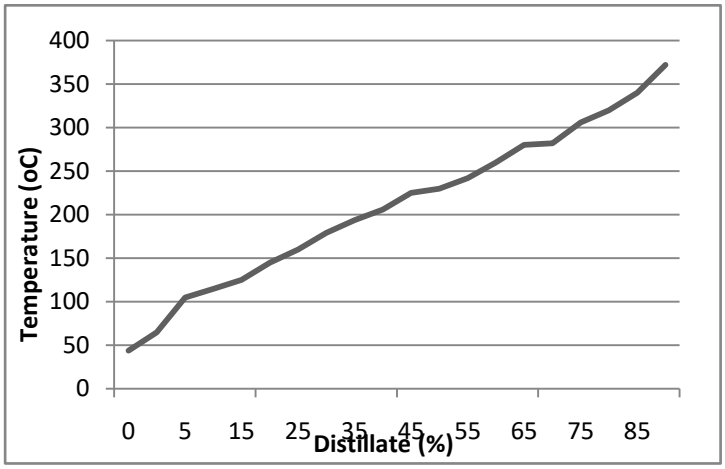
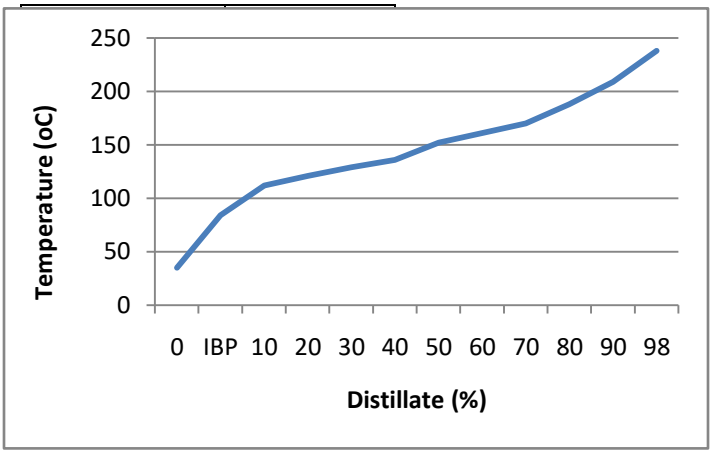


206	50
230	60
260	70
282	80
320	90
372	94

Graph 1: ASTM Characteristics of Thermal product

Gasoline:

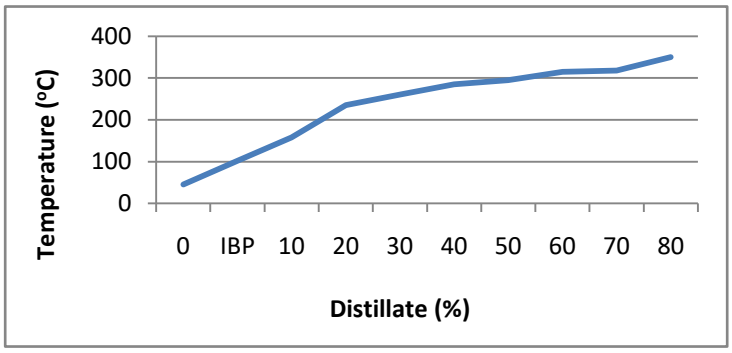
The Gasolinefraction obtained was pale yellow in colour and in the boiling range 35-209^{o}C



Graph 2: ASTM Characteristics of Thermal Gasoline

Gas oil

The gas oil fraction obtained was reddish yellow in colour and in the boiling range 45-350^{o}C.



Temperature (^{o}C)	% Distillate
45	IBP
102	10
158	20
235	30
260	40
285	50
295	60
315	70
318	80
350	83

Graph 3: ASTM Characteristics of Thermal Gas oil

B. Second set of experiment – Cracking in presence of porcelain beads

Material Balance (Overall weight basis):

Feed: 350 gm HDPE flakes + 50 gm LDPE flakes

Catalyst: 60 gm acid activated porcelain beads.

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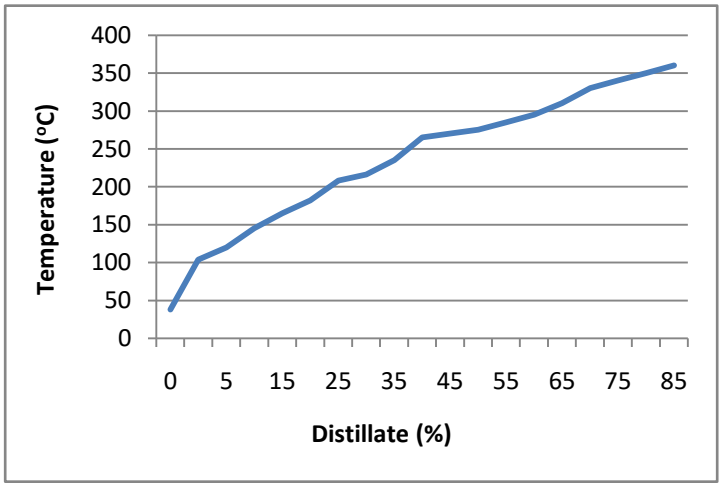
Figure 6: Porcelain Beads

Total recovery in ml - 400 ml from 400 gm feed
Total recovery in gm - 380 gm liquid product from 400 gm feed
The distillate obtained was of boiling range (38- 350°C) in ASTM distillation.

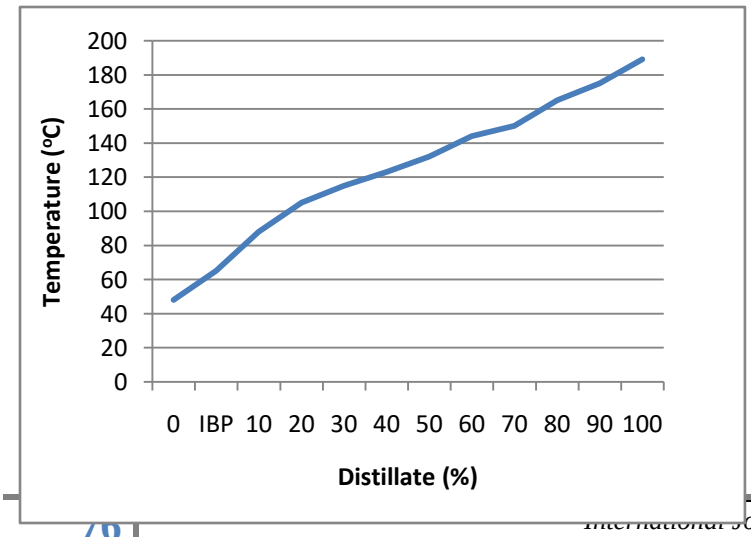


Temperature (°C)	% Distillate
38	IBP
120	10
165	20
208	30
235	40
270	50
285	60
295	70
330	80
350	85

Graph 4: ASTM Characteristics of Porcelain product

Gasoline

The Gasolinefraction obtained was pale yellow in color and in the boiling range 48-189°C



Graph 5: ASTM

Temperature (°C)	% Distillate
48	IBP
65	10
88	20
105	30
115	40
123	50
132	60
144	70
150	80
165	90
175	95
189	96

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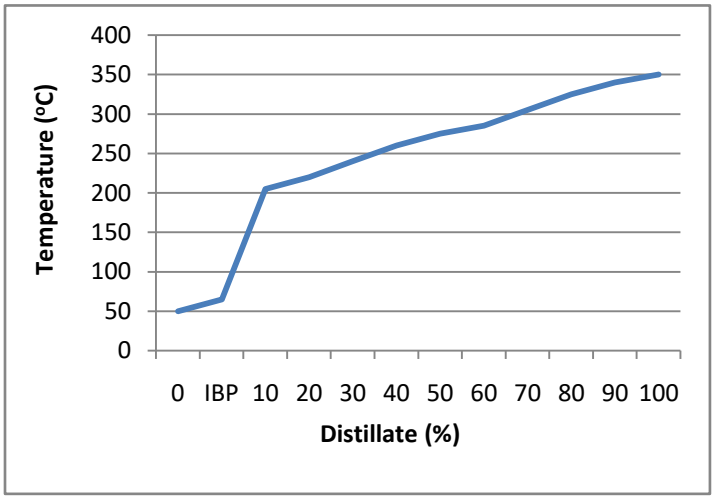
Characteristics of Porcelain Gasoline

Gas oil

The gas oil fraction obtained was reddish yellow in color and in the boiling range 50-340°C.



Temperature (°C)	% Distillate
50	IBP
65	10
205	20
220	30
240	40
260	50
275	60
285	70
305	80
325	90
340	95

Graph 6: ASTM Characteristics of Porcelain Gas Oil

C. Third set of experiment – Cracking in presence of Copper mesh
Material Balance (Overall weight basis):
Feed: 350 gm HDPE flakes + 50 gm LDPE flakes
Catalyst: Total 6 meshes of acid activated copper of 10 gm each.

Figure 7: Copper Mesh

Total recovery in ml - 420 ml from 400 gm feed
Total recovery in gm - 399 gm liquid product from 400 gm feed
FEED = LIQUID PRODUCT + (VAPOUR PRODUCT + RESIDUE)
400 gm = 399 gm + 1 gm

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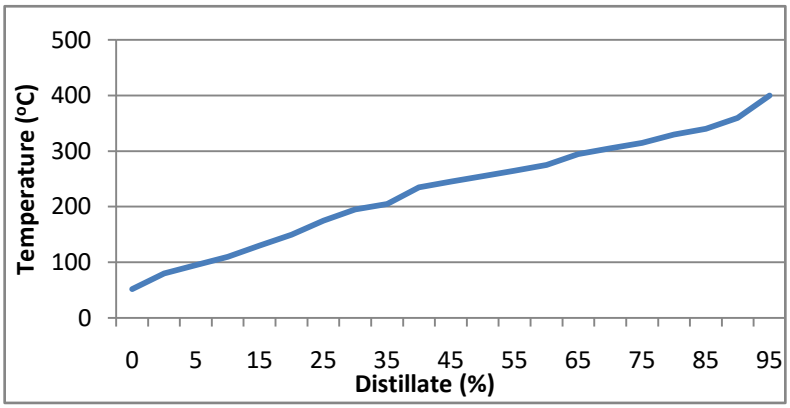
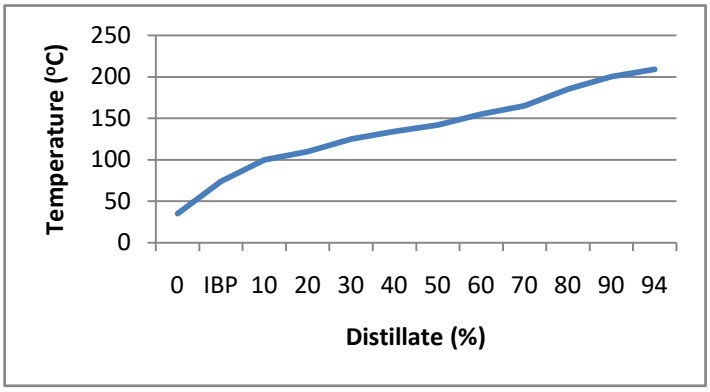
In this procedure, the yield obtained is 99.75 % i.e. 399 g.
The distillate obtained was of boiling range (52- 360°C) in ASTM distillation.



Temperature (°C)	% Distillate
52	IBP
80	10
110	20
150	30
195	40
235	50
255	60
275	70
305	80
330	90
360	95

Graph 7: ASTM Characteristics of Copper product

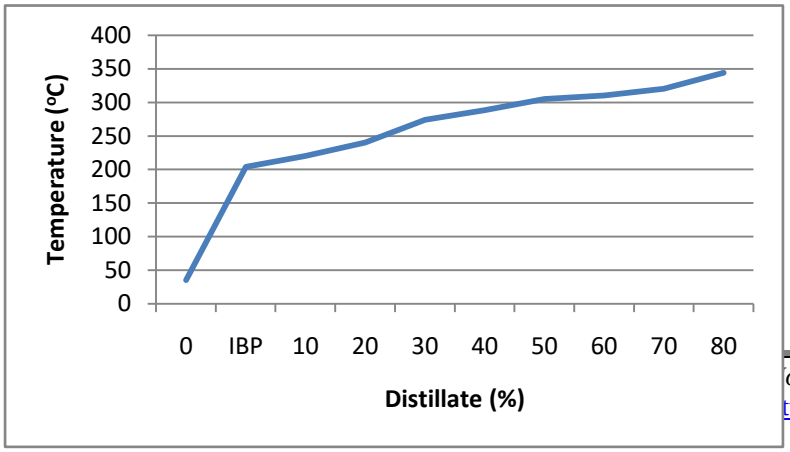
Gasoline
The Gasolinefraction obtained was pale yellow in color and in the boiling range 35-209°C



Temperature (°C)	% Distillate
35	IBP
74	10
100	20
110	30
125	40
134	50
142	60
155	70
165	80
185	90
209	94

Graph 8: ASTM Characteristics of Copper Gasoline

Gas oil
The gas oil fraction obtained was reddish yellow in color and in the boiling range 35-344°C.



Graph 9: ASTM Characteristics of Copper Gas oil

Temperature (^oC)	% Distillate
35	IBP
204	10
220	20
240	30
274	40
288	50
305	60
310	70
320	80
344	82

CHARACTERISTICS OF PRODUCTS OBTAINED FROM THREE SETS OF EXPERIMENTS

Table 2 : Cracked Product

Sr no.	Test Properties	Thermally Cracked	Porcelain Catalyst	Copper Catalyst
1	Colour	Black	Reddish Brown	Yellowish Brown
2	Density (g/cm^3)	0.7944 (33^oC)	0.7856 (32^oC)	0.7729 (36^oC)
3	Specific Gravity	0.8548 (33^oC)	0.7763 (32^oC)	0.7637 (36^oC)
4	API Gravity (^{o}API)	34.0310 (33^oC)	50.7749 (32^oC)	53.7699(36^oC)
5	Viscosity (cst)	5.1465 (34^oC)	3.6255 (31^oC)	3.324(32^oC)
6	CCR (%)	0.375	0.001	0
7	Pour Point (^oC)	13	10	19
8	Cloud Point (^oC)	17	19	25.5
9	Flash Point (^oC)	75	35	35
10	Aniline Point (^oC)	80	80	56
11	Copper Corrosion Characteristics	Not worse than 1a	Not worse than 1a	Not worse than 1a
12	TAN (mg KOH/g sample)	1.0601	0.7886	1.0549
13	Bromine Number	9.4653	9.9577	9.7828
14	Drop melting point of distillation residue (^0C)	54	54	51

Table 3: Gasoline Fraction

Sr no.	Test Properties	Thermally Cracked	Porcelain Catalyst	Copper Catalyst
1	Density (g/cm^3)	0.7561 (34^oC)	0.7538 (33^oC)	0.7519 (35^oC)
2	Specific Gravity	0.8292 (34^oC)	0.8287 (33^oC)	0.8266 (35^oC)

3	API Gravity (^{o}API)	39.1454 (34^{o}C)	39.2517 (33^{o}C)	39.6831(35^{o}C)
4	Viscosity (cst)	0.7215 (34^{o}C)	0.7085 (32^{o}C)	0.6851 (35^{o}C)
5	Pour Point (^{o}C)	Not obtained upto -25^{o}C	Not obtained upto -25^{o}C	Not obtained upto -25^{o}C
6	Cloud Point (^{o}C)	5.4	3	2
7	Flash Point (^{o}C)	35	35	35
8	Copper Corrosion Characteristics	Not worse than 1a	Not worse than 1a	Not worse than 1a
9	TAN (mg KOH/g sample)	1.0617	0.7854	1.0511
10	Bromine Number	17.0762	16.6829	17.088

Table 4: Gas Oil Fraction

Sr no.	Test Properties	Thermally Cracked	Porcelain Catalyst	Copper Catalyst
1	Density (g/cm^3)	0.8126 (34^{o}C)	0.8109 (33^{o}C)	0.8095 (35^{o}C)
2	Specific Gravity	0.8670 (34^{o}C)	0.8666 (33^{o}C)	0.8651 (35^{o}C)
3	API Gravity (^{o}API)	31.7194 (34^{o}C)	31.7825 (33^{o}C)	32.8023 (35^{o}C)
4	Viscosity (cst)	3.5335 (34^{o}C)	3.3572 (33^{o}C)	3.2178 (35^{o}C)
5	CCR (%)	0.351	0.231	0.112
6	Pour Point (^{o}C)	25	19	17
7	Cloud Point (^{o}C)	32	25.5	24.7
8	Flash Point (^{o}C)	35	39	39
9	Aniline Point (^{o}C)	83	59	54
10	Copper Corrosion Characteristics	Not worse than 1a	Not worse than 1a	Not worse than 1a
11	TAN (mg KOH/g sample)	1.047	0.5257	1.065
12	Bromine Number	9.7721	9.3961	9.4463

Figure 8: Final products as obtained from the experiment

The figure above shows the following product (from left to right):

- Obtained from Copper Mesh
  1. Crude oil
  2. Gasoline
  3. Gas oil
- Obtained from Porcelain Beads
  1. Crude oil
  2. Gasoline
  3. Gas oil
- Obtained from Thermal Cracking
  1. Crude oil
  2. Gasoline
  3. Gas oil

ASTM Standard Specifications:[4]

Table 5: Gasoline

Sr No.	Test Properties	Range
1	Density (g/cm^3) *	0.7-0.78
2	Specific Gravity*	0.7-0.8
3	API Gravity (^{o}API) *	30-39
4	Viscosity (cst) *	0.37-0.44
5	Pour Point (^{o}C)	-40
6	Cloud Point (^{o}C)	3
7	Flash Point (^{o}C)	45
8	Copper Corrosion Characteristics	Not worse than 1a
9	TAN (mg KOH/g sample)	0.5

(*Note: At 60^{o}F)

Table 6: Diesel

Sr No.	Test Properties	Range
1	Density (g/cm^3) *	0.83-0.87

2	Specific Gravity*	0.81-0.89
3	API Gravity (^{o}API) *	30-42
4	Viscosity (cst) *	2.6-4.1
5	CCR (%)	0.2
6	Pour Point (^{o}C)	-6
7	Cloud Point (^{o}C)	6
8	Flash Point (^{o}C)	165
9	Aniline Point (^{o}C)	65-70
10	Copper Corrosion Characteristics	Not worse than 1a
11	TAN (mg KOH/gsample)	0.5

(*Note: At 60^{o}F)

4. CONCLUSION

Based on the results obtained from the three sets of experiments performed it can be concluded that the cracking of plastics is a viable way for the disposal of plastic wastes, considering the environmental hazards posed by the generation and consumption of huge amount of plastic waste. Since plastic is a petroleum product and the energy lost in the form of plastic waste can be recovered back to the energy contained as hydrocarbon liquids and gases by pyrolysis process. This way the environment can be saved from the threat due to plastic wastes and at the same time, to some extent, non-renewable source of energy (petroleum) can be conserved. Therefore the conversion of plastic waste to liquid and gaseous hydrocarbons can be used as a source of energy and/or as a feedstock for petrochemicals which seems to be an environmentally and economically best option available.

It is observed that the product obtained from the cracking of plastic waste in the presence of ceramic beads and copper is more stable than the thermally cracked product. However, the product obtained from cracking of waste plastic in the presence of ceramic beads is waxy in nature similar to the product that is obtained from the thermal cracking of waste plastic. While the product obtained from the cracking of waste plastic in the presence of copper mesh has higher yields, less waxy nature and color stability compared to the products obtained from the other two sets of experiments.

From these observations, it appears that the cracking of plastic waste in presence of copper mesh is most efficient process compared to thermal cracking and cracking in presence of porcelain beads.

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Accident Prevention and Control - An Overview of Literature

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Abstract

Injury can be intentional or unintentional. Intentional injuries occur due to willful act of individuals and unintentional injuries occur due to accidents. This paper looks into unintentional injuries and illustrates an overview of literature on accident prevention and control. Hazards in combination with favorable work place interfaces cause accidents and injuries. Since all accidents are caused, all should be investigated to identify and correct causes. Accident prediction models help to understand and analyze accident process. Accident prevention and control measures should start from design and it should continue throughout the life cycle. The paper refutes Heinrich's theory of accident causation that 88% of accidents occur due to unsafe acts as details of research methodology followed by him are not available. Similarly, Heinrich's theory that in a group of 330 accidents of same kind, involving same person, there is a constant ratio of 1:29:300 between major injuries, minor injuries and near misses also has been disproved due to inconsistency in the definition of accidents in different editions of his book. Modern theories indicate that accidents occur due to organizational reasons, rather than workers' fault. Approach of organization towards principles of human, organization and technical factors affects accident prevention and control. Studies also indicate that reporting of high frequency and low consequence near misses should be imbibed into organizational safety culture as it gives ample opportunities for preventing accidents of low frequency and high consequence. The paper also emphasizes requirement of management commitment and positive safety culture within the organization to foster an accident prevention culture.

Keywords:

Accident Causation; Hazard Identification; Near Miss; Risk Assessment; Safety Management

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1. Introduction

Hazard is a characteristic of a system or process that represents potential for an accident, causing injury to people; or damage to property or environment [13]. In any system, risk cannot be eliminated fully; however it can be reduced to acceptable level by additional corrective measures. Hazards in work environment are identified through plant safety inspections or system features and corrected through Safety Related Deficiency Management System (SRDMS). Despite this, there could be some residual hazards, which on interaction with external agencies can cause near misses.

Near misses are relatively harmlessdisruptions from normal operation without any personal injury or property loss. Near misses under different circumstances could cause accidents or events of serious consequences. Near misses are prevented from escalating into accidents by providing safety barriers. Safety barriers may be physical i.e. machine guards, protection systems etc or non-physical i.e. administrative controls, work permits etc. Accidents occur due to a series of failures or errors occurring in a sequential path.Safety barriers break this sequential path and prevent accidents. Failure of safety barriers may exacerbate near misses into accidents [19], [32].

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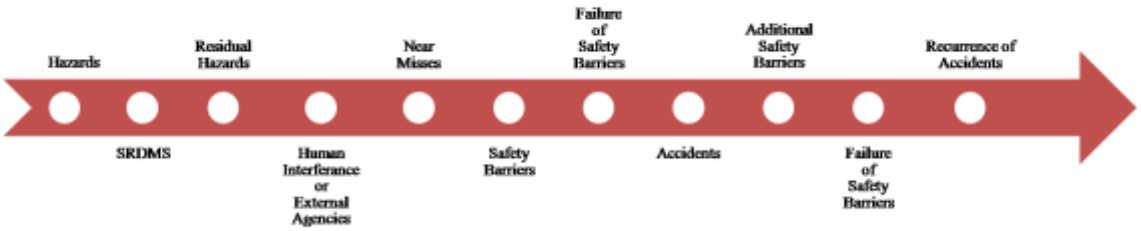
All accidents are investigated and additional safety barriers are provided to prevent recurrence. However, failure of existing or additionally installed safety barriers may cause recurrence of accidents as shown in **Figure-1** [26], [30]. Whenever safety barriers are challenged, situation becomes closer to accidents. Even though multiple safety barriers are deployed, maintenance of barriers is essential to prevent accidents. About 30-40% of accidents and precursors occur due to shortfalls in barrier maintenance, introduction of new hazards during maintenance or due to non-maintenance related causes [29].

Figure-1: Sequence of Escalation of Hazards to Accidents



Accidents may or may not cause injury. Injury is bodily damage resulting from overexposure to energy in excess of threshold limit of physiological capacity [15]. Energy can be mechanical, thermal, electrical, chemical or radiant energy. Injury can be intentional or unintentional. Intentional injuries occur due to willful act of individuals i.e. homicide, violence, suicide etc. Unintentional injuries occur due to accidents i.e. fall of persons, fall of objects, caught in objects, struck by moving objects, electric shock etc.

This paper looks into unintentional injuries due to accidents and illustrates an overview of literature on accident prevention and control.

2. Taxonomy of Literature

Hazards in combination with favorable work place interfaces cause accidents and injuries. Since all accidents are caused, all should be investigated to identify and correct causes. Approach of organization towards principles of human, organization and technical factors also affects accident prevention and control. Accident prediction models help analysis of accident.

Considering the above sequence, literature on industrial accident prevention and control can be categorized as hazard control, accident causation, accident investigation, human, organizational and technical factors, accident control and accident prediction. This paper comprises of nine sections. Section 1 presents introduction, Section 2 gives taxonomy. Section 3 deals with hazard control, Section 4 is on accident causation, Section 5 reviews accident investigation, Section 6 gives an account of human, organizational and technical factors pertaining to accident prevention, Section 7 is on accident control, Section 8 looks into accident prediction and Section 9 gives discussion and conclusion of the review.

3. Hazard Control

Hazard control is a function, directed towards recognizing, evaluating and eliminating or reducing destructive effects of hazards to protect workers from injuries [27]. Hazard control involves following six essential processes:

1. Hazard identification
2. Hazard ranking
3. Management decision making
4. Establishing preventive and corrective measures
5. Monitoring, and
6. Evaluating programme effectiveness

3.1 Hazard Identification:-

A person working in the neighborhood of hazards is vulnerable to the risk of accident and injury. Severity of injury depends up on the amount of energy transferred to victim's body during the accident. A systematic method for hazard identification is the first step towards accident prevention and control.

Hazard identification methods are categorized as comparative methods and fundamental methods. Comparative methods involve comparison of plant conditions by checklist, safety audit, hazard indices etc.Fundamental methods of hazard identification involve stimulating a group of people for identifying hazards by raising a series of questions by What-if Analysis, Failure Modes and Effects Analysis and Hazard and Operability Study etc [13], [20].

Khanzode et al.[18] propose following approaches for hazard identification:

- *Biased reactive approach*, where hazards are identified based on information after an accident.
- *Biased proactive approach*, where hazards are identified based on historical data before the accident.
- *Unbiased proactive approach*, where hazards are identified before the accident, without considering the presence of historical data.

Results of biased reactive approach depend on expertise and professional competency of persons carrying out the job. Biased proactive approach depends on prior information about processes and systems. Unbiased proactive approach is not completely unbiased as historical data and previous work experience are essential in this approach.

Rathnayaka et al.propose System Hazard Identification, Prevention and Prediction (SHIPP) framework for chemical processes hazards [32]. SHIPP framework considers safety barriers related to human, organizational and technical aspects for hazard control. Depending on success or failure of safety barriers, it considers six consequences for an event i.e. safe, near-miss, mishap, incident, accident and serious accident.

3.2 Hazard Ranking:-

Objective of hazard ranking is to prioritize corrective actions, based on risk assessment. Risk is determined from the probability and severity of event with the help of risk matrix. Typical risk matrix and actions to be taken at various risk levels aregiven in **Table-1** in **Table-2** respectively [12], [14], [23].

Major pit falls in risk assessment[43] are:

- Risk assessment is carried out to justify decisions already taken.
- Generic risk assessment is used when specific assessment is required.
- All the hazards and risks in a particular activity are not identified.
- Results of risk assessment are not used for implementing corrective measures.

Table-1
Risk Matrix

Severity → / **Probability of Occurrence ↓**	**Slightly Harmful**	**Harmful**	**Extremely Harmful**
Highly Unlikely	Trivial Risk	Tolerable Risk	Moderate Risk
Unlikely	Tolerable Risk	Moderate Risk	Substantial Risk
Likely	Moderate Risk	Substantial Risk	Intolerable Risk

Table-2
Risk Based Action Plan

Trivial Risk	• No action is required and no documentary record needs to be kept
Tolerable Risk	• No additional controls are required. • Monitoring is required to ensure that controls are maintained
Moderate Risk	• Risk reduction measures should be implemented
Substantial Risk	• Work should not be started until risk has been reduced. • Urgent action should be taken to reduce risk.
Intolerable Risk	• Work should not be started or continued until risk has been reduced. • If it is not possible to reduce risk, work should remain prohibited.

3.3 Management Decision Making:-

Management decision making involves modification in design, work environment or procedures; repair or replacement of equipment for eliminating or controlling hazards and risks.

3.4 Establishing Preventive and Corrective Measures:-

Hazards can be eliminated or controlled at source, path and at receiverby design, administrative control or by Personal Protective Equipment (PPE) [27], [20]. Methods of hazard control by design are elimination, substitution and engineering controls; these are preventive actions. Administrative control and PPEs do not remove hazards, but reduce exposure to hazards; these are contingent actions. Preventive actions do not rely on human performance, hence are not prone to human errors. Contingent actions depend on human performance, hence are less effective. Work places should be designed to avoid overly stressful work methods, by consideringhuman capabilities and limitations. Design should consider probability of errors in human interactions with use of PPEs as low as reasonably practicable [23]. In fact a multitier defense-in-depth approach with a combination of design, administrative control and PPEs should be adopted for effective control of accidents.

3.5 Monitoring

Monitoring is essential to verify whether hazard control measures meet the objectives and to identify any new hazards due to introduction of hazard control measures.

3.6 Evaluating Programme Effectiveness

Final process in hazard control process is evaluation of its effectiveness in terms of reduction in accidents and injuries.

Despite the above, effectiveness of hazard control programme depends on organizational commitment and competence to identify and remove potential hazards [33].

4. Accident Causation

Systems are reasonably well designed to provide automatic protection with minimum human intervention. In case of any failure, some may get recovered; some may fail in safe manner and some others may escalate into minor or major accidents. It is difficult to design a safe system, unless accidents are anticipated and understood. Accident causation models are aimed at this objective; and for answering why and how do accidents occur [1].

Accident causation theories are evolved over five different ages. First age is closely associated with technological aspects, where accidents were attributed to mechanical and structural failures. In the Second age, human errors were considered to cause accidents. Third age is based on the premise that, if design of system is human error prone, instead of human error reduction programmes, design modifications should be attempted first. Third age realizes that humans are not the sole cause of accidents. Fourth age is associated with organizational safety culture. Fifth age is related to resilience of people to adapt safe practices before the accident [31].

4.1 Factors Contributing Accidents and Injuries

Accidents and injuries occur due to individual factors, job factors and organizational factors [18].

Individual Factors:

Individual factors are age, work experience, living habits etc. Inadequate work experience, increase in age and unhealthy living habits increase injury risk. Injury risk follows a bath tub curve with age. It is high during the initial years of employment due to lack of awareness and work experience. It diminishes as individual acquires work experience and rises again with age due to physiological weaknesses and lack of mental comprehension. There is also another view thatinjury risk may increase with work experience as individual may become complacent and pay less adherence to safe work practices [47]. This aspect can be addressed by deploying workers with different levels of experience, varying from novice to highly experienced.

Negative traits such as absenteeism, lack of emotional stability, risk taking behavior, job dissatisfaction and violations may reflect in individual's relationship within organization and also contribute accidents and injuries. Living habits such as consumption of alcohol and tobacco also cause accidents and injuries [18].

Job Factors

Hazardous jobs performed at unsafe locations without requisite safety measures increase potential for accidents and injuries. For example, machine related accidents in US had caused 8505 fatalities between 1980 and 1989 with an average annual fatality rate of 0.8 per 100, 000 workers [5]. Manual material handling is one of the major causes of workplace injuries due to musculoskeletal disorders, strains and sprains. Poor housekeeping, inadequate working space, working in night shifts, high job stress, high job dissatisfaction, less job responsibility and poor work execution also add to workplace injuries [18].

Organization Factors:

Organizational factors which cause accidents are shown in **Figure-2** [33]. Brief description of each factor is given below:

Pathological-Reactive: Safety practices in industry are the barest minimum to meet regulatory requirements, with no management commitment.

Incipient-Reactive: Safety practices are just above regulatory requirements and management shows some signs of concern.

Worried-Reactive: Management is worried about continuing occurrence of accidents.

Repair-Routine-Reactive: Management gives reasonable sensitivity to accidents and takes corrective measures.

Conservative - Calculative - Reactive: Management emphasizes auditing and work place safety measures based on technical and human error aspects.

Incipient-Proactive: Management begins to accept importance of organizational factors and actively finds engineering solutions for accident prevention and control.

Generative-Proactive: Management is highly committed and takes many proactive measures. Organizational safety and corrective measures are continuously reviewed and implemented.

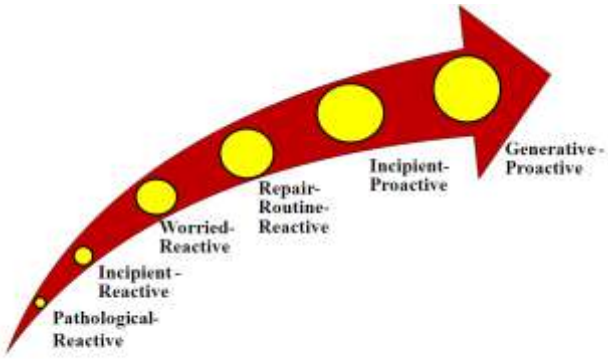


Figure-2: Organizational Factors Contributing to Accidents

Significant organizational factors considered for occurrence of accidents are safety climate, workgroup size, management support, coworker support, supervisory support, workplace safety practices and management commitment towards safety. Higher the support and commitment, the less will be the accidents.

4.2 Accident Causation Theories

Injury due to accident occurs due to unplanned or unwanted release of energy or hazardous materials above the threshold limit of human structure. Severity of injury depends on the amount of energy or hazardous materials transferred and vulnerability of body tissue to get damaged.

Accident causation theories can be categorized based on the themes i.e. person as cause, system as cause, person and system as cause and system-person sequence as cause. Person as cause theme holds individual factors for accident causation. System as cause theme states that accidents occur due to system failures and not due to individuals. Person and System as cause theme considers that accidents occur due to individual factors and system failures. System-person sequence as cause theme assumes that sequential interactions between system and person cause accidents. Classification of accident causation theories is given in **Table-3** [20], [18].

Person as Cause Theme:

Pure Chance Hypothesis states that everyone has equal chance for an accident. There are no specific patterns for an accident and accident is considered as an act of God. This hypothesis is based on feelings.

Accident Proneness Theory suggests that certain groups within a population are more likely to meet accidents due to some natural personality traits called accident proneness. Accident proneness could be due to stress and socio-psychological behavior of individuals. An individual's accident proneness may change with age. At younger age, high energy for taking risk may cause accidents; whereas at old age, low energy to overcome risk may cause

accidents. These models blame individuals for accidents and recommend behavioral interventions for improving safety performance.

Unconscious Motivation Theory is based on psycho-analytic theory. It believes that accidents are caused by subconscious processes due to guilt, aggression, anxiety, ambition and conflict. The theory focuses on personality traits and individual's perception about work environment. It suggests that low feeling about job and work place; and withdrawal from work contribute accidents. The theory prompts behavioral interventions for improving safety performance.

Adjustment-Stress Theory holds the view that, individuals who cannot adjust with their work and work place, have more tendencies for accidents than who can adjust. Inability to adjust may be due to physical and psychological stressors.

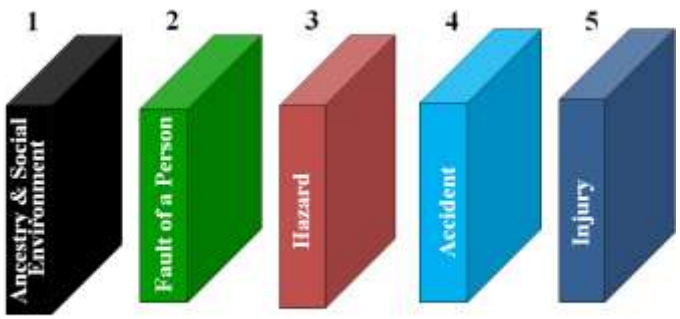
Goal Freedom Alertness Theory says that some individuals are accident prone due to lack of alertness on the job and flexibility in setting objectives of the job.

Table-3
Classification of Accident Causation Theories

Accident Theme	Accident Causation Theory
Person as Cause	1. Pure chance hypothesis 2. Accident proneness theory 3. Unconscious motivation theory 4. Adjustment stress theory 5. Goal freedom alertness theory
Person or System as Cause	1. Heinrich's domino sequential theory 2. Bird's domino sequential theory
System as Cause	1. Swiss cheese theory 2. Epidemiological theory
System - Person Sequence as Cause	1. Systems theory 2. Houston theory 3. Socio Technical System theory

Person and System as Cause Theme:

Heinrich's *Domino Sequential Theory* postulates that injury happens due to a series of events represented by fall of five dominos i.e. ancestry and social environment, fault of persons, hazards, accident and injury as shown in **Figure-3**[10].Removal of any one of the dominos breaks accident sequence and prevents injury [10]. The first two dominos i.e. ancestry and social environment; and fault of persons are not within the control of organization; hence the third domino i.e. hazards due to unsafe conditions and unsafe acts, are controlled to prevent accidents. Ancestry, social environment and fault of persons and unsafe acts follow person as cause theme. Unsafe conditions are attributed to system and follow system as cause theme. In combination, this theory adopts person and system as cause theme for the accidents. Heinrich postulates that 88% of the accidents are due to unsafe acts, 10% due to unsafe mechanical or physical conditions and balance 2% are not preventable.



1. Ancestry and social environment 2. Fault of a person 3. Hazard 4. Accident 5. Injury

Figure-3: Heinrich's Domino Theory of Accident Causation

Bird and Loftus [2]replaced first three dominos of Heinrich by "Lack of Control" due to inadequate management programme, "Basic Causes" of personal and job factors and "Immediate Causes" of unsafe acts and unsafe conditions.

Domino theories conclude that unsafe acts and unsafe conditions are the only causes of accidents, leaving apart other causes due to organizational factors. Heinrich theory of 88% of accidents occurs due to unsafe acts is false as information on data collection, survey documents, quality of information and analytical methods used by him is not available. Modern theories on accident causation indicate that accidents occur due to organizational reasons, rather than workers fault. Overemphasizing on unsafe acts and unsafe conditions as causes for accidents, may divert attention to human errors and dilute essence of accident prevention [23].

System as Cause Theme:

Reason's *Swiss Cheese Model* comprises of a series of randomly holed Swiss cheeses arranged in series as shown in **Figure-4.** Each slice represents a safety barrier and each hole represents a possible condition for barrier failure. Whenever a failure mechanism makes it through all the holes, there will be accident. If there is deflection from sequence, there will be anomaly. Anomaly in combination with favorable circumstances may cause accident. Anomaly indicates a failure in system and hence follows system as cause theme [23],[25], [26], [28].

Gordon's *Epidemiological theory*

Gordon [7]compares injury as agency causing harm to human body similar to disease. While injuries damage human body quickly, diseases do so at a slower pace. Epidemiological theoryassumes an equilibrium between host, agent and environment to maintain healthy or injury free condition. Any disturbance to this equilibrium will make the host unhealthy or cause injury.

System - Person Sequence as Cause Theme:

Systems model of accident causation assumes thatworker, equipment and environment interact with each other to produce output. Worker senses hazards and takes appropriate control measures to bring back system into safe state. Equipment must be designed, maintained and used to ensure safety of workers. Work place environment should be designed to ensure health, safety and comfort of workers. An accident interrupts this process. Effective management of interfaces between worker, equipment and environment will reduce likelihood and consequence of accidents [27].

Houston theory of accident process envisages that an accident occurs due to sequential interaction between target, driving force and trigger [20]. Principal driving force is energy. Target has threshold intensity, below which driving force has no effect. Trigger also has threshold level, below which it does not operate. Trigger causes driving force to injure the target. Accident can be prevented by reducing energy of driving force by safety barriers between energy and target.

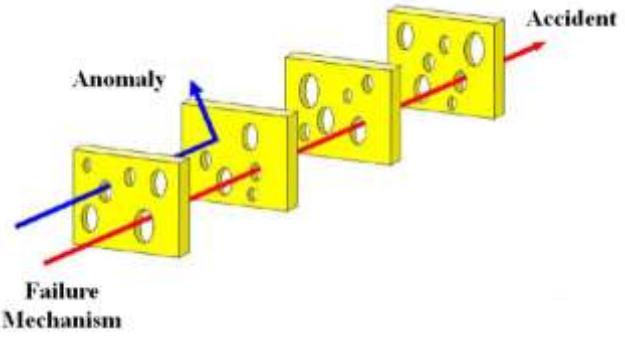


Figure-4: Swiss Cheese Model of Accident Causation

Brown et al. [3] opine that safety hazard, safety climate and production pressure influence safety efficacy and cavalier attitude. Likelihood of accident increases during peak production period. High levels of production pressure might weaken safety efficacy. Employees with cavalier attitude may violate safety requirements and become risk seekers.

Manchester and Leiden Universities observe that deficiencies in hardware, design, maintenance management, goals, housekeeping, communication, organization, training, safety defenses and introduction of error causing conditions also cause accidents ([41], [42].

5. Accident Investigation

Accident investigation provides valuable information on accident causation and deep insight into accident prevention and corrective action [25]. Depth of accident investigation is a measure of openness, safety culture and management commitment to know and correct causes of accidents. Despite having outstanding safety performance, accidents occur or recur if organizations do not learn from accidents and fail to correct root causes.

In organization with positive safety culture, management will be interested in knowing true causes. In such organizations, accident investigations will be based on facts. Success of accident investigation depends on blame free culture, freedom from fear of reprisals and faith that information collected will be used for the benefit of all. In order to make an accident investigation unbiased, it should be carried out by an independent team not related to area and job in which accident has occurred [23].

Barriers inhibiting true accident investigation are:

- Inadequate training and knowledge of investigation team.
- If supervisors investigate accidents, they may not indicate shortcomings for which they themselves are responsible.
- Detailed investigation is not possible, if management is not supportive.
- In organizations with blaming culture, corrective actions may involve reprimanding of individuals.

Human error is not the only cause for an accident, but it is a symptom of systemic failures. A systemic accident model focuses on the whole system comprising of design, development, operation and maintenance of system; not on human errors alone. First step to address human errors is to examine the design of workplace and work methods [23]. The aspects to be considered in design for safety are:

- Risk should be within acceptable level
- Failure of work systems and methods due to human errors should be low.
- Hazards and risks during operation and maintenance should be low.
- While performing job, need of personal protective equipment should be less.

Many serious injuries and fatalities are low probability events, with unique, multiple and complex contributing factors; attributed to poor design, shortcomings in supervision, poorly made procedures, undetected manufacturing defects, maintenance failures, inadequate training, inadequate tools or equipment and other technical, operational, cultural or administrative issues [23]. Most of the serious injuries and fatalities occur:

- During non-routine works and plant transients.
- During plant shutdowns, maintenance and start-ups.
- While working near high energy sources.
- During construction and modifications.

Before any accident, there would be disruptions or anomalies. Recurrence of disruptions is a precursor for an accident. Precursors are alerts or signals of an impending accident. Under alternative circumstances precursors may escalate into accidents in presence of certain immediate factors. Immediate factors are exacerbating factors such as failure in interaction between work team, hazardous workplace or equipment and materials [36]. Next to occurrence of a precursor, accident will occur, if there are immediate factors without mitigating factors, i.e.

Accident = Precursor + Immediate Factors - Mitigating Factors.

If corrective measures are not taken, accident will recur in the absence of mitigating measures i.e.

$\text{Accident}_{(n+1)} = \text{Accident}_{(n)}$ + No corrective measures + Time - Mitigating Factors.

Identification and correction of causes of precursors provide opportunity to interrupt accident sequence from escalating into a more severe incident [34]. Precursors and immediate factors occur more frequently than accidents. Therefore, correcting causes of precursors and immediate factors will help in accident prevention. Safety at work place can be improved by real-time tracking of precursors and immediate factors [35], [50].

Accident investigation involves finding answers to five Ws and one H, i.e. what? when? where? why? who? and how? [33]. 'How' of these involves identification of root causes by using "Five Why Technique", in which, why is asked five times to determine the root cause. Ideal accident investigation is based on the principle of "what-you-find-is-what-you-fix", which means that first identify causes of accident, then implement corrective measures to fix the causes. Jonas et al. [17] say thatthough most of the investigations follow "what-you-find-is-what-you-fix", many constraints influence identification and implementation of effective remedial measures; hence "what you find is not always what you fix". Some of the constraints to achieve "what-you-find-is-what-you-fix" are experience and competency of investigators; resources, time, availability of data, management support, acceptance of investigation results and lack of stop rule to decide the extent of investigation.The common issues with most of the accidentsareineffective leadership, weak supervisory oversight and lack of organizational learning [37]. Accident investigations should be aimed to prevent recurrence, to fix responsibility and to develop accident models for theoretical understanding [9].

Accident investigation should be unbiased. However, some degree of bias creeps into accident investigation due to author bias i.e. reluctance to accept findings of other investigations; confirmation bias i.e. tendency to confirm preconceived causes; frequency bias i.e. tendency to classify causes in common categories; political bias, where status of individual gives undue influence and sponsor bias, where causes are influenced by possible damage to the reputation of organization [17]. Ingress of bias into accident investigation can be reduced by formation of independent investigation committees with experts from heterogeneous fields relevant to accident.

Collection and analysis of accident data are important for risk assessment and taking risk informed decisions on accident prevention. However, true and factual data with quality and depth of information are difficult to obtain due to under reporting or non-reporting [9]. Incidents with less severity are either under reported or not reported due to lack of impact in the media. If at all reported, available data will be just to meet regulatory requirements. This often reduces accident investigations to mere checklist filling, without touching upon underlying causes [4].

6. Human, Organizational and Technical Factors

Human factors are environmental, organizational and job factors, which influence human behavior at work and affect health and safety [46]. Overall objective of human factors is to design systems, jobs and organizations to match with human capabilities and limitations. Nature of issues related to human factors varies according to the type of systems. For example, issues of human factors in manual systems and automated systems will be different. Human factors should be integrated in the design and development process by considering following aspects [39]:

- Effective way to control hazards and risks associated with human factors is to address these at design stage and continue it throughout the life cycle.
- System design should support operators.
- Addressing issues of human factors as afterthought will be ineffective.
- Human factors activities must proceed in parallel with technical development.

Majority of accidents occur due to actions initiated bypeople and could have been prevented by correct actions at right time. About 80% of the accidents attributed to human factors are due to either actions or omissions of people [45]. Though modern controls, automated safety systems and structured documentation systems facilitate safe work environment; human intervention is crucial in accident prevention and control; hence responsibility of operators for ensuring safety shall not be ignored [32].

A study by the University of Aberdeen concludes that higher the management commitment to safety, lower the rates of accident. Failures in decision making are one of the major causes of accidents. Errors in decision making may remain dormant for many years and can cause accidents later on. The study recommends that benchmarking of safety management strategy and safety climate among the companies at regular intervals will help in ensuring safer work environment and improving safety climate [40], [42]. Many serious injuries occur due to less than adequate conservative decision making and shortfalls in organizational safety culture. Latent weaknesses such as unsafe

design, inadequate supervision and failure to identify and correct unsafe conditions, inadequate training and improper tools; in combination with weak organizational safety culture may cause accidents and injuries.

In organizations where management commitment is strong, high priority is given to safety. Key characteristics of these organizations are; active managerial involvement, delegation of authority, consistency in safety practices, leadership to improve safety, supervisors serve as role models, effective personal communication and overwhelming priority given to safety. Casual factors for accidents and injuries are largely systemic and are reflections of organizational safety culture. Organizational safety culture comprises of basic values, norms, perceptions and practices within the organization and among the individuals that safety related issues are received the importance as warranted [23]. It is permanent in nature. Culture created by top management influences organizational safety culture. As unsafe conditions in workplaces are easier to manage than human minds, top management shall become a driver for fostering positive safety culture within organization to address human factors.

7. Accident Control

A process is always associated with transmission of energy in controlled environment. At some occasions, control is lost and energy is released above the physiological tolerance of human body, cause accidents and injuries.Three characteristics of accidents are; it occurs as a combination of circumstances, it is preceded by near misses and there may be wide variations in the consequences of accidents, i.e. from near miss in one circumstance to severe injury and loss of life or property in some other circumstance.Near misses are warning indicators of potential accidents and act as pointers to alert organization that "all is not well" with respect to safety [20], [26], [30].

Heinrich et al. say that in a group of 330 accidents of same kind, involving same person, there is a constant ratio of 1:29:300 between major injuries, minor injuries and near misses. This implies that a person who suffers a major injury had on an average 300 chances of narrow escapes without any injury [10].However, this theory is proved to be false as there is no consistency in the definition of accidents in different editions of Heinrich's book. In the first edition, accidents were considered to have "same" cause. In the second edition, it was changed to "similar" and "of the same kind" and in the third edition, accidents were considered to be "of the same kind and involving same person". Heinrich has not explained reason for the above changes. If the data based on the first assumption was valid, how does the conclusion can change from edition to edition of same book [23]? However, studies also show that high frequency and low consequence near misses give opportunities to correct causes of accidents; hence prevent accidents of low frequency and high consequence. In orderto develop a strong accident prevention system; reporting of near misses and correction of causes should be imbibed in organizational safety culture. Studies also show that whenever line managers had shown increased focus in reporting and correcting of causes of near misses, there were reductions in accidents. Since near misses give an overall picture of risks in the organization, not considering near misses in risk assessment can lead to significantunder-estimation of "true" risk. Major accidents and injuries occur due to slow movement of human, organizational and technical systems towards a state of high risk. This movement is indicated by near misses and corrective actions based on this movement will facilitate accident prevention [6], [17], [21], [24], [26], [30], [32], [35], [36], [38], [48], [49].

Hovden et al. [11] categorize accident models as cause-consequence models, descriptive models, and system models. All these models supplement to each other and rove around human, organizational and technical factors associated with safety management. Accident models affect the way people think about safety. Accident models are simplified representations of real-life accidents and are utilized for reactive and proactive safety management. Accident models facilitate the followings:

- To understand accident phenomena.
- To prevent personal biases in accident causation.
- To provide wider range of preventive measures.
- To guide investigations regarding data collection and accident analyses.
- To analyze interrelations between factors and conditions of accident causation.

Both individual and organizational factors contribute to accidents. Employees with better education demonstrate better compliance to safety measures and are less susceptible to injuries. On the contrary, employees with high job

insecurity and dissatisfaction exhibited reduced motivation, less compliance to safety measures and high level of injuries. Organizational factors such as safety climate, organizational support and job satisfaction influence safe behavior of employees and their general perceptions about management concern towards their well-being. Effective communication and information sharing will support reduction of accident frequency [8].

Accident control follows five step management decision model comprising of collection of data, analysis of data, selection of remedy, application of remedy and monitoring as shown in **Figure-5** [10].

Accident control measures can be either short term or long term. Short term approach is by direct control on worker performance, equipment performance and work environment. Long term approach is through enforcement and education. If an unsafe condition needs to be addressed in fool proof manner, it should be done without considering associated unsafe act.An effectively implemented accident prevention strategy would break chain of events and prevent accidents [19]. Design improvement is one of such strategies. UK HSE analysis indicates that about 59% of the accidents are due to inadequate design specification and design implementation [44]. Some of the design related causal factors are; design not as per accepted standards, failure of defense in depth in design due to inadequate back-up measures and operating outside design envelope due to misunderstanding between designers and operators.

Figure -5: Accident Control Model

8. Accident Prediction

Accident prediction is a science of postulating anticipated accidents, based on available information and perceptions [51]. Objective of accident prediction is to facilitate accident prevention and control measures before the real casualty and loss. Generally followed accident prediction models are Scenario analysis, Regression method, Time-series method, Markov chain method, Grey model, Neural networks and Bayesian networks.

Scenario analysis is a process of analyzing possible future events by considering different situations. Since accidents are caused by the interaction of human factors, situational work factors and environment factors, accident scenario will depend on the interaction of these factors. Scenario analysis helps to predict possible accident scenarios and identify factors which might have caused accidents.

Regression model uses dependent variable as a function of independent variables to predict accident scenarios based on historical data of accidents. Depending upon the research objectives, regression models can be linear, non-linear exponential, logarithmic or polynomial etc. Regression model is widely used in prediction of events.

Time-series methods use historical time-series accident data for forecasting future accidents. Time-series data involve a sequence of observations at different time points.

Markov chain model uses stochastic processes for estimation of transition probabilities between discrete states in the observed systems. Markov chain model is suitable to predict events with large random fluctuations. However it cannot be utilized for accident trending.

Grey models for accident prediction are based on the theory of grey system. A white system is one in which all information on it is known and black system is one in which nothing is clear. A gray system is in between these two. This model is applied to accidents with uncertain and insufficient information.

Neural Networks isused to fit complex non-linear relationships between inputs and outputs. Applications of Neural networks for accident prediction are divided into trend prediction and causality prediction. While inputs for trend prediction are time-series data, inputs for causality prediction are a set of influencing factors related to accidents.

Bayesian Networks are probabilistic graphical model to quantify cause-effect relationship between various factors related to accidents. Bayesian Networks help to predict and identify causes of accidents.

Accident prediction models are selected based on nature of data, prediction accuracy and required information. Each method has its own limitations, depending on the data. As one method alone may not be able to produce realistic prediction, a combination of different methods is adopted to have a reasonable accuracy of prediction.

9. Discussion and Conclusion

Causes of accidents being multi-disciplinary in nature, prevention and control of accidents have always been a big challenge. With the influence of human, organizational and technical factors, accident prevention has become more complex and continual efforts are required to control or reduce probability and severity of accidents. Accident prevention and control measures should be included in the design and subsequent operation to bring risk within the acceptable limits. Engineering or administrative safety barriers can be provided to reduce risk; however maintenance of these barriers is also essential to prevent accidents. Accidents may or may not cause injury. Injury can be intentional or unintentional. Accidents cause unintentional injuries.

Accident prediction and causation models help to know why and how do accidents occur. Heinrich's theory that 88% of accidents occur due to unsafe acts by workers has been disproved as information on research methodology used by Heinrich is not available. Modern theories on accident causation indicate that accidents occur due to organizational reasons, rather than workers' faults. Hence, focus of accident prevention should be shifted from workers' behavior to improving design of work systems and reducing complexity of work procedures.

All accidents should be investigated as it provides valuable information on the genesis of accidents and deep insight on accident prevention. In order to make an accident investigation unbiased, it should be by an independent team, not related to the area and job in which accident occurred. Accident investigation involves finding answers to five Ws and one H, i.e. what? when? where? why? who? and how? Of these, How' involves identification of root causes by using "Five Why Technique", in which why is asked five times to determine root cause.

An accident is preceded by near misses or precursors, where most, but not all of the conditions for an accident are met. Heinrich theory that in a group of 330 accidents of same kind, involving same person, there is a constant ratio of 1:29:300 between major injuries, minor injuries and near misses is refuted under the premise that there is no consistency in the definition of accidents in different editions of Heinrich's book. Despite this, other studies says that high frequency and low consequence near misses give ample opportunities to correct causes of accidents, hence to prevent accidents of low frequency and high consequence. Therefore, reporting of near misses and correction of causes should be imbibed in to organizational safety culture. Accident models facilitate understanding of accident phenomena. These are simplified representations of real-life accidents.

The paper also emphasizes requirement of management commitment, positive safety culture and supportive safety climate to foster an accident prevention culture within the organization.

Conflicts of interest

None of the contributing authors have conflicts of interest to declare.

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LEADERSHIP: PREDICTORS OF SAFE BEHAVIORS AND PERFORMANCE

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Abstract

The study sets out to explore the safety leadership factors and assessing their application on sites within the UAE construction industry. The initial focus of the study was to determine whether there was a consensus amongst the various experts on the factors that constituted safety leadership. Following the analysis, the researcher was able to identify some common ground. However, an overall consensus was not possible to achieve within the timescale of the research project.The study further explored whether factors of safety leadership were being appliedto sites within the construction industry. Although responses from site managers and subordinates were (on the whole) positive, statistically they were unreliable and therefore a definite and consistent conclusion could not be derived. Another objective of the study was to see whether site managers and subordinates were in agreement on the factors that were 'least' and 'most' important for a site manager to demonstrate safety leadership. The results supported that both groups are having the same two factors in the top two positions and agreeing precisely on the remaining seven.

The primary purpose of the study was to see whether there was enough evidence to claim that sites reporting to be more active in the area of safety leadership had a better safety performance. The results of the data analysis to this effect were not conclusive, andthe link between leadership and performance was not established. Further refinement of the principles used in this study could be undertakento explore this in future. This report provides detail on the research context, the methods selected for gathering the data, the results of the analysis and conclusions drawn.

Key Words:
Safety;
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1.0 Introduction

1.1 The Study Context

Effective leadership has been identified within previous studies into human factors as a critical factor in influencing (both positively and negatively) the behaviour of workers (Miles, 1999). 'Human Factors' is a complex issue and much research has been conductedto understanding the subject in more detail.The context of this research was behaviour-based, in that it aimed to develop and apply a series of subjective tests to measure the extent of current understanding of the factors of safety leadership on some construction sites within major contractors in UAE. The extent to which these factors were being efficiently applied on a day-to-day basis was also explored.The analysis was carried out on data gathered, which sought to build on previous research into leadership within the construction industry, provide further insights into the aspects that constituted good safety leadership and try to establish whether there was a link between 'safety leadership' and 'safety performance.'

1.2 An expert's view of Leadership

Leadership has been recognised in history for a variety of reasons. Sir Ernest Shackleton displayed great leadership securing his expeditions escape from the South Pole. His country for very different reasons also considered Adolf Hitler to be a great leader (Shackleton, 1999).

People will be dedicated to specific people who, on the organisation chart, have little authority, but instead have the zest, dynamism, expertise and compassion for their teammates. On the other hand, non-leaders in management, but they have little influence over others.Effective leaders convey firmness and coherence in their actions, in line with the image of the future they paint. The result: clarity of purpose, the credibility of leadership, and integrity in the organisation (Shackleton, 1999).
One of the best-known names in the leadership business is Warren Bennis. Bennis identified the following essential ingredients of leadership as being: -

- Guiding Vision
- Passion
- Integrity
- Trust
- Curiosity, and
- Daring

1.3 Project Case Study

Building on previous research in the field of leadership the researcher sought to identify whether there was agreement amongst today's 'experts' on the factors that constituted safety leadership. The extent to which these factors were being appliedto sites within the construction industry was then tested. The extent of application of safety leadership factors was tested from two dimensions, one being the view of the site manager and the other being that of subordinates – stated vs observed level.

Site managers and subordinates were asked to rank safety leadership factors in order of importance separately. A comparison was sought to determine whether there was an agreement between these two groups on the factors of safety leadership that were most (at least) important of a site manager when demonstrating safety leadership.Safety performance data was calculated on a site-by-site basis to see whether a link could be found between site safety performance and the application of factors of safety leadership.

1.4 Project Objectives

The objectives of this research were to: -

- Build on earlier research conducted for 'supervision' and 'senior management' to identifying the safety leadership behaviours of site managers.
- Seek to identify associations between safety performance and safety leadership, (i.e. determine whether safety leadership has a positive impact on health and safety or not).
- Check the extent of agreement between site managers and subordinates on the factors of safety leadership that are most (at least) significant when demonstrating safety leadership.

2.0 Research Methodology and Data Collection

A range of literature and previous research in the field of leadership and how these views and opinions helped form the context for this research project has been examined. This study sought to build upon the earlier work, provide new perspectives in the field of safety leadership and provide a further source of reference for the future.This section provides detail on the objectives to be achieved, the methods used to collect and then analyse the data, anticipated errors and mitigation measures.

2.1 Study Methods (General)

To achieve the objectives a number of methods were selected. The study project required the use of both *qualitative* and *quantitative* methods. The qualitative aspects included the development of two questionnaires, which provided the primary source of data to study the objectives. Quantitative techniques were applied to score the response to the questionnaires and during the data analysis phase.
A literature review was completed to understand the views of leadership 'experts'. This qualitative method was requiredto achieve the first objective. Quantitative methods were used to obtain incident data from the participating company to test whether there is a link between safety leadership and safety performance.

2.2 Company of study and demographics

For this study project, neither the company nor sites were directly identified. Where differentiation was required from one site to another, this was achieved, by merely referring to the sites as A, B or C etc.

The company selected for the study project was a major construction company in the United Arab Emirates (UAE). The Company has invested a significant amount of time, effort and money in the area of safety leadership.The Company's operation involves the building and community development projects, roads bridges and infrastructure construction and industrial turn-key projects.

6 Sites were chosen for the study project representing four building sites and two infrastructure construction sites. The estimated sample population of these eight sites requested to participate in the study project is in the region of 168 personnel, representing subordinates and site managers, the more substantial population being that of the subordinates.

2.3 Literature Review

The literature review phase of the project was undertakento establish the context of the study that current guidance on the factors of safety leadership demonstrates a convergence of expert opinion.

2.4 Defining 'Factors of Safety Leadership'

To verify the extent to which factors of safety leadership were being applied to sites within the construction industry and in order to test the level of agreement between site managers and subordinates on which factors are most and least significant when demonstrating safety leadership, there was a need first to determine just what the factors of safety leadership were.

The literature review completed provided the primary source of data on which to establish the factors of safety leadership for the study project. Each of the characteristics, traits, personalities and events discussed within these (and other) documents was tabulated. From this table, the study then sought to group the issues to identify a number ofkey headings on which to use for the study project.

The study concluded on nine 'groups' or factors of safety leadership for the study project, being: -

- Factor 1 - Setting a personal example
- Factor 2 - Involving and consulting people in decision making
- Factor 3 - Rewarding safe behaviour
- Factor 4 - Disciplining unsafe behaviour
- Factor 5 - Trustworthy and open
- Factor 6 - Demonstrating safety priorities over production
- Factor 7 - Communication and feedback
- Factor 8 - Personal involvement in safety initiatives
- Factor 9 - Building relationships with people

2.6 Questionnaire design

Some publications on attitude survey's and questionnaire design were reviewedto ensure the questionnaires used within this research project would be a reliable means to gather the necessary data.

One of these publications, in particular, Oppenheim's Questionnaire Design, Interviewing and Attitude Measurement, proved valuable when considering the design of the questionnaires for this research project.

Oppenheim makes several recommendations including 'not assuming that questionnaires used previously in the UK will suit other projects' and 'not use personal questions at the front of a questionnaire'. Oppenheim also suggests: -

- Questions should not be too long (max 20 words)
- Avoiding double-barreled questions
- Avoid double negatives
- Don't know and not applicable categories are often left out.
- Need to stick to simple words
- Avoid acronyms, abbreviations, jargon and technical terms
- Beware of dangers of alternative usage – child's age next birthday.
- All closed questions should start their lives as open ones
- Beware of leading questions
- Beware of loaded words
- Don't overtax the respondents
- Pay attention to detail

Every effort has been made to ensure that these recommendations were considered in the design of the two questionnaires used for the research project**.**

2.7 Questionnaire Scoring System (Likert Scale)

Following a review of the various means of scoring/answering used on previous questionnaires, the researcher opted to use the Likert Scale as the method that respondents should use for answering each of the statements within the two questionnaires.

Although the Likert procedure has its disadvantages, it is undoubtedly less laborious than other scales and is the most popular scaling procedure in use today.

The Likert scoring system was applied in part 2 of the questionnaire as the means for scoring the extent of site manager activity based on the statement being asked.

The Likert scoring system involves a 5 point scale, requiring respondents to state whether they (1) strongly agree, (2) agree, (3) neither agree nor disagree, (4) disagree or (5) strongly disagree with a statement being made.

2.8 Data Analysis

The study used some methods to analyse the data. These methods are covered in detail in Section 3.0. However, a summary is provided here. SPSS (Statistical Package for the Social Sciences) was used as the basis for holding the data collected for objective 2 and 3. This software package provided a range of data management and statistical techniques (Norusis 1992). Frequency methods to determine the number of times a particular factor of safety leadership was referenced from a range of sources. Comparing data from two sources, to see whether there was enough evidence to support the study objective that sites that were more proactive in safety leadership had a better safety performance.Every effort was made to ensure the validity and reliability of the statistical processes undertaken.

3.0 Data Analysis and Conclusions

3.1 Analysis methods

The literature review process provided the primary source of information for studying the objective. A broad range of publications, journals and previous studies into leadership (particularly safety leadership), were reviewed to achieve the objective.The frequency that same factor was mentioned within the different reference sources provided the evidence to support if there was a 'consensus' among the experts on the factors that are most important in demonstrating safety leadership.Responses to site manager and subordinate questionnaire were collected,and each of the statements was entered into the SPSS software. SPSS was used to provide primary output for each of the 34 statements regarding the number (and percentage) of respondents selecting a particular category. The 34 statements were then grouped under their assigned factor of safety leadership, using the code at the end of each statement.

The Likert scoring system (described below) was used to provide total scores for each of the nine factors. The factor scores for the site manager and subordinate questionnaires were then compared, to see whether the two groups were in agreement on the level of safety leadership is applied. The total Likert scores for each of the nine factors of leadership were calculated for both site managers and subordinates. A further calculation was undertaken to determine the 'standard deviation', for each of the factors for both groups.

The construction industry uses a standard calculation to obtain an 'incident frequency rate' (IFR) which is then used to compare performance year on year. This calculation (detailed below) was used to obtain an IFR for each site participating in the study project.

$$\frac{\textit{Number of incidents x 10,00,00}}{\textit{Number of hours worked}} = \textit{incident rate}$$

Note – the incidents selected for the calculation were only those that resulted in 'injury' to personnel and did not include near misses, damage to plant or environmental incidents.The overall total of the Likert scores for site managers and subordinates were calculated on a site-by-site basis. This score was indicative of the level of safety leadership activity being reported on each site.The site Likert scores for each site was then compared with the IFR for each site to see whether those sites with the higher Likert scores had lower IRF's.

A scattergram was used to display the results (see section 3.2 below).

3.2 Results of analysis

The three most frequently suggested factors of leadership from the range of sources referenced were: -

- Building **trust** with subordinates (recorded 8 times)
    - Reflecting the values and aspirations of your followers (O'Toole)
    - Leaders must be trusted (Bennis) (O'Toole) (HSE)
    - Need to win and hold trust (Gardner)
    - Leaders must be approachable (Sefton)
    - Leaders must be honest (Sefton) (Cacioppe)
- Maintaining **integrity**, and (recorded nine times)
    - Task-relevant knowledge (Kets De Vries)
    - Expertise (Powell)
    - High standards of integrity (Nanus)
    - Leaders need integrity (HSE)(Sefton)(O'Toole)
    - Leaders demonstrate integrity in their behaviour (De Pree's)
    - Competence (Cacioppe)
    - Leaders need to know their strengths and their weaknesses ((Bennis)
- **Listening** to subordinates. (recorded five times)
    - Workgroup participation in decision making (HSE) (Sefton)
    - Listening to others (O'Toole)
    - Inclusion (O'Toole)
    - Workforce involvement (HSE)

Table 2 below summarizes the Likert 'mean scores' for each of the nine factors of safety leadership.

Table 1: Application of Safety Leadership Factors

Mean Score Table			
Factor Number	**Factor Description**	**Site Managers Mean Score**	**Subordinates Mean Score**
1	Setting a personal example	3.24	4.94
2	Involving and consulting people in decision making	4.11	3.75
3	Rewarding safe behaviour	4.09	3.68
4	Disciplining unsafe behaviour	4.00	3.31
5	Trustworthy and open	4.24	3.95
6	Demonstrating safety priorities over production	4.53	4.12
7	Communication and feedback	4.07	2.77
8	Personal involvement in safety initiatives	4.07	3.96
9	Building relationships	3.85	2.11

On the whole, the results for all factors reported positive results, to varying degrees, with upwards of 50% of the Likert scores being either neutral or positive.

Factor 1 '*Setting a personal example'* resulted in an 88% positive score by the site managers and 73% by subordinates. One of the main areas of disagreement was in statement 10 '*people work safer when the site manager*

is walking about on site'. 67% of site managers believed that they did have an influencing effect on subordinate behaviour when they were on site, whereas only 36% of subordinates is agreeing and 40% disagreeing. Factor 2 '*Involving and consulting people in decision making'* resulted in an 82% positive score by site managers and 75% by subordinates. There was little disagreement on any of the four statements in this factor. Encouraging was the closeness of the results for statement 31 'The site manager encourages the workforce to take on a more active role in health and safety'. The scores for this were almost identical, with 93.4% and 93.1% either agreeing or strongly agreeing and the others are remaining neutral.Factor 3 '*Rewarding safe behaviour'* resulted in an 82% positive score for the site managers and 74% for subordinates. The main area of disagreement was in statement 1 '*people are rewarded for taking on additional safety responsibilities'*. Subordinates scored much lower (only 54% positive) than site managers (80%).

Factor 4 'Disciplining unsafe behaviour' resulted in an 80% positive score for the site managers and 66% for subordinates. The main difference in opinion lay around statement 21 'people are appropriately disciplined on the site for breaches of safe working practices'. Subordinates scored this much lower than site managers (34% against 73%) with more subordinates remaining neutral (47%).

Factor 5 'Trustworthy and Open' resulted in an 84% positive score for the site managers and 79% for subordinates. There were a number of areas of disagreement between site managers on this factor. For statement 16 '*subordinates trusted the site manager enough to approach them on any matter*' scored well with only 10% between the scores (subordinates scoring lower) and the negative scores for both groups being higher on the site manager side rather than the subordinates. 100% of site managers agreed that there was '*no reason why people should feel afraid to report incidents on site*' (statement 24), however, 41% of subordinates either disagreed or remained neutral (59% positive). There was a very positive score by the subordinates for statement 32 '*I feel I could tell the site manager if I had a concern about safety on site'*, with 97% either agreeing or strongly agreeing with the statement.

Factor 6 '*Demonstrating safety priorities over production'* resulted in a 91% positive score for site managers and 82% for subordinates. The most significant finding in this factor was in statement 11 'there is no *pressure to get the job done at the expense of adhering to safe working practices'*. One of the site managers disagreed with this statement.Factor 7 'Communication and feedback' resulted in an 83% positive score by the site managers and 78% for subordinates. Statement 19 '*the site manager talks more about safety than production*' seemed to affect the scores most significant, with site managers scoring only 46% and subordinates 22%, with many remaining neutral.

Factor 8 'Personal involvement in safety initiative' resulted in 76% positive by the site managers and 78% for subordinates. There were no significant findings from this factor.Factor 9 'Building relationships' resulted in a 77% positive score by the site managers and 75% for subordinates. The main observation was in statement 17 '*the site manager pushes the safety agenda purely to satisfy senior management'*. One of the site managers agreed with this statement. It is evident that the results for factors 2 to 9 that there is a likelihood that the results could have occurred by chance and therefore statistically they are not significant.

The results for factor 1, reported a significance score of 1.95, which means that there is only a 3% chance that the results could have occurred by chance and therefore (statistically) there is evidence to suggest that the site managers and subordinates are in fact not members of the same group and that some confidence can be placed on the results.Table 3 summarizes the mean scores obtained following the calculation of points from the ranking exercise, described in section 3.1 above. A column is included in the table to show where the factor ranked for subordinates and site managers.

Table 2: Factors of Safety Leadership

Mean Score Ranking Table					
Site Managers			**Subordinates**		
Factor	**Mean Score**	**Final Rank**	**Factor**	**Mean Score**	**Final Rank**

Number			**Number**		
1	8.73	1	1	6.54	2
2	5.06	5	2	5.00	5
3	3.20	8	3	3.25	8
4	1.93	9	4	3.16	9
5	6.20	2	5	7.01	1
6	5.40	3	6	5.27	3
7	5.13	4	7	5.17	4
8	4.27	7	8	4.69	7
9	4.80	6	9	4.80	6

Interesting to observe that subordinates view factor 5 '*Trustworthy and open'* as their most important factor, above '*setting a personal example'* with site managers ranking these in reverse order.

Table 4 below provides a summary of the injury frequency rates for each site along with the combined Likert scores for site managers and subordinates.

Table 3: Injury Frequency Rates

Site	Injury frequency rate (IFR)	Site rank by IFR score	Likert score for site managers and subordinates	Site rank by Likert score
A	0.00	1	268.9	4
B	3.25	6	289.0	2
C	2.66	5	298.2	1
D	0.00	1	284.8	3
E	0.58	2	256.0	5
F	1.05	4	252.6	6
G	0.00	1	243.4	7
H	0.89	3	Excluded – no SM quest returned	Excluded – no SM quest returned

A scattergram was used to plot the results for each site and identify whether there was anyapparent association between Likert scores and Incident Frequency Rates (IFR's). Thisis shown in *figure 2* below.

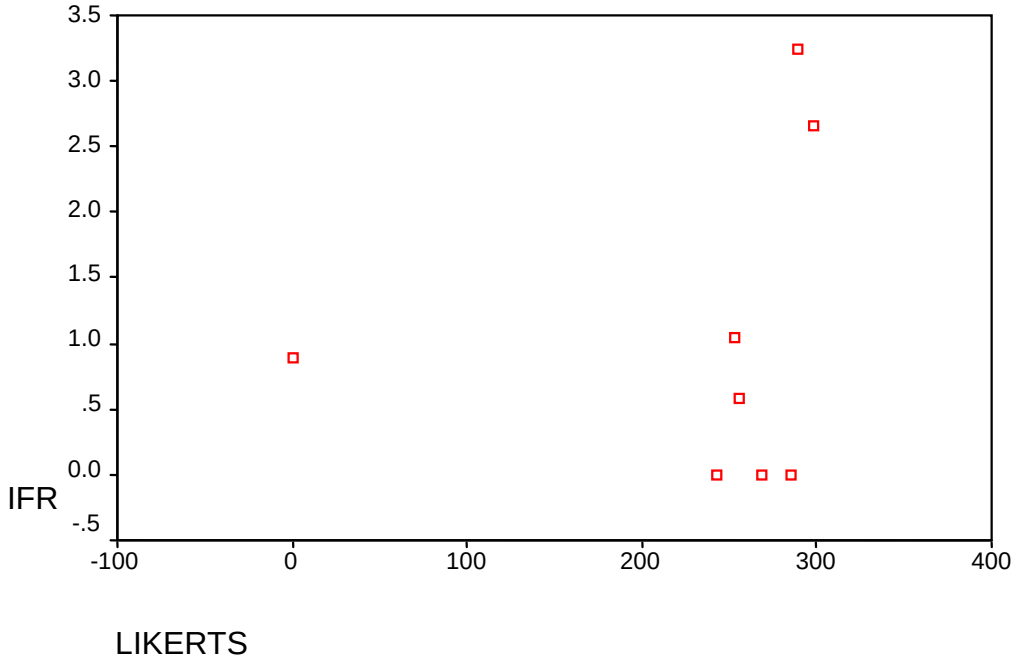

Figure 1: Factor Likert Score V's IFR

3.3 Study Conclusions

The purpose of this study project was to explore the safety leadership factors influence in Safety Culture. The evidence gathered during the project, and the resulting analysis provides a foundation on which to either refute or support each objective.

The review of literature covered approximately 28 reference sources. Some aspects of leadership were clearly identified from a range of sources (experts), as isnecessary, such as trust, integrity and listening.

The is a considerable amount of opinion in the area of leadership, with some experts focusing on the *relationship* aspects between leaders and subordinates, others on the *characteristics* and *traits* of a leader and also view that leadership is an *event* and should not be characterised physically by ideals of behaviour.

Although some common ground amongst the experts was evident during this 'small-scale' review, the study was not extensive enough to be sure that the results of the sources referenced were in fact representative of other available sources.

There was evidence to support that factors of safety leadership were being appliedto sites within the construction industry.

The study highlighted some areas of disagreement in that subordinates suggested they did not alter their behaviour when the site manager was on site, that people were not always rewarded for taking on additional safety responsibilities and that some incidents may not be reported through fear of victimisation. Both groups seemed unsure whether disciplinary action was used appropriately.Only factor 1 scored highly on the significance test with some level of confidence reported that the results for factor 1 were in fact from two distinct groups. Based on this it can be inferred that the factors of safety leadership are not actively appliedto sites within the Construction industry in UAE. Although site managers and subordinates did not agree on the order of the first two factors of safety leadership, both groups had the same factors as their top two most crucial safety leadership factors. More surprisingly, was the order in which site managers and subordinates placed the remaining seven factors of safety leadership. Results show that both groups ranked the remaining seven factors of safety leadership in precisely the same order.

Given the significance test results for factor 1 '*setting a personal example'* and the evidence presented in Table 3 above, it can be concluded that t*here is a*consensus between subordinates and site managers on the factors that are most important when demonstrating safety leadership.In order for this objective to be confirmed a number of factors needed to be present in that firstly, incident data was required on which to complete the calculation to determine the incident frequency rate (IRF) and secondly that the Likert scores were available for each of the sites. Looking at Table 4 in section 3.2 above is evident that some sites reported no incidents during the review period, which although very positive concerning the sites safety performance meant that those sites could not be included in the study of the objective.

The final issue was about the data available and its association with the objective being tested. It was evident from the data that there was little association between those sites reporting low IFR's and those sites scoring highly within the questionnaires. Thisis shown in Figure 2 above.Although the relationship between attitude and behaviour has been shown in some studies to have a relationship to accident rates in the chemical, automotive, steel and construction industries (Boyett et al., 1998; Whittington et al., 1992), the results of this study project proved to be inconclusive.

3.4 The need for further study

The study was unable to define precisely what the factors of safety leadership were from the range of expert opinion available. Although some areas of common ground were identified, the available range of opinion on safety leadership proved to be too extensive to be covered satisfactorily within the timescale of this study project and therefore more extensive study is needed.There was little statistical evidence to support the application of factors of safety leadership on sites within the construction industry. A more substantial population of site managers may have provided very different results, and therefore an opportunity exists to undertake this in the future.The study has provided evidence that site managers and subordinates are aligned on factors of safety leadership that are important for a site manager to demonstrate safety leadership. The consensus that '*Trustworthy and Openness'* and *'Setting a Personal Example'* featured as the two most important factors for both site managers and subordinates helps to support earlier study conducted on supervisors (HSE, 1999). The link between safety leadership behaviour and accident rates was not established. Further refinement of the principles used in this study project could be undertakento test this objective in the future.

4.0 Summary

The study has provided further insights into the application of safety leadership factors within the construction industry, with some of the findings reported in an earlier studybeing supported, i.e. the importance that '*setting a personal example'* and '*openness and trust'* have to play when demonstrating safety leadership. The importance of consultation had also been recorded in an earlier study (Whittington et al., 1992) and there was evidence to support this earlier study within this project.

The alignment between site managers and subordinates on the ranking of safety leadership factors was unpredictable, however also very encouraging, highlighting that management and the subordinates may be more closely aligned than previously thought – if this population sample reflects the broader population.

The ability to identify the 'key' factors of '*safety leadership'* from the literature review was unsuccessful. The difficulties in identifying common ground amongst the experts on the factors of safety leadership (and leadership in general) have been identified by Kits de Vrie's (1995). He concluded that, although most studies would agree that traits such as conscientiousness, energy, intelligence, dominance, self-confidence, sociability, and openness to experience, task-relevant knowledge, and emotional stability are important, beyond that limited area of agreement, 'the myriad theories diverge, and it is easy to lose oneself in the academic hair-splitting Kits De Vrie's (1995).The study failed to identify a link between safety leadership behaviour and accident rates. The reasons for this could be many, however further study in this area may prove to be useful in understanding the role that safety leadership has to play in the overall 'organisational factors' affecting today's workplaces.

Opportunities to further enhance safety leadership factors have been provided by this study, with regards to ensuring appropriate disciplinary action is being used. The study also provided some areas for an address in that there were still views that subordinates may not be reporting all incidents through fear of retribution.
One last observation related to whether the subordinate behaviour was influenced positively when the site manager was on site. Readers could make two interpretations of these results. Either site managers are not positively influencing subordinate behaviour, or the subordinates are working safely irrespective of whether the site manager is on site or not.

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MANAGEMENT OF HSE RISK AND IMPLEMENTATION OF SAFE WORK PRACTICES IN ELECTRICAL INSTALLATIONS

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Abstract

The chance of fatality increases when a person comes into the contact of substantial electric current. As it passes through the body (following low resistance path)to ground causes skin lesion, fibrillation, organ damage or death etc., nature of these fatalities are almost accidental but, most of it occurred due to unsafe working condition and unsafe acts which, in terms can be predicted as an electrical safety issue in the working procedure of an organization. Electrical accident follows the pattern and extensive burns with charring cloths were being depicted in cases of high tension electrocution. There is a very high possibility of fatality when the person remains unattended after electrocution. Seeing the industrial accidents in order to manage HSE risks and implementation of safe work practices there is a need to transform the electrical power industry in terms of generic risk assessments and electrical safety checklist at any working voltage.
This paper gives the importance of generic risk assessment and electrical safety checklist for managing HSE risks with the help of some relevant case studies based on electrical accidents.

Keywords:

HSE risks;
Safe work practices;
electrocution,
working voltage;
industrial accidents;
power industry

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1. Introduction

Electrical installations are the group of equipments installed from a common electrical supply in order to serve and fulfill the required task of conveying electricity to a point of consumption or used to generate or store electricity. All the fittings are combined to form as a part of the system. There is a story which makes no sense at all but very famous as it leads towards the adaptation of electrical safety procedure, in the late 1800s, it was evident that hotels

had to place signs and posters for assuring their guests that electricity is harmless in order to increase their guest list. By the late 1900s, the scenario got changed totally and now, signs had to be hung to remind everyone that electricity is a hazard for and to maintain a safe distance from it. In fact, the transition of electricity from a silent and casual interpretation to a deadly hazard is a change that many cannot understand until it happens to them in order to affect their well being. Because of these facts, the total acceptance of an electrical safety procedure became a requirement for the health and welfare of workers.(Kumar, Verma et al. 2014)Electricity is an inherent part of present generation and its unsafe handling increases the probability of getting minute electric shock to electrocution which is normally preventable with the implementation of safety measures. In industries many workers are daily exposed to electrical energy while performing their general duties but, only few understands that even a small amount of electrical energy can lead to electrocution. For an e.g. electric current from 7.5W/120V incandescent lamp when passed through our body (hand to hand or hand to foot) through chest is sufficient to cause fibrillation. It is evident that normal household appliance also imposes very high risk in case someone operating it in an unsafe manner or breakdown of insulation. The end result i.e. Electrocution may happen from 7.5W electrical bulb or overhead electrical power lines. So, electricity is always treated as a hazard irrespective of its intensity and person while working with electricity online must wear an appropriate personal protection accordingly. There is no country remained unaffected by occupational accidents and power sector is most critical in the sense that, even though one can try to reduce the probability of accidents by applying control measures but, most of the times severity remains unchanged. Many efforts are aggravated in terms of continual improvement and up-gradation of safety precautions and legal regulations but, it seems not a single country can negate the outcome of electrical accidents. Of course, there is a vast difference in the safety precaution and significant controls when we compare countries in terms of implementation, which is solely depends its own economic capacity, strength and vigilance of enforcement agencies. (Bastian, Carman et al. 2015)To capture ground potential rise during ground fault there exist an electronic recording system. When a distribution network is supplied by wye-transformer subjected to ground fault, the fault current returns back to transformer wye point via earth, local grounding grid as well as any metallic parts and there is a rise in ground potential leads to creation of touch and step potentials inside and within the surrounding areas of substation until the operation of protective devices or self clearance of fault. So, if the grounding system is not working properly there is a chance of electric shock to employees and public in the vicinity of substation. Therefore, substation grounding system should be regularly accessed via. Visual inspection, ground continuity testing, low current injection testing etc. with specified time frames as recommended by different regulatory standards.

Factors Affecting the Severity of Electric Shock

- **Physical Condition:** A good physical condition tends to cause less trauma for a given amount of electrical current flow whereas, a person with any medical problem (e.g. heart or lung ailments) are severely affected by the effect of electric shock.
- **Current Duration:** We know that,

$$J = I^2RT$$

Where,
J: energy; Joules
I: current; Amperes
R: resistance; Ohms
T: time of current flow; Seconds

As the energy delivered by current through our body is directly proportional to the time duration therefore is increase in the duration of flow of current, increases the severity or trauma.
Since, the frequency of current flow does not match with the frequency of heart beat per minute. Therefore, even shorter duration current leads from minute electric shock and fibrillation to electrocution as this current tends to overlap the body's cardiac cycle.

- **Frequency of Current Flowing:** For higher frequency currents, Joule heating effect ($J= I^2RT$**)** become less momentousas there is an increase in capacitive current flow in higher frequency. It is also evident that there is

apparent difference between DC (zero Hz) and power line frequency (50Hz) at equal magnitude of current in terms of the phenomenon of "let-go" threshold, which is higher in case of DC than that of AC.

- **Voltage Magnitude:** Initially it was assumed that at same magnitude of electric current 200V source would create the same effect as 2000V source. But, practically higher voltage is more lethal for these reasons:
    1. Electrical pressure above 400 volts may be sufficient to puncture epidermis as there is a significant amount of resistance provided by epidermis to current flow, here current magnitude dramatically increases.
    2. For greater cellular voltage gradient, the degree of electroporation is higher as severity of electroporation increases at higher fields.
    3. There is an increased chance of electric arcing with higher voltage at the point of contact with the electrical conductor.

Power Generation, Transmission and Distribution System in India

In India Power sector is ever growing at very fast speed. Within year 2017-18 (till 30.09.2017), the Peak Demand (P_d) is aproximately 164.1 GW & it is increasing day by day and the Installed Capacity (Ic) is 329.3 GW at present with the mix generation of Nuclear (2.1%), Renewable (17.7%), Hydro (13.6%) & Thermal (66.6%). Power generation, transmission and distribution sources in India is totally unbalanced and are unevenly dispersed as, it is concentrated within few pockets but spread throughout the country. The natural resource of hydro power is located in the foothills of Himalayas and in the North East. Coal reserves are particularly centered in Jhadkhand, Kolkata, Orissa, Chhattisgarh belt and certain segments of Madhya Pradesh whereas Tamil Nadu and Gujrat are the sources of lignite. Over the years a wide-ranging network of Transmission lines has been build and developed as the power is produced by various power generating stations, transmitting to substations and distributing the same to the consumers in order fulfill their load demands. Subjected to the amount of power and the distance involved, there have been electrical lines laid down. The ostensible EHV (Extra High Voltage) lines in particular are ± 800 kV HVDC & 765kV, 400 kV, 230/220 kV, 110 kV and 66kV/33KV, 11KV AC voltages ect. All the SEBs (State Electricity Boards) and those including in central sectors have been installed these lines.

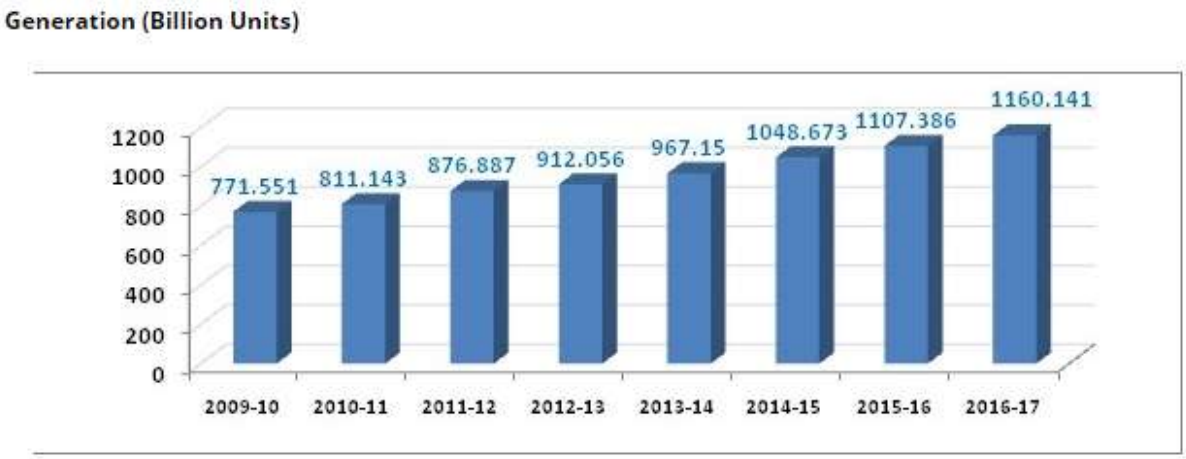
Total of 12,551 circuit km of lines have been commisioned in 2017-18 (April toSeptember 2017 quarter) and the annual target of 54.4% is already achieved which is of 23,086 ckm for 2017-18 and in addition to this the transformation capacity of 42,065 MVA substations has also been supplemented during 2017-18 (April to September 2017) which constitutes to 77.9% of the 53,978 MVA total annual target for the year 2017-18.

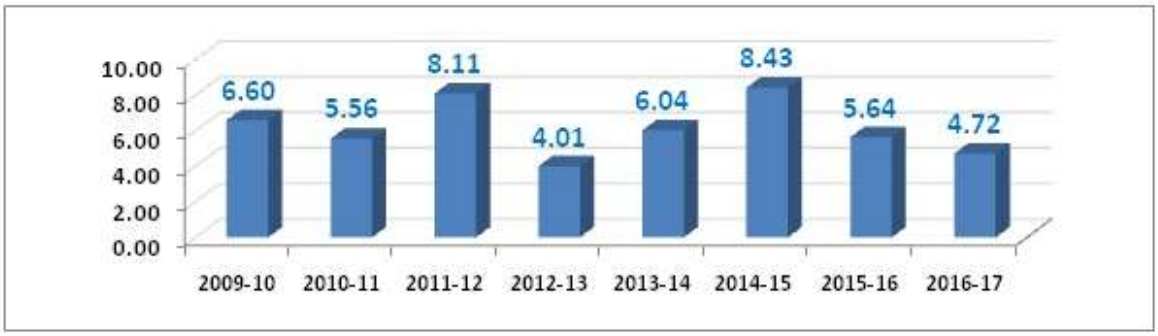
As on 23-10-2017 **Source: OM SECTION**
Total Installed Capacity (As on 31.09.2017) : Central Electricity Authority (CEA)

Sector	**MW**	**% Of Total**
State Segment	81,102	24.6%
Central Segment	103,033	31.3%
Private Segment	145,165	44.1%
Total	**3,29,298**	

Fuel	**MW**	**% Of Total**
Total Thermal		
Oil	1,93,427	66.60%
Gas	25,185	58.70%
Coal	838	7.60%
Hydro (Renewable)	44,653	13.60%
Nuclear	6780	2.10%
RES *(MNRE)	58,303	17.70%
Total	**3,29,226**	

Growth in conventional generation of power in India - between 2009-17, URL: (http://powermin.nic.in)





Risk- Evaluation, Assessment and Management

Hazard: It is basically, source or situation that has is likely to cause harm in terms of injury or ill health of a person, defect/harm to machine or equipment, property, environment etc. and depends on nature and position. For example, in electrical industries: poor wire insulation, unauthorized working, unprotected electrical parts, loose electrical connection, over voltage or short circuit or over current due to any electrical fault, gradual phase changing, maintenance without control of hazardous energy via. LOTO, inappropriate PPEs etc. which can lead to the risk (combination of severity of injury and likelihood of occurrence of hazardous event) of electrocution.

(Luko 2014)Risk Assessment techniques-There is a lot of deviation in understanding the notion and utilization of principles of risk management and ANSI Z690.3-2011 is most useful for mid management and quality engineers but not as useful for technical specialists.
(Aven 2016)Risk assessment and management plays very important role in decision making process and are established as a scientific field of study and made to continual improvements in order to meet with new challenges every now and then.
It is very important to distinguish between risk management and risk assessment.

- ✓ The phenomenon of risk assessment provides us with the answer to: How risky the situation is?
- ✓ Whereas its management provides us with the answer to: what should we do about it?

The phenomenon of Risk management provides us with the systematic function of management policies, practices and procedures so as to analyze access & control risks and associated identified hazards in order to protect employees, general public of the vicinity as well as local/global environment as well as company assets while avoiding business discontinuity. We can also define Risk Management as the continual process of identification, evaluation, selection, and implementation of actions plans to turn down health risk and to ecosystems. The risk management is having a goal which is dependably sound and economic by preventing risks taking integrated actions that reduce while taking into account of civil, cultural, ethical, political, and legal legislations. Risk management is a step by step and logical process to identify, reduce and control the workplace hazards. This process includes any or all of the following steps:

- Identify the hazards
- Define risks levels
- Define risk reduction measures through control measures
- Obtain signature of approval form authourity (generally CEO)
- Implement risk reduction measures through control measures

Risk assessment is defined to be, identification of hazards and its associated risk analysis and evaluation in order to analyze the form, characteristics and dimension of the risk. Here the formulation of risk assessment sheet is done by the process of collection of data of respective processes and operations from appropriate sources and used to estimate probability and severity of occurrence in order to provide its control measures and reduce the estimated probability and severity indices as a result of brain storming sessions. A risk assessment is an estimation and evaluation of the potential health effects on workers who are continuously exposed to hazardous materials or situations. It should consider all pertinent, veracious, and reasonably available information, and must explain the criteria for selecting all the relied informations. Risk assessment steps:

- Identification of hazard (area by area basis)
- Decide who is getting affected
- Evaluate risk and decide its precaution in terms if control measures
- Record finding and implement them
- Review risk assessment sheets and update for continual improvement

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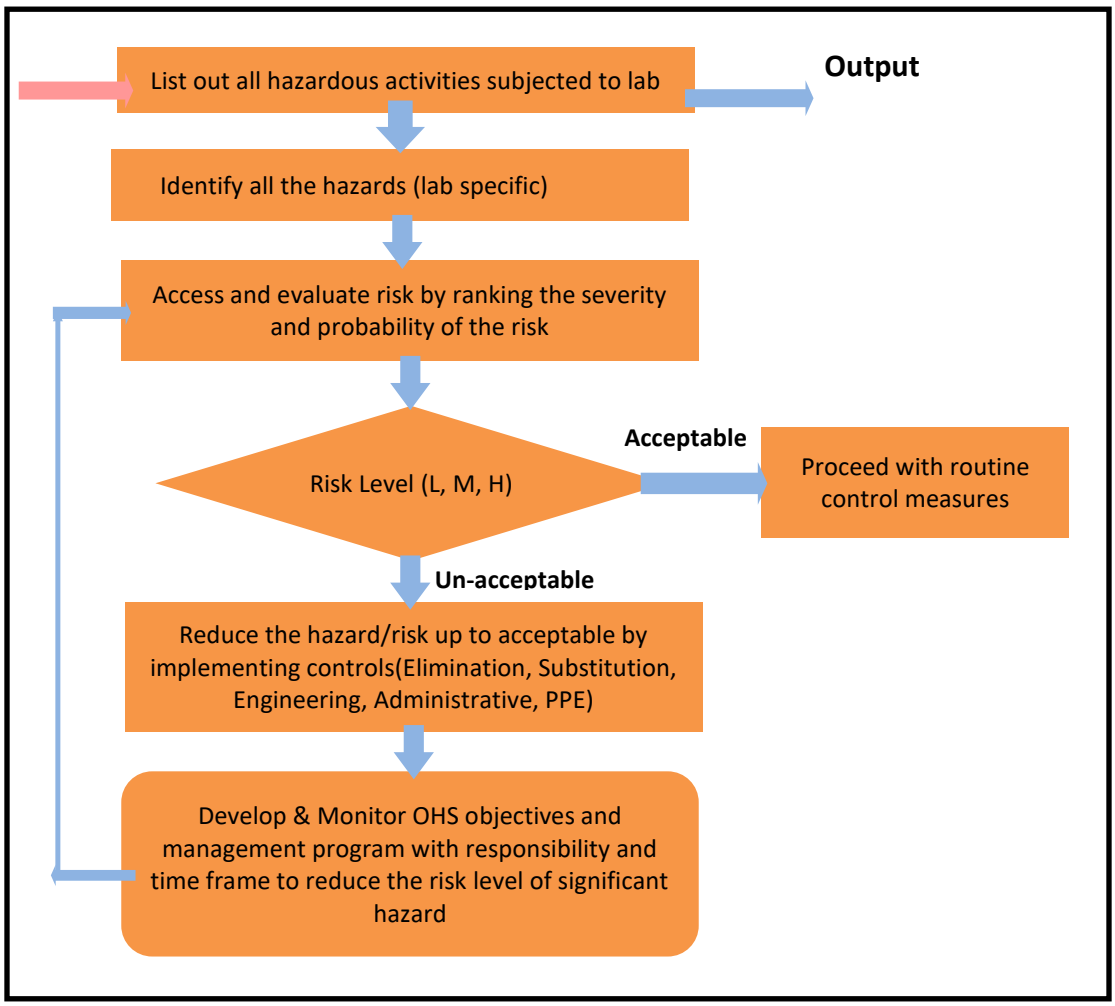

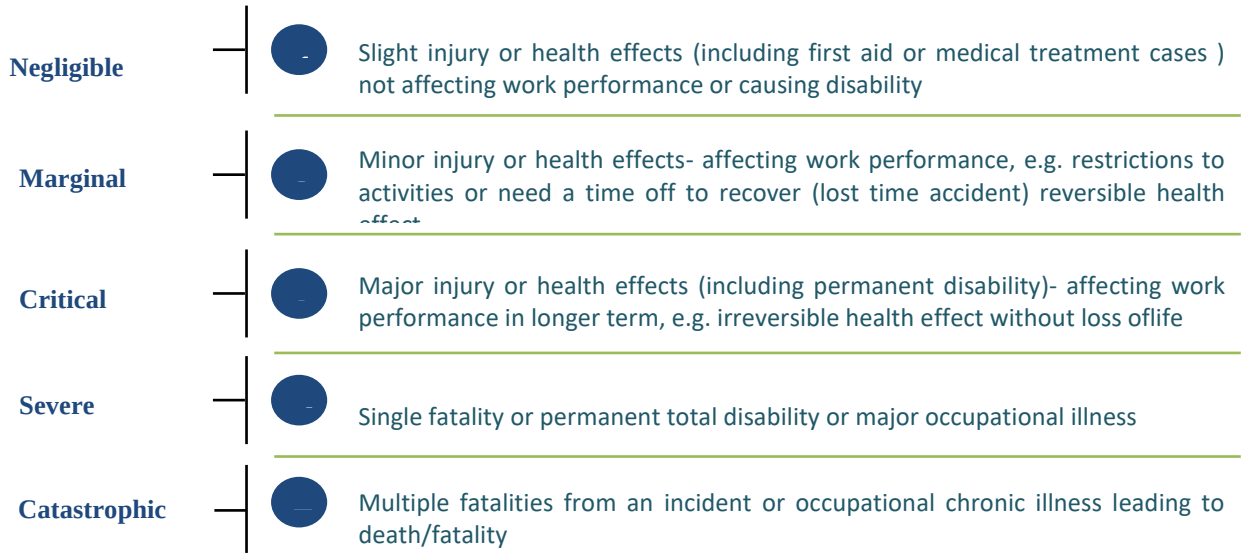

2. Case Study

Case Study	Methodology	Main Findings/Conclusions
Electrocution related mortality in Northern India	5 years contemplative study	• Out of total 83 cases 71.1% of electrical accidents having contact marks, 17% of accidents having electrical contact and grounding marks and no such marks are visible in 10 victims. • Death due to electrocution mostly occurred from July to Sept. (Monsoon).

		• These accidents signify that workers do not have any elementary knowledge of risks from electric shocks and most of the accidents were preventable.
Maintenance Method based on Risk Estimation for 170kV Gas Insulated Switchgear (GIS)	FMEA and risk analysis for pneumatic type GIS based on collected historical data of failures and surveys of experts	• Defined sub systems of failures and functional failures by classifying historical data. • Estimation of frequency by classifying failure types using Analytical Hierarchy Process (AHP). • Risk estimation • By doing condition assessment test, disassembling and examination the GIS operable on outdoor substation for more than 20 years, it is founded that operational performance of the parts of pneumatic system got degraded with time and its risk priority is high.
(Tuyou, Jiekang et al. 2016)Power supply risk assessment method for relay protection system faults	• Relay protection system, hidden faults of reduced power supply load power-A Probability analysis • Calculation of risk value due to relay protection system sudden faults.	• The hidden fault is the cause of all the occurrences of over-load, reduced power supply load or outage of the relay protection systems. • Reduced power supply load power probability is proportional to the risk value due to hidden faults of relay protection system.
Risk assessment techniques as decision support tools for military operations	Qualitative and Quantitative risk analysis	• Both the analysis techniques for risk assessment can be applied as decision support tools. • Qualitative risk assessment identifies all the possible events which impacts transportation and Quantitative RA estimates good relevance of the time duration in much precise form.
(Ünsar and Süt 2015)Occupational accidents in energy sectors in Turkey between 2002-2010	Study of work accidents statistics (Turkey Electricity Generation Corporation website) between 2002 to 2010	• Trends shows that number of accidents every year is more than 100 accept 2005, 2006 and 2009. • Number of deaths increases 2.5 times as on 2009 compared to 2002. • Percentage of accidents is higher when workers are not wearing PPEs, unsafe materials, personal faults and insufficiency in these plants. • Work accidents mostly occurred while workers are doing maintenance. • More emphasis must be given to incident investigation and employee training with the formation of work security culture.
(Jia, Qi et al. 2015)Hierarchical risk assessment of transmission system considering the influence of active distribution network	Case study depicting • Distributed generation capacity influence on system risk. • System risk due influence to DGs' capacity proportion.	• As distributed generation capacity increases, expected energy not supplied (EENS)-MWh/y and Severity Index- system min/y, decreases smoothly. When the generation capacity is 40% of maximum load maximum power is observed. • The effectiveness of Power support from micro turbine is better than wind generation and photovoltaic generation because these two are having random power output and cannot be maintained rated.

	• DGs' dispersion influence on system risk. • System risk due to component outage probability. • DGs' location influence on system risk.	• EENS (expected energy not supplied), PLC (probability of load curtailment), EFLC (expected frequency of load curtailment), SI (severity index) all indices is inversely proportional to dispersion degree. • EENS & SI increases with increase in outage probability therefore it is evident that DGs cannot able to generate sufficient power generation in order to transform from abnormal to normal condition. • DGs to be located in order to maintain balance between DGs capacity and local load.
(Mukherjee, Farooqui et al. 2015)Retrospective study of fatal electrocution in rural region of western Maharashtra, India	Investigation of deaths, autopsied in different hospitals of Maharashtra due to electrocution via. Medico logical records and subjective analysis of postmortem reports.	• Out of 2292 autopsies, 2.31% of deaths are fatality due to electrocution and are accidental in nature where majority is for males nearly 79.25%. • Highest number to fatalities is observed during June to sept. And in 90.57 % of cases are having electric mark or burn. • Majority of deaths occurred before even brought the victims to hospital.

3. Conclusion

It is very evident that from the review that for all workers (whether electrical or non electrical) in an industry, electricity is somehow the part of their work what they are performing and majority of electrical accidents had occurred because of the reasons: Improper knowledge, Inappropriate use of materials while working on line, Inappropriate protective equipments, Personal faults, Lack of training and Lack of risk management

So, in order to manage the risk from electrical energy and implementation of safe work practices, every task must where there is a requirement of working with electrical energy directly or indirectly should have Generic risk assessment sheet , Electrical safety checklist.

These two should be the minimum requirement to check any indicative potential hazard before starting any work. These RA sheets and checklist should be updated and modified time to time in order to provide continual improvement.

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SUSTAINABLE OPTIONS FOR E-WASTE MANAGEMENT

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Bahukhandi Kanhan Deoli

Abstract

"E-waste" is a popular jargon for electronic products nearing the end of their useful life. E-wastes are considered dangerous, as certain components of some electronic products contain materials that are hazardous, destined for reuse, resale, salvage, recycling, or disposal depending on their condition and density. The hazardous content of these materials pose a threat to human health and environment. Discarded computers, televisions, Laptops, servers, stereos, copiers, fax machines, electric lamps, cell phones, severs, audio equipment and batteries if inappropriately disposed can leach lead and other substances into soil and groundwater. Many of these products can be reused, refurbished, or recycled in appropriate options so that they are less harmful to the ecosystem. This paper is basedonsecondarydatathat study the e-waste composition, Global and Indian E-waste scenarios and the hazards of e-wastes, the need for its appropriate management, public awareness and environment friendly technological sound options that can be implemented.

Keywords:

E-Waste;
Environmentally sound management ;
Sustainabile development ;
Extended Producer Responsibility;

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1. Introduction

Electronic waste or e-waste is the term given to describe any electronic product, or product containing electrical components, that has reached the end of its usable life cycle [1]. We are constantly confromusnted with environmental changes across the world, ranging from mismanagement of wastes, contamination and industrial revolution followed by the advances in information technology during the last century has radically changed people's lifestyle. In recent time, waste electrical & Electronic equipment(WEEE) or electronic waste (e-waste) generation, trans-boundary movement and disposal are becoming issues of concern to solid waste management professionals, environmentalists, international agencies and governments around the world [2] ,[3].Electronic waste contain toxic substances such as lead, mercury, cadmium and lithium [4]. These Toxic materials can be released upon disposal posing a threat to human health and the environment. For example, Laptops contain certain components, which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, plastics and plastic additives. These days computer has become most common and widely used gadget in all kinds of activities ranging from schools, residences, offices to manufacturing industries. Basel Action Network (BAN) estimates that the 500 million computers in the world contain 2.87 billion kgs of plastics, 716.7 million kgs of lead and 286,700 kgs of mercury. E-waste is becoming a crucial waste stream in terms of both quantity and toxicity [5]. The total amount of e-waste produced has reached approximately 41 million ton in 2014 and increasing at a rate of 3-5% every year [6]. However electronic waste also contain precious metals such as gold ,silver which offer opportunities for economic extraction. Recycling of WEEE is significant not only for the recovery aspect of valuable materials there are also significant energy savings when recycled materials are used in place of virgin materials [7].

2. Toxic effects on environment and human health

Disposal of e-wastes is a particular problem faced in many regions across the globe. E-Wastes that are landfilled produces contaminated leachates, which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil. Incineration of e-wastes can emit toxic fumes and gases, thereby polluting the surrounding air. Improperly monitored landfills can cause environmental hazards. Mercury & other heavy metals will leach when certain electronic devices, such as circuit breakers are destroyed. The same is true for polychlorinated biphenyls (PCBs) from condensers. In addition, burning e-waste is the open-air burning of plastics in order to recover copper and other metals. The toxic fall-out from open air burning affects both the local environment and broader global air currents, depositing highly toxic by products in many places throughout the world. The World Health Organization states that heavy metals such as lead and cadmium, even at low levels, can threaten child development and cause neurological damage [8].

Table I summarizes the health effects of certain constituents in e-wastes. If these electronic items are discarded with other household garbage, the toxics pose a threat to both health and vital components of the ecosystem. In view of the ill-effects of hazardous wastes to both environment and health, several countries exhorted the need for a global agreement to address the problems and challenges posed by hazardous waste. International outrage following these irresponsible activities led to the drafting and adoption of strategic plans and regulations at the Basel Convention. The Convention secretariat, in Geneva, Switzerland, facilitates and implementation of the Convention and related agreements. It also provides assistance and guidelines on legal and technical issues, gathers statistical data, and conducts training on the proper management of hazardous waste.

Table I: Toxic Effects of E-Waste components on health

Source of e-wastes	Components	Health effects

Relays and switches, printed circuit boards	Mercury (Hg)	Chronic damage to the brain. Respiratory and skin disorders due to bioaccumulation in fishes.
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (PB)	Damage to central and peripheral nervous systems, blood systems and kidney damage. Affects brain development of children.
Chip resistors and semiconductors	Cadmium (CD)	Toxic irreversible effects on human health. Accumulates in kidney and liver. Causes neural damage. Teratogenic.
Corrosion protection of untreated and galvanized steel plates, decorator or hardner for steel housings	Hexavalent chromium (Cr) VI	Asthmatic bronchitis. DNA damage.
Cabling and computer housing	Plastics including PVC	Burning produces dioxin. It causes Reproductive and developmental problems; Immune system damage; Interfere with regulatory hormones
Plastic housing of electronic equipment and circuit boards.	Brominated flame retardants (BFR)	Disrupts endocrine system functions
Front panel of CRTs	Barium (Ba)	Muscle weakness; Damage to heart, liver and spleen.
Motherboard	Beryllium (Be)	Carcinogenic (lung cancer) Inhalation of fumes and dust. Causes chronic beryllium disease or beryllicosis.
Rubber	-----	Phthalate plasticizer, BFR
Batteries	-----	Lead,Lithium,Cadmium,Mercury

3. Results and Analysis

3.1 Basel Convention

The fundamental aims of the Basel Convention are the control and reduction of trans-boundary movements of hazardous and other wastes including WEEEDirectivesandRestrictionofuseofCertain HazardousSubstances(RoHS),whicharealsoimplementedbyother countries.According to EU directives, itis mandatoryforall27countriesofEuropeanUniontorecycletheire-waste [9],[10] . The increasing number of environmental regulations like EU's Restriction of Hazardous substances Directive(RoHS), the Registration, Evaluation, Authorization and Restriction of Chemicals(REACH) regulation and the Waste Electrical and Electronic Equipment (WEEE) directives makes it imperative for companies to engage in sustainability and good environmental practices.

3.2 Mnagement of E - Waste

It is estimated that 75% of electronic items are stored due to uncertainty of how to manage it. These electronic junk lie unattended in houses, offices, warehouses etc. and normally mixed with household wastes, which are finally disposed off at landfills. This necessitates implementable management measures.

In industries management of e-waste should begin at the point of generation. This can be done by waste minimization techniques and by sustainable product design. Waste minimization in industries involves adopting:

- Eco Design
- Volume Reduction
- Extended Producer Responsibility
- Recovery and reuse.
- Awareness and Communication

3.4 Eco Design

Eco design is state of art to the actions during product development to minimize its environmental impact during its life cycle (cradle to grave) approach. It is an important consideration since it forms the basis of most of the environmental impacts during production, consumption and disposal of a product. Eco design activities include design for reduction or elimination of environmentally hazardous materials, design for re-use, design for recycling design for remanufacturing and design for resource efficiency.

3.5 Volume reduction

Volume reduction includes those techniques that remove the hazardous portion of a waste from a non-hazardous portion. These practices are usually to reduce the volume, and thus the cost of disposing of a waste material. Segregation of wastes is in many cases a simple and economical technique for waste diminution. Wastes containing different types of metals can be treated separately so that the metal value in the sludge can be recovered. Concentration of a waste stream may increase the likelihood that the material can be recycled or reused. Methods include gravity and vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc.

3.6 Extended Producer Responsibility:

One of the important features of the e-waste (Management and Handling) rules 2011 & e E-Waste (Management) Rules, 2016 are the inclusion of extended producer responsibility (EPR) under the provisions of these rules thus making EPR mandatory. In particular, the producer is entrusting with financial and physical responsibility of their product, once the consumer discards them. This extends the responsibility of the producer for a product's life cycle. The main concept is that the responsibility and costs of managing, recycling, and disposing of a particular product is to be borne by the producer of that product, rather than society [11].

The rules state that EPR can be implemented by the producers either individually or collectively. Individual Producer Responsibility (IPR) means the responsibility of producers for its products through the entire cycle including the collection and end of life management. Collective Producer Responsibility (CPR) implies that consortium of producer takes responsibility for end of life management of products of all the members of the consortium. According to these rules the producers have to ensure e waste is collected through authorized collection agencies and channelized to a registered dismantler or recycler. The EPR suggests that the producer (manufacturer or importer) of the product is responsible for the management of product through the life cycle of the product including the end of life management of products. This could be done by means of increase in use of recycled constituents in the products, enhancing the ease of product disassembly and by considering other ways to reduce the overall environmental footprints of a product.

3.7 Recovery and reuse

This technique could eliminate waste disposal costs, reduce raw material costs and provide income from a saleable waste. Waste can be recovered on-site, or at an off-site recovery facility, or through inter industry exchange. A number of physical and chemical techniques are available to reclaim a waste material such as reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation etc. However recycling of hazardous products has little environmental benefit if it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use non-hazardous materials, such recycling is a mirage.

3.8 Awareness and Communication:

An essential aspect in the process of compliance of any rule is the creation of awareness among the stakeholders on the various aspects of the products, including the requirements for the environmentally sound management of the product at the end of life. The awareness creation can also be done through educational institutions. Awareness is also essential regarding the hazardous constituents present in the equipment as well as the safe handling and disposal of the product after its use. The producers should provide information on safe handling of the product to ensure its safe delivery and installation for use. In the same manner the producers should also provide information for safe handling of the end of life product.

3.9 Indian Scenario

While the world is manifesting at the technological revolution, countries like India are facing an imminent danger. The high rate of reuse and refurbishment of electrical and electronic products in India has enable the growth of the secondary market there are extending the life of product and only small quantity of e-waste are destined for recycling. In fact, it is estimated that by 2017, global e-waste production will increase by 33%, which is approximately 72 million tons. E-waste of developed countries, such as the US, dispose their wastes to India and other Asian countries.India has become a major destination for E-waste exports from the developed nations[12]. Moreover, Indians have been generating rapidly increasing amounts of E waste domestically [13], [14]. A recent investigation revealed that much of the electronics turned over for recycling in the United States ends up in Asia, where they are either disposed of or recycled with little or no regard for environmental or worker health and safety. India's rate of PC obsolescence is growing dangerously. As up gradation beyond a point become uneconomical and incompatible with new software, a vast amount of hardware will soon be added to the waste stream [15].

It is imperative that developing countries and India in particular wake up to the domination of the developed countries and set up appropriate management measures to prevent the hazards and mishap due to mismanagement of e-wastes.

3.10 Management Option

Considering the severity of the problem, it is imperative that certain management options be adopted to handle the bulk e-wastes. Following are some of the management options suggested for the government, industries and the public.

3.11 Responsibilities of the Government:

At the Government level regulatory agencies should be set up. Government ought to enforce stringent laws and administrative procedures[16].The Ministry of Environment and forests, Government of India has notified the e E-Waste (Management) Rules, 2016 under the Environment (Protection) Act, 1986. These rules are applicable to the producers of electrical and electronic equipments, the consumers, collection centres, dismantlers, and recyclers handling e-waste. According to these rules every stakeholders in the e waste value chain is responsible for environmentally sound management of e-waste.Under this law, the agency concerned should

- Collect basic information on the materials from manufacturers, processors and importers and to maintain an inventory of these materials. The information should include toxicity and potential harmful effects.
- Identify potentially harmful substances and require the industry to test them for adverse health and environmental effects.
- Control risks from manufacture, processing, distribution, use and disposal of electronic wastes.
- Encourage beneficial reuse of "e-waste" and encouraging business activities that use waste".
- Set up programs so as to promote recycling among citizens and businesses.
- Educate e-waste generators on reuse/recycling options and producers should also provide information for safe handling of the end of life product.
- Governments should encourage and support NGOs and other organizations to involve actively in solving the nation's e-waste problems.
- Governments should explore opportunities to partner with manufacturers and retailers to provide recycling services.
- Polluter pays principle and extended producer responsibility should be adopted.

3.12 Role of industries

1. Generators of wastes should take responsibility to determine the output characteristics of wastes and if hazardous, should provide management options.
2. Companies can adopt their own policies while handling e-wastes. Some are given below:
    - Use label materials to assist in recycling.
    - Standardize components for easy disassembly.
    - Create computer components and peripherals of biodegradable materials.
    - Utilize technology sharing particularly for manufacturing and de manufacturing.
    - Encourage or promote for green supply chain.

3. At the production level the industries can reduce the quantity of hazardous materials by reviewing the material purchase procedures and the inventory tracking system.[17].Companies should adopt waste minimization techniques, which will make a significant reduction in the quantity of e-waste generated and thereby lessening the impact on the environment. It is a "reverse logistics" system that designs infrastructure to recover and reuse every material contained within e-wastes metals such as copper, gold, and various plastics. These practices can lead to considerable gains in efficiencies, competitive advantage and deliver significant benefits to the bottom line.

4. Manufacturers, distributors, and retailers should undertake the responsibility of recycling/disposal of their own products.

5. Manufacturers of computer monitors, television sets and other electronic devices containing hazardous materials must be responsible for educating consumers and the general public regarding the potential threat to public health and the environment posed by their products.

3.14 Individual Effort

Waste prevention is perhaps more preferred to any other waste management option including recycling. Electronic waste collection among the recyclers should be extended to household rather than focusing on industries and commercial organizations [18] Donating electronics for reuse extends the lives of valuable products and keeps them out of the waste management system for a longer time. But care should be taken while donating such items i.e. the items should be in working condition. Reuse, in addition to being an environmentally preferable alternative, also benefits society. By donating used electronics, schools, non-profit organizations, and lower-income families can afford to use equipment that they otherwise could not afford.

E-wastes should never be disposed with garbage and other household wastes. This should be segregated at the site and sold or donated to various organizations. NGOs should also adopt a participatory approach in management of e-wastes.

4. Conclusion

Manufacturers, retailers, users, and disposers should share responsibility for reducing the environmental impacts of products. Adopt product stewardship approach i.e. a product-cantered approach should be adopted to preserve and protect environment. Thus E- waste management initiatives are valuable for the environment as well for the industries. They play an important role in achieving the "triple bottom line" of social, environmental and economic benefits leading to sustainable development.

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IN-VITRO REGENERATION AND CALLUS INDUCTION OF

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PSEUDARTHRIA VISCIDA(L.)WIGHT& ARN.

Priya P S*

Abstract

Ayurveda is a traditional medicinal system in India and an alternate system practiced in other parts of world. Trade data indicates that the demand for many ingredients in Ayurvedic medicines has exceeded the supply and the species of many medicinal plants are not available in the required quantities. This leads the un-scientific plant collection and the destruction of valuable medicinal plant species. In this context, designing the protocol for *in-vitro* propagation of such species becomes more relevant. Micro propagation of *Pseudarthriaviscida* (L.) WIGHT & ARN. among dasamula has been attempted. It is extensively used in the preparation of Ayurvedic formulations to soothe tridosha, pain, arthritis, intermittent fever, respiratory diseases etc. The results indicate that most suitable and appropriate medium for callus induction in *Pseudarthria* is MS with 3.5mg/L BAP and 1mg/L NAA. Best callus response is shown by the leaf explant in *Pseudarthria*. Best explant for bud proliferation is axillary bud. MS medium with 0.5 mg/L of NAA and 0.5 mg/L of BAP was the best suited medium for lengthening of axillary bud. Root formation occurs when axillary bud is inoculated in the MS medium with 4mg/L IAA and 0.5mg/L BAP.

Keywords:

Pseudarthria viscida;
Callus;
Medicinal plant;
In-vitro.

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1. Introduction

Pseudarthria viscida is a shrub having thin branches and trifoliated leaves.It is an important ethno medicinal plant of Fabaceae and one among the "Dasamoola" (ten roots). Its medicinal importances were indicated in the ancient Ayurvedic manuscripts. It is an inevitable ingredient in many Ayurvedic medicines like Dasamoolarasayanam, Dasamoolarishtam, Agastyaharitakirasayana, Anuthaila, Brahma rasayana, Sudarshanachurna, Narayanathaila, Dhanuantharaghrita, etc [12].The whole plant is a panacea for an extensive range of diseases like rheumatism, fever, bronchial asthma, haemorrhoids and diabetes mellitus. It is an effective medicine for bleeding, oedema, heart diseases and blood disorders. Other properties like antihypertensive, antioxidant [11], antiulcer, antifungal, antidiarrheal and antitumor have also been reported from *P. Viscida*[1].

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In Indian Ayurvedic industrial scenario, turnover of the industry is estimated to be around Rs 650 crore [4]. The large market for medicinal plants has resulted in unscientific over harvesting and depleted at a much faster rate than it is being replenished. India is exporting the medicinal plants as raw materials like roots stem, wood, Bark, flower, whole plant etc in a large scale. The plant collections involve the destructive harvesting and over exploitation. And most of the medicinal plants are habitat specific slow growing with limited distribution and habitat requirement [6], [10].

P. viscida has high trade value as its pharmaceutical value goes on. It has been incorporated in the Red listed (it is vulnerable with high trade status) medical plants and it comes under high conservation concern [8]. It is one among the major group of extensive trading medicinal plants. The un-scientific collection resulted in successive depletion of this medicinal plant from wild. At present, its population is highly reduced in the nature.In contempt with its huge pharmaceutical and economic potential, this plant could not been cultivated in large scale as it has low viability rate of seeds, germination rate and seedling establishment ability in younger stages. For conservational and commercial strategy, the *in-vitro* method of plant regeneration can be utilized successfully from a single shoot tip or axillary bud. A huge number of uniform, healthy plants with sound genetic qualities can be created within a short span of time. [3], [6], [10]. In many plants there are reports of successful callus induction and plantlets regeneration: *Ocimum basilicum*[7], *Enicostemmaaxillare*[9] , *Desmodium gangeticum*[5] , etc

2. Research Method

The selected plant *Pseudarthria viscida*(L.) Wight &Arn**.** collected from wild has been grown in the green house. The explants to be inoculated were collected from green house. The culture medium used was Murashige and Skoog (MS, 1962) [2]. Sucrose 4% (Analytical grade, Hamedia, India), agar-0.8 percentage (Bacteriological grade, Hamedia, India) were also added. Some growth regulators like cytokinin and auxin were used. Cytokinin used was 6- Benzyl aminopurine (BAP) and auxin was Indole acetic acid (IAA), Naphthalein acetic acid (NAA).

Concentrated stock solutions were prepared. Then culture medium was made by adding required quantities of all constituents from the stock solution. Then hormones were fortified to the basal medium either as alone or in various combinations. Then, pH of culture medium was adjusted to 5.8(by using 1N KOH or 1N HCl) prior to autoclaving at 120^0C. Then 300 ml tissue culture tube was filled with 50 ml culture medium and then autoclaved. The explants that used for inoculation were node, leaf, internode, axillary bud and shoot tip. The explants collected were sterilized with 0.1 % Mercuric chloride. The sterilized explants were inoculated in the medium and incubated for16-hour photo period with light intensity of 2000 to 2500 lux and temperature of 25 ± 1 ^{0}C. The light intensity provided by cool white fluorescent tubes.

Maximum callus growth in terms of weight was recorded after 60 days of inoculation. Direct organogenesis was also recorded. The data was recorded in10 to 15 days duration. After shoot proliferation, newly formed shoots were transferred to rooting medium. And after rhizogenesis, the plantlets were acclimatized and planted in the field. The photographs were taken at appropriate time by using a Digital Camera (Nikon D50).

3. Results and Analysis

3.1. Surface sterilization of explants

For eliminating the microorganisms that causes future contamination, sterilization processes were carried out. The collected explants were thoroughly washed under running tape water for 15-20 minutes following by a wetting agent teepol and then thoroughly washed with distilled water. Then dipped in ethyl alcohol (70 %) for 1 minute and washed gently using sterile distilled water for three rounds. It was then treated with 0.1% Mercuric chloride for different time intervals. After the treatment explants were dipped in autoclaved distilled water to wash-off even the traces of sterilants. In *Pseudarthria*, optimum exposure time in 0.1% Mercuric chloride for all the explants was 4 minutes .The average culture establishment of explants after 7 days of inoculation was 53.62% when it was exposed to Mercuric chloride for 4 minutes.

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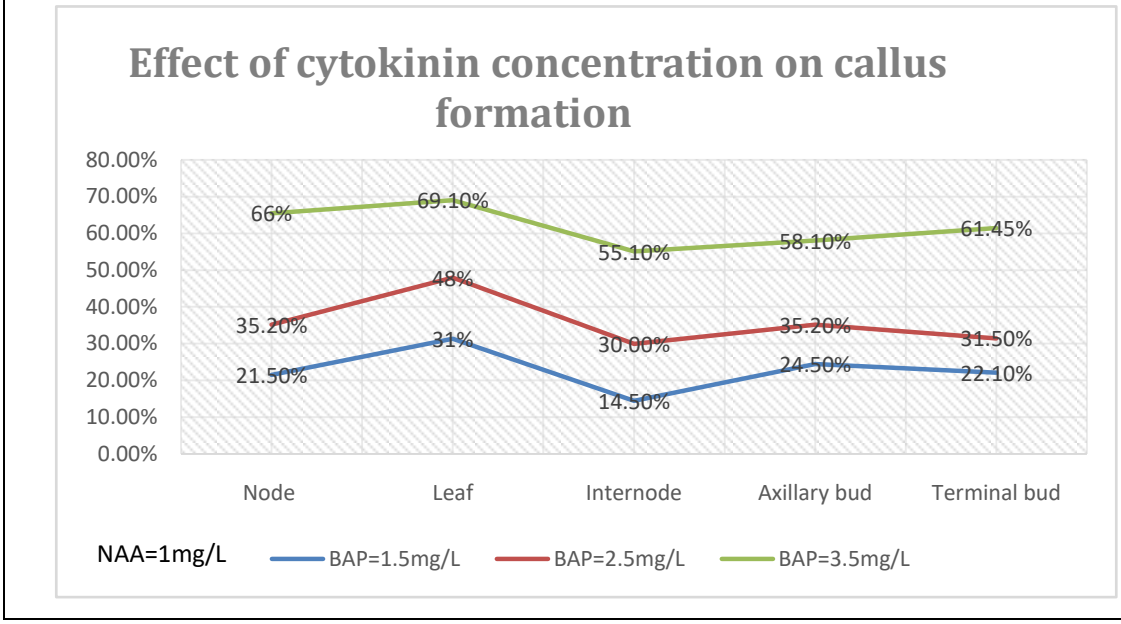
3.2. Callus formation



Callus formation was observed from buds, nodal segment, internode and leaf segment. The best explant for callus induction was leaf segment. A friable yellowish green coloured callus was observed. (Fig1a). Maximum callus response was seen in the MS medium fortified with 1 mg/L NAA and 3.5 mg/L BAP. Concentration of

NAA kept constant as 1 mg/L and the combination of BAP was altered as 1.5mg/L, 2.5mg/L and 3.5mg/L. There was a fashion of increased callusing as cytokinin concentration increases (illustration 1)

Illustration 1

3.3. Direct organogenesis

MS medium with equal quantities of hormones (say 0.5 mg/L NAA and 0.5 mg/L BAP each) was the best-suited medium that contributes maximum for both the elongation of shoot and multiple shoot formation from axillary bud. Shoot initiation was also possible from axillary bud grown in MS medium fortified with IAA and BAP, IAA being in large concentration compared to BAP.When nodal explants and shoot tips were inoculated, multiple shoots were observed. (Fig1b). The combinatorial action of auxin and cytokinin helps in the formation of multiple shoots as well as the shoot lengthening.

Table1. Direct organogenesis from buds and node

Explant	Basal medium	Growth Hormone	No of shoots	Maximum shoot length (in cm)
Axillary bud	M S	0.5mg/L NAA & 0.5mg/L BAP	4	6.5 ± 0.51
	M S	3.5mg/L IAA & 0.5 mg/L BAP	3	5.4 ± 0.69
Shoot tip	M S	0.5 mg/L NAA & 2 mg/L BAP	2	5.1 ± 0.63
Node	M S	1 mg/L NAA & 3 mg/L BAP	4	6.1 ± 0.56

3.4. Rhizogenesis

After shoot formation, it was taken out from the medium and re-inoculated in the rooting medium. Root formation occurs when axillary bud was inoculated with 4 mg/L IAA and 0.5 mg/L BAP in the MS culture medium (Fig1c).

3.5. Hardening

After rhizogenesis, the plantlets were washed thoroughly to remove all the traces of agar medium from the root and transferred into small pots containing sterile sand, soil and leaf moults and grown in the green house (Fig1d). Regenerated plants were successfully established in the soil after acclimatization.

Fig 1a: Callus from leaf Fig 1b: Multiple shoots (from node shoot tip and axillary bud) Fig. 1c: Root formation Fig. 1d: A newly formed explant plantlet

4. Conclusion

Through this study, it was attempted to frame up a protocol for the *in-vitro* regeneration of a vulnerable medicinal plant. In a combination of auxin and cytokinin, callus induction was observed more as the cytokinin concentration increases. Shoot regeneration and multiple shoots were observed from buds, nodes and internodes when auxin and cytokinin mixed up in different proportions. Root formation was induced when auxins were used in increased concentration. Leaves were the best explants for callusing.

Around 50% of approved drugs produced during last three decades are from either directly or indirectly from natural products. Plant *in-vitro* techniques help the propagation of plant or plant tissues under aseptic atmosphere totally independent of geographical and climatic factors. It offers an alternative technology for producing plant metabolites as well as the cultivation of whole plant as such. If this is possible majority of our threatened plants and natural resources will be conserved.

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IMPROVEMENT OF SITE SAFETY CULTURE IN CONSTRUCTION INDUSTRY; A CASE STUDY ON METRO CONSTRUCTION INDUSTRY

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Abstract

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Unsafe acts plays major role in accidents and as per Henrich's classical theory 88% of accidents caused due to unsafe acts. Behaviour is explained with the help of ABC model (Antecedent, Behaviour, & consequences) within Behaviour-Based Safety. Antecedent can rule our behaviour towards the safe or unsafe behaviour.
In the present study, a work was carried out inorder to improve safety culture in Metro construction industry by setting a goal that more than five unsafe acts per year performed by an empolyee will be not tolerated by company. This experimental study was conducted on 100 workers. After five unsafe acts the employees/workers will get penalized. The effectiveness of antecedent had been measured by a safe behaviour checklist which was used to observe the behaviour of workers engaged in work at height, scaffolding, hot works, crane operations and ladders. This study resulted in the improvement of safety culture in metro construction industry.

Keywords:

Safety culture;
antecedent;
safe and unsafe acts;
safe and unsafe behaviour percentage.

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1. Introduction

In India construction has accounted for around 40 percent of the development investment during the past 50 years. More than 30 million people in India are getting with an opportunity of employment in construction industry whereby creating an assets worth over $ 200 billion [3]. Construction is considered most dangerous industry due to the major hazards like fall from height, electrocution, motor vehicle crash and excavation accidents [2]. To avoid these hazards, Behaviour based safety programme become a popular approach in managing the safety related issues in workers [5].

Behavior-Based Safety is about integrating behavioral technology into the management of safety in industries. Behavioral technology is the system and process for applying the laws and principles that govern human behavior [6]. The objective of applying these laws and principles is to achieve behavior change. The major objective of an effective behavior-based safety process is to make safe behavior a habit i.e., changing unsafe habits to safe habits and for changing an organization's safety culture [4].

The ultimate aim of a safety initiative is a "total safety culture"; however, this concept is rarely defined. A total safety culture is a culture in which:
a) Every employee of the installation hold safety as a 'value' and not just a priority;
b) Every employee should check, correct the safety of their co-workers in addition to themselves; and
c) All levels of employees are willing and able to act on their sense of responsibility.
To build this type of safe work behaviour the management has to make employee's aware of safety before going to actual work place. To explore the challenge to the human soul in organizations is to build a bridge between actual work and doing it safely [1].

Behaviour based study were measured with the following methods:
(a) Daily safe and unsafe observations for regular activities
(b) A yes/no question, to check either they are doing their job under supervision
(c) Daily observation were measured based on checklist (i.e., productivity, quality, safety, other) and compare with previous status.

The present study was conducted in the Metro construction industry and the objective of the study is to.

a) Study of behavior pattern of workers pre and post after providing HSE training.
b) Study the effectiveness of safe work behaviour (SWB) license as an antecedent.
c) Calculation of safe act index.

2. Material and Methodology

Study area and data collection

The study area of present research was Metro construction area in India.Sample size of the workers for the present study was100. The workers behaviour was assessed on primary data collection, check list analysis and SWB license card. The primary data was collected with the help of checklist. Primary data belongs to a particular project, so company details and documents were kept confidential. Checklist (Table No.1) was a questionnaire used to record the workers behaviour. The checklist consist two options yes and no where 'Yes' means safe behaviour and 'No' means unsafe behaviour. Another management tool used by the study area was SWB license. SWB license is a card which contains five warning indicators which indicate the severity level from low to high. The level is classified by the consequences that may result from the unsafe acts. In those five warnings, three warnings are circle with 'D', one warning is circle with 'A' & another is circle with 'AF'.

Circle with 'D' – Chances of occurring accident Damage to property without human injury
Circle with 'A' – Chances of occurring accident, which may cause human injury and damage to property or only human injury.
Circle with 'AF' – Chances of occurring accident, which may results Fatality

SWB Guidelines are

1. Warnings will be given when card-holder performs any unsafe act
2. If the person didn't get any mark in a span of year will be awarded in such a way people have goal towards safety
3. If worker is working unsafely under supervision of supervisor, both of them get the warnings in their respective SWB license
4. If worker is working unsafely before same skilled workers, then those workers should correct him to safe work. If they not correcting then they will also get the warning along with the worker who is doing unsafe act
5. If supervisor is forcing worker to do unsafe work, then he can feedback to HSE department (This system will increase the safety culture from reactive to interdependent as per Bradley curve)
6. If the person receives warnings with combination of 2D's, A & AF or all the five are filled in case all are near misses, then the person will get the punishment by the company like, financial penalties, removal from the site and cancelation of license.
7. If the person's unsafe acts which leaded to an Accident of A or AF type, then the person should leave the company and also license will be cancelled.
8. If license get cancelled then the person can't join in any company due to the Aadhar link who are following this same system until he/she renew the card.
9. To renew the card he/she should gone through preferred training by company or authorized persons and get renewed the card with apologies letter.

Table 1: Checklist for observation

S.No.	Checklist Questions	Yes (Y)	No (N)
Work at height			

1	Does worker prefer proper and secure working platform and access to perform work?		
2	Effective guard rail/ life lines provided for workers to anchor their safety belt/Harness?		
3	Workers are under the direct supervision of a supervisor?		
4	Workers are using safety belt/harness/fall arrester?		
5	Are workers using life line?		
6	Anchor anchored in effective position?		
7	Proper access & aggress are using by workers?		
Hot works			
1	Is worker performing Hot work under the supervision of supervisor?		
2	Is worker checked that no combustible or flammable materials around the area where Hot Work is performing?		
3	Is worker kept fire extinguisher nearby?		
4	Is worker checked the Gas cylinders flashback arrestors?		
5	Is worker protected DTL Cable with Fire Blankets/Sheets?		
6	Is there proper equipment earthling provided by worker?		
7	Using proper PPE?		
8	Does worker using equipment with all cables free from wear & tear?		
Scaffolds			
•	Is the surrounding area and in the vicinity of the basis for scaffold no water logged checked by worker before working on that scaffold?		
•	Is worker working in the platform where easy access to climb?		
•	Is there sign boards provided? (safe/ unsafe)		
•	Are ladders giving access to working platforms securely fixed top and bottom, complete and undamaged in every way?		
•	Are all working platform completely decked out and toe board fitted?		
Lifting and crane operations			
•	Is operator using Audible alarm / warning horns when needed?		
•	Is rigger present?		
•	Is taglines are using properly?		
•	Operator is experienced and competent?		

Stairways & Ladders			
•	Is worker checking that ladder position for 4:1 ratio before using it?		
•	Is worker checking that ladder kept 3ft above the platform before working on it?		
•	Is person checking ladder either it is in good condition or not before using?		
•	While climbing ladders & stairways, is every worker wearing shoes and helmet?		
•	Are workers holding hand-rails while climbing?		
•	Are workers wearing chin-strip properly?		
Total Safe and Unsafe observations respectively		∑Y	∑N
Total no. of observations		∑Y + ∑N	

Methodology

To find the effectiveness of SWB license 100 workers engaged in five different activities before and after HSE training had been interviewed using checklist. The checklist was used for recording the Pre and post observations. With the help of this checklist, overall safe behaviour percentage and unsafe behaviour percentage was calculated by using formula 1&2 (according to Safe Act Index):

Safe Behaviour % = (Total no. of "Yes" observation's/ Total observations) *100

= (∑Y/∑Y + ∑N) *100 …….. (1)

Unsafe Behaviour % = (Total no. of "No" observation's / Total observations) *100

= (∑N/∑Y + ∑N) *100 ……..…….. (2)

3. Results and Analysis

Pre-observations and post-observations (after providing HSE training) for 100 workers were recorded with the help of checklist for five activities (height at work, hot-works, scaffolds, lifting & crane operations and stairways & ladders).Table No 2,3,4,5 and 6 recorded the pre and post observation of the workers engaged in different activties.

Activity 1: Work at Height

Table 2: Observed Checklist for work at Height

S.No.	Questioners	Pre		Post	
		Yes	No	Yes	No
1	Does worker prefer proper and secure working platform and access to perform work?	54	36	80	10
2	Effective guard rail/ life lines provided for workers to anchor their safety belt/Harness?	15	75	50	40
3	Workers are under the direct supervision of a supervisor?	50	50	90	10
4	Workers are using safety belt/harness/fall arrester?	100	0	100	0
5	Are workers using life line?	12	88	99	1
6	Anchor anchored in effective position?	2	98	85	15
7	Proper access & aggress are using by workers?	68	12	80	0
TOTAL =660		301	359	584	76

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Safe behaviour = 45.6%, 88.5% : Unsafe behaviour = 54.4%, 11.5%

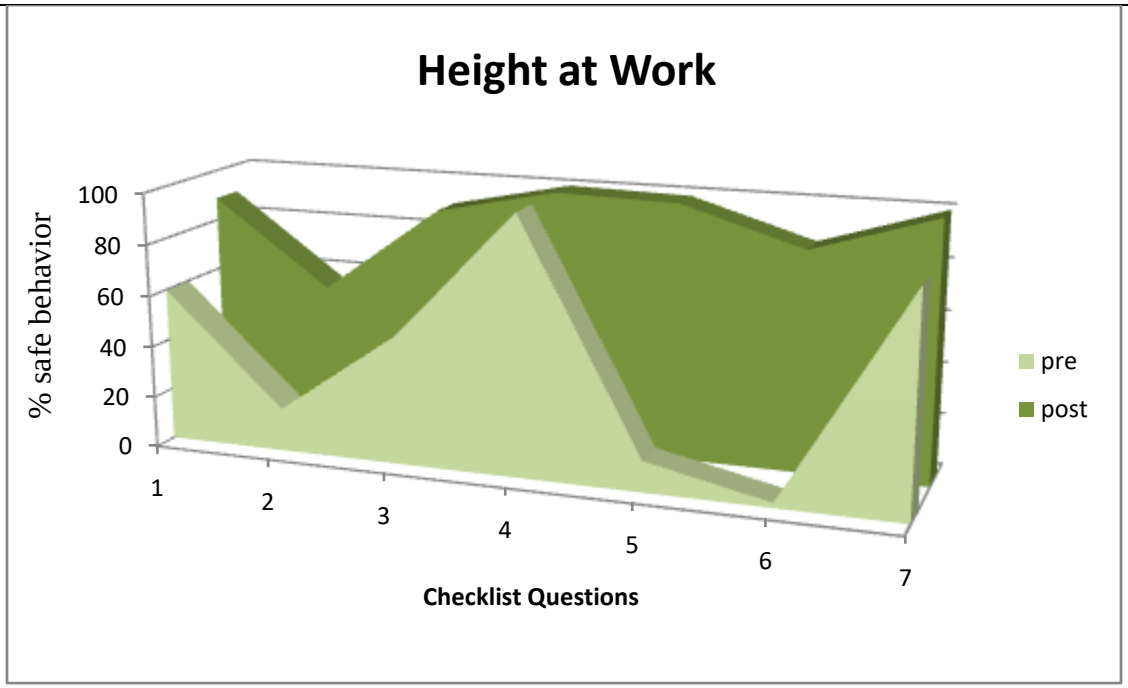

Fig 1: Safe behaviour pattern for each question of work at Height

In figure 1 it was found that percentage of safe behaviour was increasing in workers after HSE training because now workers were accustomed in using life line and anchor

Activity 2: Work at Hot Works.

Table 3: Observed Checklist for Hot work

Sr. No.	Questioners	Pre		Post	
		Yes	No	Yes	No
1	Is worker performing Hot work under the supervision of supervisor?	24	6	29	1
2	Is worker checked that no combustible or flammable materials around the area where Hot Work is performing?	29	1	30	0
3	Is worker kept fire extinguisher nearby?	30	0	30	0
4	Is worker checked the Gas cylinders flashback arrestors?	30	0	30	0
5	Is worker protected DTL Cable with Fire Blankets/Sheets?	9	1	10	0
6	Is proper equipment earthing provided by worker?	25	5	29	1
7	Using proper personal protective equipments (PPE's)?	22	8	29	1
8	Does worker using equipment with all cables free from wear & tear?	15	15	25	5
TOTAL = 220		184	36	212	8
Safe behaviour = 83.6%, 96.4% : Unsafe behaviour = 16.4%, 3.6%					

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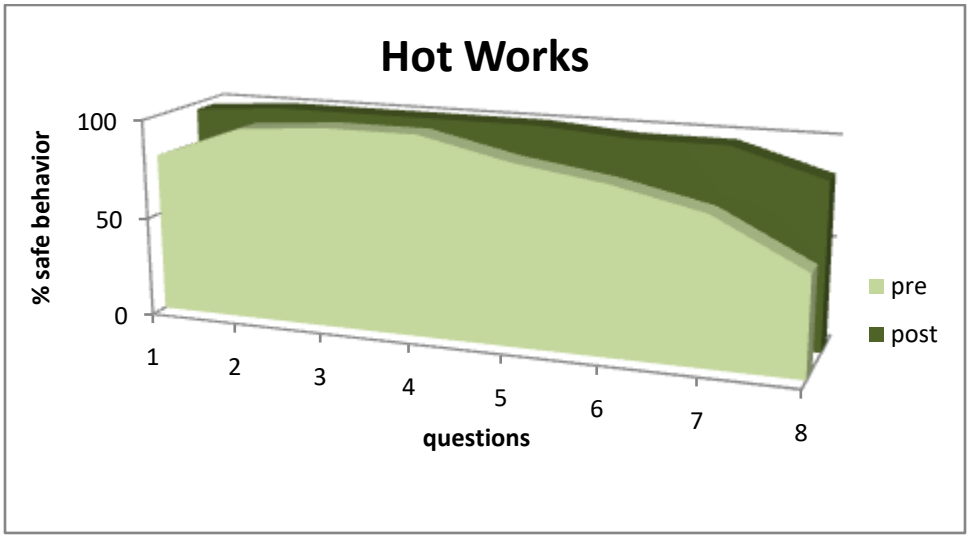

Fig 2: Safe behaviour pattern for each question of Hot Work

Post HSE training, the change in workers safety behaviour was visible and is depicted in figure 2. During working, workers were using proper cables and PPE's. Due to the presence of 24kV live cables in entire working area creating it a high risk area, so all the necessary precautions were carried from initial stages of hot work.

Activity 3: Scaffolds

Table 4: Observed Checklist for Scaffolds

Sr.No	Questions	Pre		Post	
		Yes	No	Yes	No
1.	Is the surrounding area and in the vicinity of the basis for scaffold no water logged checked by worker before working on that scaffold?	50	10	58	2
2.	Is worker working in the platform where easy access to climb?	35	30	60	5
3.	Is there sign boards provided? (safe/unsafe)	15	45	59	1
4.	Are ladders giving access to working platforms securely fixed top and bottom, complete and undamaged in every way?	8	12	18	2
5.	Are all working platform completely decked out and toe board fitted?	43	17	55	5
	TOTAL= 275	151	124	250	15
Safe behaviour = 54.9%, 90.9% : Unsafe behaviour = 45.1%, 5.45%					

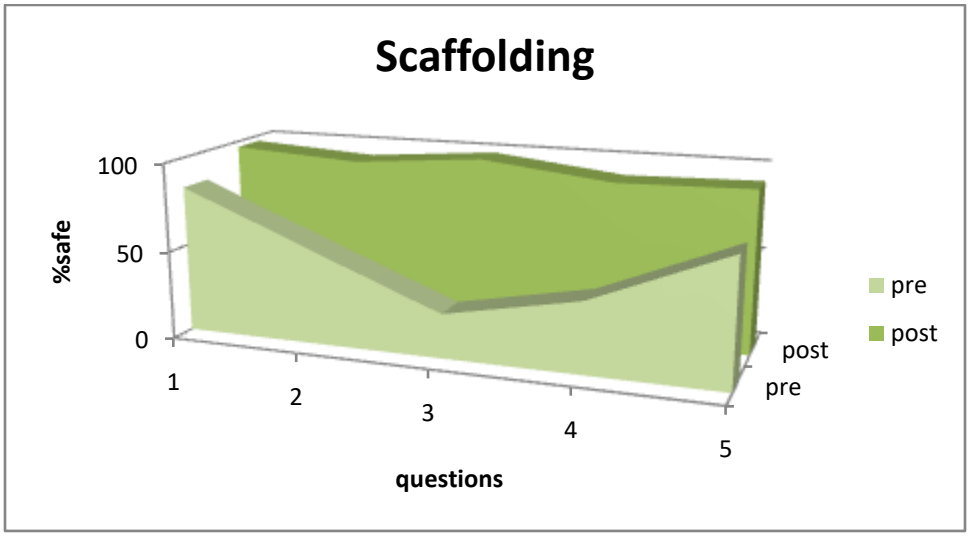

Fig 3: Safe behaviour pattern for each question of Scaffolds

In Figure-3, it was found that after post HSE training, safe behaviour pattern in scaffolding area of the workers were improved.

Activity 4: Lifting & crane operations

Table 5: Observed Checklist for Lifting & crane operations

Sr. No	Question	Pre		Post	
		Yes	No	Yes	No
1.	Is operator using Audible alarm / warning horns when needed?	3	22	24	1
2.	Is rigger present?	18	12	25	5
3.	Is taglines are using properly?	11	13	23	1
4.	Operator is experienced and competent?	25	0	25	0
TOTAL= 104		57	47	97	7
Safe behaviour = 54.8%, 93.3% : Unsafe behaviour = 45.2%, 6.7%					

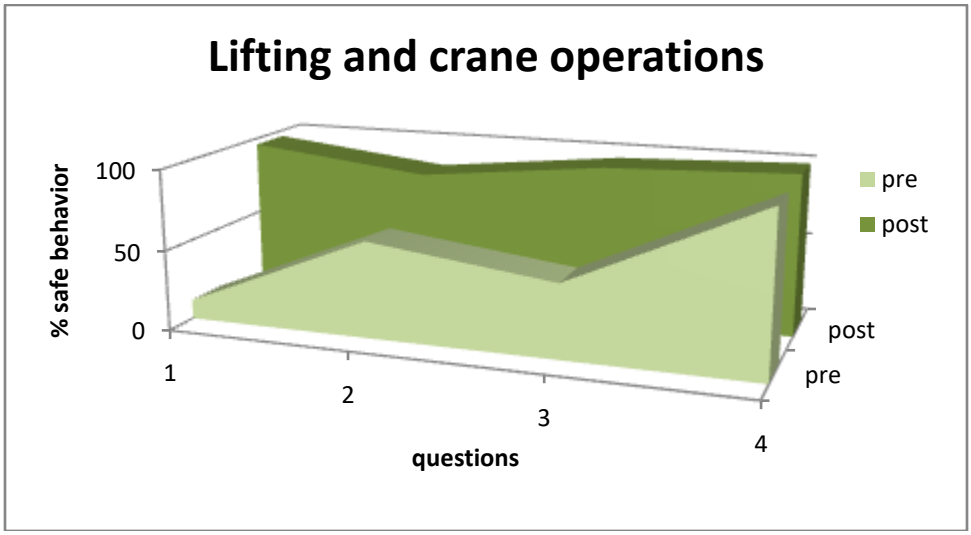

Fig 4:Safe behaviour pattern for each question of Lifting & crane operations

Post HSE training safe behaviour was improved in lifting and crane operation area as depicted in Figure 4. In lifting and crane operation area- the number of riggers, use of taglines and the use of the audible alarms or warning horns by the operators were increased.

Activity 5: Stairways & ladder

Table 6: Observed Checklist for Stairways & ladder

Sr.No	Question	Pre		Post	
		Yes	No	Yes	No
1.	Is worker checking that ladder position for 4:1 ratio before using it?	15	23	30	8
2.	Is worker checking that ladder kept 3ft above the platform before working on it?	8	18	25	1
3.	Is person checking ladder either it is in good condition or not before using?	0	60	55	5
4.	While climbing ladders & stairways, is every worker wearing shoes and helmet?	50	0	50	0
5.	Are workers holding hand-rails while climbing?	0	78	75	3
6.	Are workers wearing chin-strip properly?	9	91	87	13
	TOTAL =352	82	270	322	30
Safe behaviour = 23.3%, 91.5% : Unsafe behaviour = 76.7%, 8.5%					

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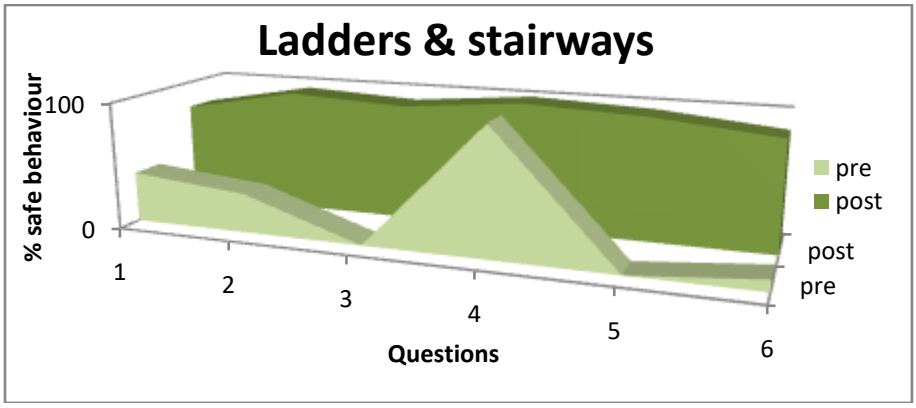

Fig 5: Safe behaviour pattern for each question of Ladders & Stairways

In Figure 5 it was found that the safe behaviour pattern was increased in the workers post HSE training. Workers were following safe procedures while using ladders i.e. keeping ladder at correct angle & position and workers were more using helmet and chin-strip properly after HSE training.

In Table No-7 the overall obervations of safe and unsafe behaviour of the worker engaged in the activities namely work at height, hot work, scaffolding , lifting and crane operation and ladder and stairways were tabulated and simunateously it was graphically depicted in figure no 6

Table 7: Results of safe and unsafe behaviour

Sr. No	Observations topics	Pre-observations		Post observations	
		Safe acts, %	Unsafe acts,%	Safe acts, %	Unsafe acts,%
1	Work at height	45.6	54.4	88.5	11.5
2	Hot works	83.6	16.4	96.4	3.6
3	Scaffolding	54.9	45.1	90.9	5.45
4	Lifting and crane operation	54.8	45.2	93.3	6.7
5	Ladders & stair ways	23.3	76.7	91.5	8.5

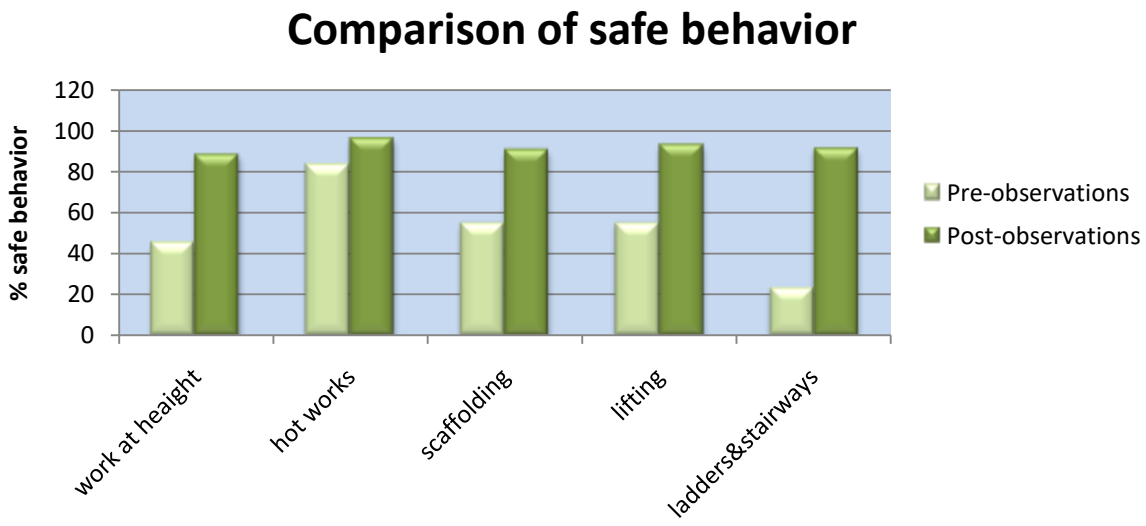

Figure 6: Comparison of safe behaviour between pre and post observations

4. Conclusion

Results of this study showed that there have been an improvement in safety behaviour up to 90-97% after implementation of safe work behaviour license. Improvement of safe act index in the present study proves that safety culture in the organization have increased.The change in safe act index indicates that SWB license card is acting as an antecedent in improving safety culture in an organization. That means that the antecedent gives the motivation to act safely by every individual and everyone checks the safe behaviour of their colleagues. This antecedent has the capability to drive/ increase the safety maturity and culture from reactive or any stage to interdependent as per Bradley curve.

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ASSESSMENT OF AIR QUALITY IN DEHRADUN CITY OF UTTARAKHAND (IMPACT OF VEHICULAR POLLUTION IN DOON VALLEY

Bahukhandi Kanchan Deoli, Siddarth Siddiqui NA & Singh Mohini

Air Pollution, Ambient air quality,

Air pollutants are added in the atmosphere from variety of sources that change the composition of air and affect the biotic environment. The concentration of air pollutants depend not only on the quantities that are emitted from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emission. The pollution concentration vary spatially and temporarily causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. The sources of air pollutants include vehicles, industries, domestic and natural sources. The presence of air pollutants in the ambient air adversely affects the health of the population. Automobile emissions, industrial emission and burning of fossil fuels are adding large amount of air pollution in the Dehradun city of Uttarakhand. These emission deteriorating the ambient air quality and which further causing lot of health problem. In this research paper an assessment of air pollution has been conducted in order to assess the ambient air quality of Dehradun city. The ambient air quality has been measured at ten different sampling location during winter season in Dehradun city. The parameter like SPM, RSPM, SOx and NOx and metrological parameter like temperature, humidity and rainfall were monitored. Total ten sampling locations were selected and samples ranging across different seasons were collected and then analyzed in Dehradun city. The high concentration of pollution were found in various sampling location which was mainly due to vehicular pollution in Dehradun city and due increased urbanization and industrialization over the past decade.

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1. Introduction

Environmental pollution is one of the major problem in all over the world including developed, underdeveloped and developing countries (Ghose et al, 2005). The effect of air pollution is very much severe on human including as

well on plants and animals and on our surrounding (Nagdene 2004, Samoli et al 2012). Air pollution causes harmful diseases and cause various environmental problem at regional and global level (Barman et al., 2010). Air pollution causes acute and chronic effects on human being (Afroz et al. 2003). It is estimated that 60 % of air pollution in India mainly caused by automobile emissions (Johansson O 1997, Kathuria, V 2002, Krawack, S. 199, Nylund et al 2003, Pundir 2001).

The pollution caused by automobile emissions are more harmful because they emit in lower level of troposphere hence directly inhaled by human being during respiration process. The pollutant like SOx, NOx, SPM and RSPM, inorganic, organic and metal pollution are mainly generated from automobile emissions and considered major air pollutant. (Agarwal and Singh 2000). According to Global Health Report of 2014 on Air Pollution published by World Health Organization it has estimated that Indian has become 9th largest industrial nation but at the same time it has become the most polluted nation in the world (Vijay Kumar 2015). The ambient air quality of Dehradun district is deteriorating at alarming rate (Kumar Vijay 2015). Vehicular pollution is one of the major cause of air pollution in Dehradun district. The study conducted by (Singh Pooja et al 2014 and 2012 DF Report 2012) estimated the growth of registered vehicle was 11 % during the past 12 years, growth of car constitute 14 % and two wheeler was 75% . It estimated that the present transportation system was mainly operated by private operator by temp and buses. Around 1300 tempo were operating in different route of Dehradun city (Singh Pooja et al. 2014). It is difficult to control vehicular emission because it emitted directly on lower level of troposphere, since dehradun is a valley where dilution and dispersion of pollution takes a very long time especially during winter season and this causes several health impact headache, nausea, irritation of eyes, various bronchial problems and visibility. The study conducted by USPCB (Uttarakhand State Pollution Control Board) in 2017 found that the concentration of PM 10 (Particulate matter) were increased up to 330.42 $\mu g/m^3$ in various locations (USPCB 2017). In order to prevent and control air pollution, the Air (Prevention and Control of Pollution) Act was enacted in 1981. The responsibility has been further emphasized under Evironment(Protection) Act, 1986. It is necessary to assess the present and anticipated air pollution through air quality survey/monitoring programs.

Physiography of Doon valley

The Doon Valley has the Himalayas to its north, the Shivalik range to its south, the sacred river Ganga to its east and the river Yamuna to its west. The city of Dehradun is surrounded by river Song on the east, river Tons on the west, Himalaya ranges on the north and Sal forests in the south. The Doon Valley is situated between the two most important rivers of India. i.e. Ganga and Yamuna, located in a picturesque setting. Dehradun is surrounded by dense forest all around and number of streams and canals dissect the city in the north-south direction. The high hills in the east and north and Sivaliks in the south give an interesting topographical setting to the city.

2. Material and Method

The methodology consist of field survey, collection of primary and secondary data, identification of sampling sites, monitoring and analysis of the samples and compilation of data and report. The air quality monitoring had been done by using sophisticated, standard instrument i.e. respirable dust sampler manufactured by envirotech, the high volume sampler and the Fugitive Monitoring Kit. The air quality monitoring had been done by using sophisticated, standard instrument i.e. respirable dust sampler manufactured by envirotech, the high volume sampler and the Fugitive Monitoring Kit. The parameter SPM (suspended particulate matter) and RSPM (Respirbale Particulate matter) were monitored and analysed by gravimetric methods by using instrument Respirbale dust sampler and fugitive monitoring kit. The determination of RSPM is by gravimetric method. For the determination of RSPM glass micro fiber paper were used as filter. These filters are having low resistance to air flow, low affinity for moisture and 98 % collection efficiency for particulate less than 10 micron in size. and for the parameter SOx and NOx , the samples were collected in pre cleaned/ sterile container. The filter paper were equilibrated in environmental condition average between 20^0 C and 30^0 C and hot varying more than +- 3 ^{0} C with relative humidity less than 50% without varying more than 5% for 24 hour before weighing. The actual and measured weights were found. Monitoring was done at 3 meter (10 feet) above the ground level. Meteorology plays a vital role in effecting the dispersion of pollutants. Once discharged into the atmosphere i.e. their transport, dispersion and

diffusion into the environment The metrological parameter like temperature, relative humidity, rainfall and wind speed were also monitored.

Following Calculation were used for the estimation of SPM and RSPM

$$RSPM = W \times 10^{6/} V$$
$$SPM = W \times 10^{6} / v$$
Volume of air sampled V = Q x T

3. Reesult and Discussion

3.1. Meteorological Parameter :

The maximum temperature recorded during the entire study period was 30^0C in the month of March and where as the minimum temperature recorded was 3.2^0C in the month of January (Table 1). The relative humidity during varied from a maximum of 98% in the month of November to minimum of 32 % in the month of March. The maximum rainfall was 27.8 mm in August and the minimum recorded was nil. The highest wind speed recorded was 7.2 km/hr in the month of February, while the predominant wind direction is noted as SW (Southwest) (Table 1).

Table 1. Meteorological Data for Dehradun City

Date	**Temperature(0C)**			**Relative Humidity (%)**		**Rainfall**	**Bright Sunshine**	**Mean Wind Velocity**	**Direction**	
				Hours						
	Max	**Min**	**Mean**	**07:19**	**14:19**	**(mm) Total Rainfall**	**(Hours)**	**(Km/hr)**	**07:19**	**14:19**
Oct	31.8	10.2	20.7	93	47	27.8	7.6	1.8	C	NW/ SW/ W
Jan	**25**	-2.4	**10.8**	**94**	**45**	**14.7**	**4.9**	**1.7**	C	W
Feb	26.3	-0.5				13.7	8.2	1.5	C	N
March	32.9	7.5	20	88	32	2.2		2.9	C	NW/ SSW

3.2 Air Quality Index

As per AQI standard the AQI index of SO_2 were ranged from 120 to 175 which indicated sensitive group of people sufferering with asthma were at risk. The health effect of SOx had increased ncreased respiratory symptoms, such as chest tightness and wheezing in people with asthma, possible aggravation of heart or lung disease. It is suggested to Children, asthmatics, and people with heart or lung disease should limit outdoor exertion. The AQI index for RSPM (Particulate matter size less then (10 µg/m^3) were ranged between 74 to 166 , sensitive group are the people with respiratory disease were the group most at risk. The health effect AQI RSPM include increased respiratory symptoms and aggravation of lung disease, such as asthma; possible respiratory effects in general population. (Source AQI calculator, Air Now https://www.airnow.gov/index.cfm?action=airnow.calculator

Table 2. National AMBIENT AIR QUALITY STANDARDS, Central Pollution Control Board Notification, 18th November 2009, Gazette of India

Pollutant	**Time Weighted Average**	**Industrial Area, Residential, Rural and Other area**	Ecological Sensitive area notified by Central government	**Method of Measurement**
Sulphur Dioxide	Annual Average* 24 hours**	50µgN/m^3 80 µgN/m^3	20µgN/m^3 80 µgN/m^3	Improved West and Geeks method Ultraviolet Fluorescence
Oxides of Nitrogen	Annual Average* 24 hours**	40µgN/m^3 80 µgN/m^3	30µgN/m^3 80 µgN/m^3	Jacob and Hochhwiser modified (Na-arsenite) method-Gas-Phase Chemilusence
SPM (Suspended Particulate Matter) As per IS 1994 Std	Annual Average* 24 hours**	360µgN/m^3 500 µgN/m^3	140µgN/m^3 200 µgN/m^3	High Volume Sampling [Average flow rate not less than 1.1 m^3/ minute]
Particulate Matter (Size less then 10 µm or PM 10 µg/ m^3	Annual Average* 24 hours**	60µgN/m^3 100 µgN/m^3	60µgN/m^3 100 µgN/m^3	Gravimetric TOEM, Beta attenuation

Sources : Gazette of India, NAAQ, CPCB, 18th November 2009

Table 3. Ambinet air quality data in Dehradun City

S.N.	Locations	Parameters in µgN/m^3			
		SPM	RSPM	SOx	NOx
1.	Bajaj service center Premnagar chowk.	350	111.11	27.8	26.80
2.	Hundai service center Prince chowk.	270	166	30.45	28.00
3.	Oberoi motor workshop majra.	416.66	166.6	35.00	30.00
4.	Chevrolet Workshop Transport nagar.	166.6	83.33	24.00	23.85
5.	Mohit auto service center Rajpur road.	138.88	83.33	25.75	20.50
6.	Rohan motors, Chakrata road.	100.00	66.66	23.85	23.55

7.	Mahindra & Mahindra Kargi Chowk.	416.6	125.0	22.65	26.25
8.	Roadways workshop Haridwar road.	138.88	74.18	26.95	26.35
9.	Hyundai motors, Haridwar road.	160.11	76.9	26.97	27.80
10.	Mayur auto Rajpur road.	146.88	91.21	25.8	21.80

3.3. Spatial and Seasonal variation in aminet air quality

The SPM concentration in the various workshop were ranged from 100 Nμg/m^3 to 416 Nμg/m^3 with a mean value of 230.4 Nμg/m^3 . The RSM concentration ranged from 66.66 Nμg/m^3 to 166 Nμg/m^3 with mean value of 104.3 Nμg/m^3 in various location of Dehradun city. The concentration of RSPM was found very high and crossed the maximum permissible limit (RSPM 60 Nμg/m^3) as per NAAQ standards (Table 1) in all sampling locations.

The SPM & RSPM were found maximum in the month of December with a mean value of 167.1 μg/Nm^3& 63.5 μg/Nm^3 and minimum was found in the month of October with the mean value of 101.62 μg/Nm^3& 35.68 μg/Nm^3respectively in Ballupur crossing chowk. The concentration of NO_x& SO_2 were recorded high i.e 36.33 μg/Nm^3& 24.85 μg/Nm^3 in the month of February respectively. Similarly concentration of SPM was recorded in the month of February as highest i.e. 393.69 μg/$Nm^3$and month of October as lowest i.e. 306 μg/Nm^3 .While the high concentration of NO_x was recorded as 38.65 μg/Nm^3 and for SO_2 as 34.02 μg/Nm^3 in the month of December in Astley Hall. Alarming concentration of both SPM and RSPM was recorded in the month of February & December with value of 454.3 μg/Nm^3& 180.86 μg/Nm^3 respectively. Simultaneously high concentration was found for NOx in the month of February at GMS road.

Vasant Vihar has range of concentration for SPM between 241.64 μg/Nm^3 – 340.86 μg/Nm^3 and range of RSPM was between 102.45 μg/Nm^3 – 156.32 μg/Nm^3 .In case of NO_x& SO_2 range was find between 10.43 μg/Nm^3 – 23.82 μg/Nm^3& 3.48 μg/Nm^3 – 14.28 μg/Nm^3 respectively. The high concentration of SPM & RSPM was notice due to movement of heavy vechile in this area having maximum value of 367.19 μg/Nm^3& 170.33 μg/Nm^3 respectively at premnager. Also due to vechicular emission level of NOx & SO2 was high about 38.93 μg/Nm^3&36.31 μg/Nm^3 respectively at Premnager while in Kanwali Road the concentration of SPM was between 147.65 μg/Nm^3 – 232.22 μg/Nm^3 , while RSPM was between 67.56 μg/Nm^3 – 110.33 μg/Nm^3 .Value recorded for NOx are between 34.32 μg/Nm^3 – 39.92 μg/Nm^3 for SO2 was between 25.14 μg/Nm^3 – 34.76 μg/Nm^3. While Haridwar are in outskirt of Dehradun and the maximums value recorded for SPM is 145.44 μg/Nm^3, RSPM is 71.45 μg/Nm^3 , NOx is 27.23 μg/Nm^3& SO2 is 19.26 μg/. Air level maximum recorded for SPM, RSPM, NOx & SO2 are 165.89 μg/Nm^3, 75.45 μg/Nm^3, 24.09 μg/Nm^3& 16.51 μg/Nm^3 respectively. Minimum level recorded are 80.76 μg/Nm^3, 30.66μg/Nm^3,14.5 μg/Nm^3& 11.79 μg/Nm^3 respectively in Rajpur Road

Prince Chock is a commercial area and the maximum level of SPM, RSPM, NOx & SO2 are 376.57 μg/Nm^3, 170.55 μg/Nm^3, 45.88 μg/Nm^3& 41.33 μg/Nm^3 respectively. Clock Tower is the center point of the City with major commercial market and high density of people so the concentration observed was found between range of 323.78 μg/Nm^3-395.17 μg/Nm^3& 116.32 μg/Nm^3 – 187.36 μg/Nm^3 respectively for SPM and RSPM. Concentration of SPM was recorded high in month of February with value of about 430.69 μg/Nm^3 .While concentration of SO2 was

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observed high in month of February with a value of 36.45 µg/Nm^3 at Selaqui Inustrial area of Dehradun. Unusual level of SPM and RSPM was recorded with a value of 520.46 µg/Nm^3& 270.55 µg/Nm^3 respectively Rispana Bridge. The first reading was before the other bridge came and second value is the clear indication of advantage with two way road. While concentration of NOx and SO2 was with in the normal range and the maximum value recorded was 43.68 µg/Nm^3& 36.53 µg/Nm^3 respectively at Rispana Bridge. Saharanpur Chowk has found to have the maximum concentration of SPM with a value of about 657.34 µg/Nm^3 and RSPM with a value of 320.67µg/Nm^3. While NOx and SO2 was found between the range of 43.56 µg/Nm^3 – 51.74 µg/Nm^3& 39.76 µg/Nm^3 – 44.67 µg/Nm^3 respectively.

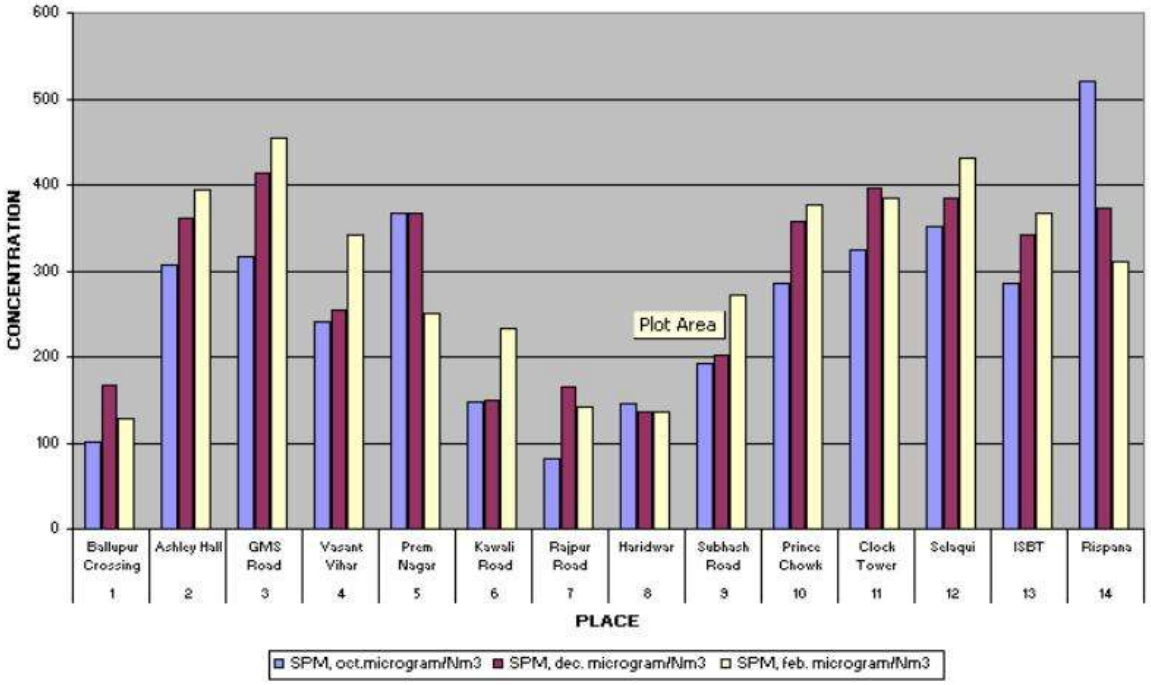

Figure 1. SPM cocnetration at different place of Dehradun city

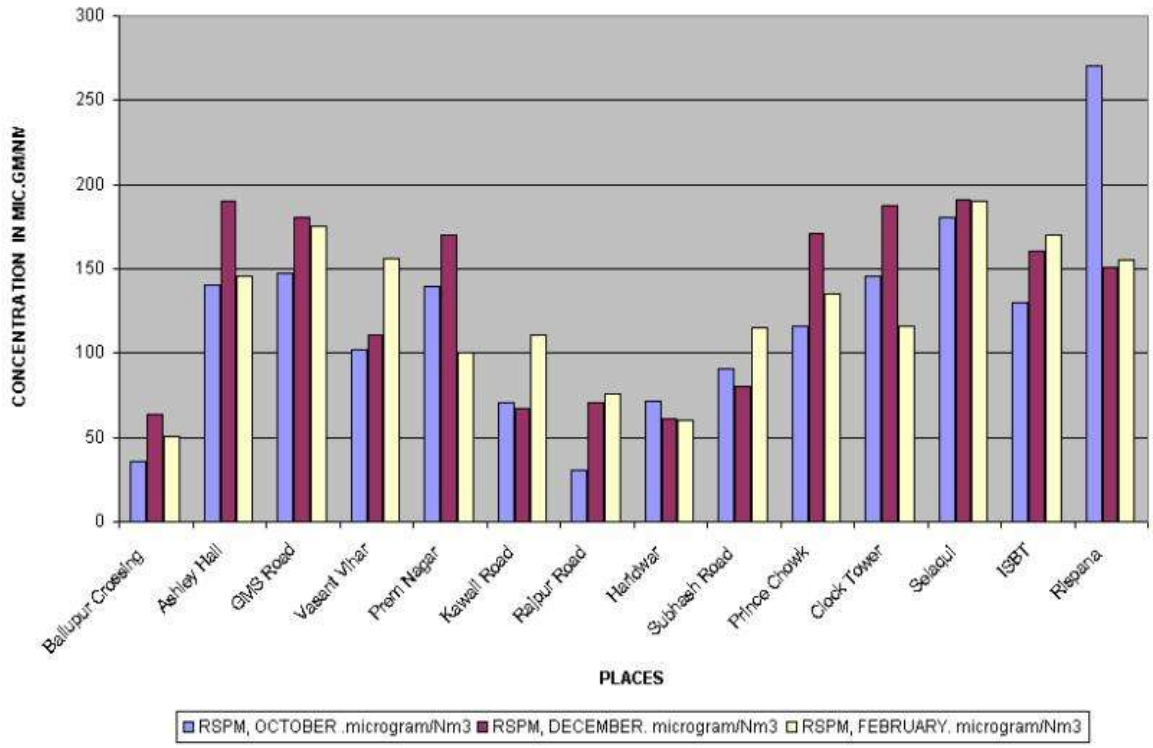

Figure 2. RSPM cocnetration at different sampling location of Dehradun city

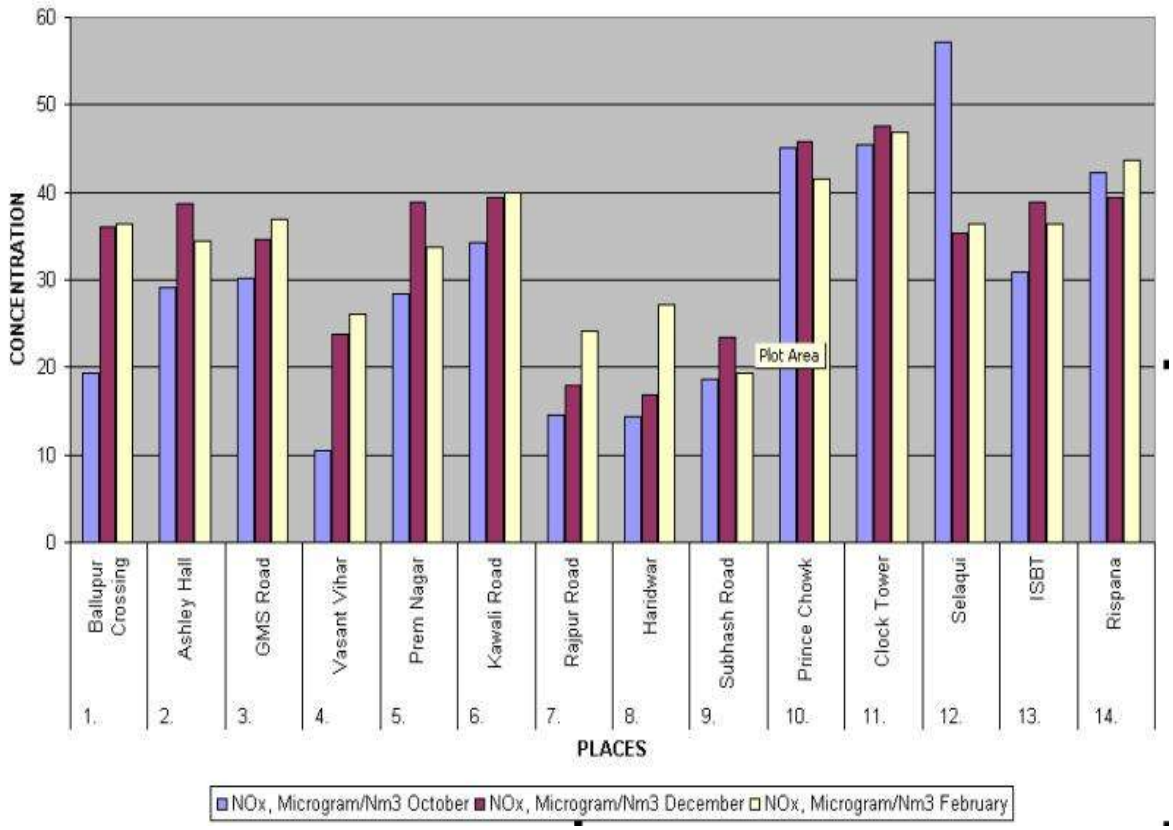

Figure 3. NOx cocnetration at different sampling location of Dehradun city

4. Conclusion

It was found that the ambient air quality parameter like SPM, RSPM and SO_2 were found in high concentration and these three parameter i.e. SPM, RSPM and SO_2 crossed the maximum permissible of NAAQ (2009) in almost all the sampling location while the parameter NOx were found under limit in all the sampling location of Dehradun city. The high concentration of pollutant were found near Clock Tower, Prince Chowk and Sharunpur chowk. This high level of pollutant were found mainly due to vehicular emission. It was observed that the number of two wheelers (Two strokes) were more.

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A REVIEW ON PHYTOPHARMACOLOGICAL ACTIVITY OF *PLUMERIA* SPECIES

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Deepak Kumar******

Abstract

"Green medicines are safer and healthier than synthetic ones" with this code, the plants are widely exploited in the tradition medicines. Due to greater advances in understanding the mechanism of action of herbs, plants gain the acceptance from the medical profession for the positive influence on health and quality of life. Phtyopharmacological studies from plant origin have tremendous therapeutic values. Natural products are effective in the treatment of various infectious diseases while simultaneously regulates many of the side effects. Therefore the present review was undertaken to validate scientifically the therapeutic role of all the species of *Plumeria*.

Keywords:

Plumeria;
Phytochemical activity;
Pharmacological value;
Plants

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1. Introduction

Natures play a very important roles as medicinal agents for thousands of years and renowned as one of the important systems of alternative and complementary medicines. Herbs or higher plants offers vital and appreciable roles in the

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modern system of medicine and serve as extremely useful natural drugs [1]. Basic compounds that provides by plants affording less toxic and more effective drug molecules. To avoid the various side effects of drugs prepared by chemical methods, indigenous plants are given priority because of their cheap, easily available and harmless condition [2]. Natural product chemistry is helpful for the exploration of biologically active prototypes for the newer and better drug synthesis. Modification of inactive natural products by biological/chemical means into potent drugs is a vital role of natural drug substances [3-5]. Various bioactive metabolites like alkaloids, terpenoids, flavonoids, steroids, glycosides etc. are present in plants and have their therapeutic value for the cure of diseases. Thus emphasis is given on the biological screening of medicinal plants for the proper exploration of their active constituents present in various parts of the plants. Apart from this, people from India have taken this work very seriously because of our excellent Ayurveda past. In our country (India) more than 75% of total population relies on traditional medicines based on plant product [6].

General Discription

Genus *Plumeria* belongs to Apocyanaceae family and widely cultivated in the tropical and subtropical region. *Plumeria* species are widely used as purgative, remedy of diarrhea, bronchitis, asthama, dysentery, cough, fever, bleeding piles, blood disorders and tumors etc. [7]. *Plumeria* species are commonly found as ornamental plants and due to its ease of propagation through cutting, various species of *Plumeria* are now widely cultivated and distributed in different part of the world [8]. As a ornamental plants, it si often seen in parks, gardens, graveyards and premises with their attractive fragrant flowers of various colour and size. This plant is grown for their aesthetic features but also have nutritive and medicinal properties. The tree of *Plumeria* genus were introduced to Malaysia and three most common species are found all over the world viz. *P. obtuse*, *P. rubra* and *P. acuminate* [9]. Although numerous hybrids and varities have also appeared and scientist recognize more than sixty species, that may reduced to seven or eight and rest are hybrids and varieties [10].

Taxonomical classification of Plumeria species are

Kingdom	Plantae
Subkingdom	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Apocynaceae
Genus	*Plumeria*

Various species of *Plumeria* is well known for its lovely strong fragrant. Its spiral shaped blooms grow from June through November. The tree is 20 inches long, coarse, blunt, deciduous leaves clustered only at the tips of the rough, thick and grey green branches. Basically it is an ornamental plant and sometime used to make necklaces which decorates coffins. Its flower give no nectar and trick their pollinators. The milky latex of *Plumeria* species contains poisonous compounds that irritates the eyes and skin. The leaves are spirally arranged near the ends of the swollen branches and flowers are large, waxy, very fragrant, in terminal or lateral stalked cluster [11]. Overall *Plumeria* is genus of laticiferous trees and shrubs and about eight species are reported from India but it is very difficult to fix their identity because of overlapping character of some species.

Chemical Constituents of various *Plumeria* species

Varoius research papers have proved that the first medicinally active compound isolated from the species of *Plumeria* were Iridoid glycosides. The other medicinally active constituents in the latex and oil of some of these species were alkaloids, tanins, carbohydrates and triterpenoids. The same components were also isolated from the different extract of roots and the other areal parts of *Plumeria* plant. The following some lines describe the bioactive chemical constituents of some of the *Plumeria* species.

1) ***Plumeria acuminate***: The active constituents present in *P. acuminate* species are steroids, alkaloids, glycosides, flavonoids and tanins. Phytochemical studies have shown that the stigmast-7-enol, lupeol carboxylic acid, lupeol acetate and ursolic acid are present in the leaves of this species. The roots of *P. acuminate* also contain Fulvoplumierin along with three new components viz. isoplumericin, β-

dihydroplumericin and β-dihydroplumericinic acid. An essential oil from *Plumeria acuminate* after steam distillation contain primary alcohols, citronellol geraniol, farnesol and phenylethyl alcohol with small amount of aldehyde and ketones (6.8%). These oil have saponification value (123) and acid value(20.2) [12,13]

2) ***Plumeria rubra***: The bark of the plant contain plumieride coumarylplumieride, protoplumericine, Rubrinol:an antibacterial triterpenoid together with teraxastery acetate, lupeol, stigmasterol, oleanolic acid [14]. Its flower contain essential oil, 1-diethoxyethane, benzaldehyde, geraniol, citral, methylbenzoate, methyl salicylate and linalool [15-17].
3) ***Plumeria alba***: Various alkaloids, carbohydrates, flavonoids, phenolic compounds, sterols, tanins and iridoid glycosides are isolated from the bark of *Plumeria alba*. The researchers have successfully reported its medicinal values with the components of amyrinacetate, β-sitosterols, mixtures of amyrins, plumeridecoumertae and plumeridecomerateglycosides [18-19]. Essential oil from its flower contain primary alcohol, geraniol, citronellol, farnesol and some linalol with quercetin and kaompferol.
4) ***Plumeria obtuse***: The fresh leaves of *P. obtuse* contain two new and three known iridoids. The new iridoids have been isolated and characterized as 6-O-acetylplumieride-p-E-coumarate[20,21] and 6-O-acetylplumieride-p-Z-coumarate [22]. The oil, isolated from P. obtuse mainly consist of benzyl salicylate (45.4%) and benzyl benzoate (17.2%), with minute concentration of alkanoic acid [23].

Medicinal value of *Plumeria* species

The seeential oil and fragrance contain the flower of various *Plumeria* species and used in perfume and cosmetic industry and aromatherapy. *Plumeria* species have been investigated to have antimicrobial, anticancer, antipyretic and antioxidant activities[24-31]. Different part of *Plumeria* also have their medicinal values and can be used for the treatment of skin cancer, antifilarial and other affliction [32]. The following few lines will summarized some recent pharmacological activities of *Plumeria* species.

1) **Antioxidant properties:** *Plumeria alba* leaves are the promising source of antioxidant activity. The methanol extract was found to have the free medical scavenging activity even more than that of ascorbic acid at the test concentration with the minor activity in chloroform and petroleum ether extract [33]. In other studies, an antioxidant activity was confirmed by invitro studies in *P. rubra* and a flavone glycoside was isolated and a significant reduction of serum triglycerides in alloxan-induced hyperglycemic rats was reported [34].
2) **Antipyretic properties:** Several experimental studies have investigate the antipyretic and antinociceptive activity of methanol extract of *P. acuminate* leaves. A significant reduction in brewer's yeast induced administration of *P. acuminate* leaves extract with different doses (100,250 and 500mg/kg) [35]. Ethanolic extract of the leaf of *Plumeria rubra* was reported for their antipyretic activity. It is useful in maintaining normal body temperature and reducing boiled milk induced elevatal rectal temperature in rabbits. An standard antipyretic drug e.g. aspirin were taken as standard [36].
3) **Antimicrobial properties:** Various extract of *Plumeria rubra* leaves were studied for their antimicrobial activities against eleven human pathogenic bacteria. Chloroform and ethyl acetate extract showed moderate to good antimicrobial activity against all the tested pathogens. The ethyl acetate extracts showed the largest zone of inhibition (25mm in diameter with 2000mg/disc extract) against *E. coli* and with fungal radial mycelial growth (62.00% with 100mg extract /ml medium) in A. ustus ethyl acetate extract [37]. The ethanolic extract from the stem bark of *Plumeria acutifolia* was tested for antimicrobial activity against both gram positive and gram negative bacteria and fungi by disc diffusion method. Results have

shown that the extract have very strong antimicrobial activity against *E. faecalis, B. subtilis, S. aureus, P. aeruginosa, S. typhimurium, A. niger* and *C. albicans* [38].

4) **Antitumor properties:** In indonesia, the bark of *Plumeria rubra* was investigated for their cytotoxic constituents. 2,5-dimethoxy-p-benzoquinone and three iridoids viz fulvoplumierin, allamcin and allamandin were active phytoconstituents of the petroleum ether and chloroform and the iridoid plumerian and the lignin liriodendrin were isolated from the aqueous extract [39]. Methanolic extract of *P. alba* was also investigated for antitumor using invitro cytotoxic and mean survival time[40]. Researcher have noticed a decrease in the tumor volume and viable ell count in the DLA tumor hosts. Kardono et. al. reported the three cytotoxic iridoidsfulvo plumierin, allamcin and allamandin from the bark of *P. rubra*.

Conclusion

The present review describes the phytochemical and pharmacological screening of various *Plumeria* species. Studies have shown that there is a vast scope of pharmaceutical activities for the plant of genus Plumera. The evaluation needs to be carried out for their clinical application for the betterment of the man kind.

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DEVELOPING A GEOSPATIAL BASED APPROACH TO LOCATE WINDFARM IN MELUR TALUK, TAMIL NADU, INDIA

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Abstract

Wind Energy technologies transform the kinetic energy of the wind into useful electrical power. Wind energy is renewable, inexhaustible and it generates clean and climate-friendly energy, which can cut down fossil fuel dependency. Among the renewable energy resources wind energy has been the most popular for the investors. In India, Tamil Nadu has a very large potential for wind power. Selecting the location for wind farm is byzantine that involves not only technical aspect, but also physical, economic and environmental requirements that may results in ambivalence objectives. The most favorable locations for wind farm will be acted based on environmental Land

Keywords:

Keywords- Kinetic Energy, Geospatial, GIS, MCA (Multicriteria Approach),

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Weighted Overlay

use factors, wind resources and water treatment. The performance of wind farms depends on location-based variables, implying the need for geospatial information analysis to find the best fit for each segment. Geospatial technology means collection of tools that contributes to the geographical & location component and analysis of earth. Geospatial information technology is therefore proving to be an essential component of decision making process in wind energy.
The main benefit of using Geographical Information System (GIS) is not merely the user-friendly visual access the display, but it has better decision-making capabilities & also featured with data collection and integration capabilities, management, analysis and presentation of geographic and other spatially defined data. So an integrated model will be developed to evaluate the potential locations of wind in Melur Taluk, Tamilnadu. For predicting the best locations, we adopt the multi-criteria approach utilizes the Weighted Overlay method to determine the weightage of sitting criteria (factors and constraints), and to develop the best describable map from single-factor maps to represent these criteria.

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1. Introduction

Wind is a form of Solar energy that cause by uneven heating of the atmosphere by the radiation of Sun, unevenness of earth's surface and off course rotation & their flow pattern is govern by earth's terrain, water bodies & vegetation cover[1]. When these factors are harvested and subjected to modern technology then this source can be used to generate mechanical power of electricity and illuminate by converting from kinetic energy of wind. Its free, clean, fresh, renewable source and a good prospect for future unlike fossil fuel dependency on large scale in present. Believing on stats, by today's technology wind energy could provide 20% of America's electricity with turbines installed in less than 1% of its land[2]. Taking an edge over fossil dependency, wind energy is now the world's fastest growing energy resource and expanding rapidly across industries worldwide. Nonetheless accessing the wind farm location is cumbersome as it holds several factors that restrains for wind power generation. Mainly three factors include Physical, Social & Economical factors set the benchmark for predicting best locations and rejecting unfavourable sites to possibly extract maximum energy efficiency[3].
Physical factor includes the wind farm location is best develop by of Geospatial technology that inhibits the advancements of modern tools for geographical locations benefit for settling up project by Multi Criteria Decision Making approach use for weighted overlay of all undertaking parameters and analyse the best pick up location for Wind farm installation. Social factors hinders the public acceptance & project approval of protected areas whereas economics include site accessibility, proximity of grid and availability of installation equipment. In India, Tamil Nadu has very large potential for wind power. Several wind power companies that participated in RENERGY 2012, a renewable energy event organised by the Tamil Nadu Energy Development Agency, have said that despite having

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6,300 MW of wind power capacity – about 40 per cent of the total installed capacity in the country – Tamil Nadu has a lot of good sites to offer. [4][5].

2. Methodology

The methodology for the proposed area is explained comprehensively for best site selection for Wind Turbine. The entire methodology is summarized pictorially in Fig. 1

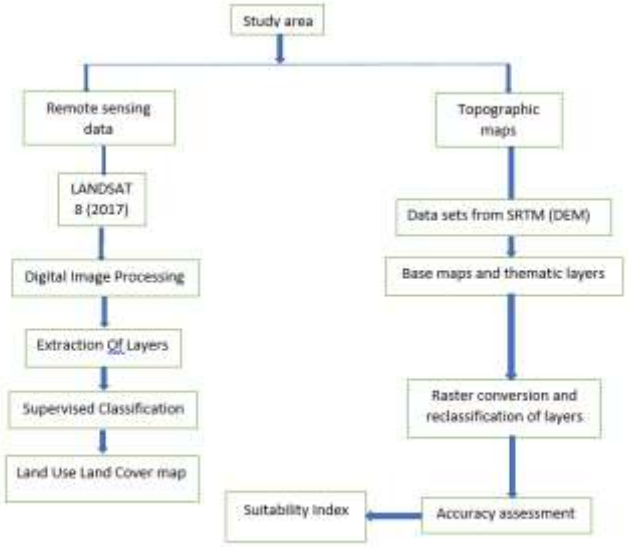

Fig.1 Working flowchart of the project

Tables and Figures are presented center, as shown below and cited in the manuscript.

3. Study Area

Melur is a town and a municipality in the Madurai East in the Indian state of Tamil Nadu (Fig. 2). The name Melur name comes from "Mela Nadu". Melur is called Thaikramam ('Mother of Villages')[6]. Melur Taluk is bounded by Siaganga Taluk towards South, Kottampatti Taluk towards North, Singampunari Taluk towards North, and Tiruppuvanam Taluk towards South. Thirupuvanam City, Sivaganga City, Natham City, Madurai City are the nearby Cities to Melur. It is the biggest taluk within the Madurai District. Melur is one of the largest populations of Madurai district (Fig. 3). The chief occupation of this area people is Agriculture. It is located 31 Km towards East from District headquarters Madurai. It is a Taluk head quarter. Geographic location of Melur Taluk (Table 1)[7].

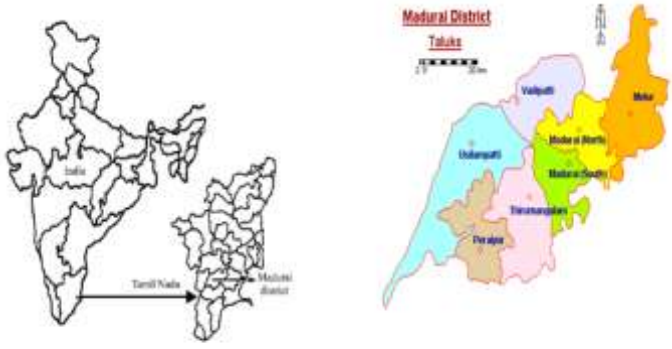

Fig. 2 Location of Study area in India, Tamil Nadu, Melur taluk, Madurai District

4. Softwares Used

The remote sensing and GIS software used in this study were ArcGIS (a product by ESRI) & Erdas Imagine (a product by Hexagon Geospatial Pvt. Ltd. Earlier by Intergraph).
ArcGIS is a Licensed based GIS tool for working with maps, it also includes creating, compiling, analyzing, sharing and many more with the data[8].

Table 1 Geographical Coordinates of Melur Taluk, Tamil Nadu

Coordinates	10.05°N 78.33°E
Area Total	664.9 km^2(256.7 sq mi.)
Elevation	149 m (489 ft)
Climate	It is too Hot in summer. Max Temp variation 29-42°C

Erdas Imagine is a Remote sensing application with main focus on geospatial raster processing that allows the user to prepare, display and enhance the digital images for mapping. Its an image processing software [9].

5. Data Collection & Preparation

According to the workflows for the criteria, the datasets were obtained from different organizations such as International Renewable Energy Agency (IRENA) for Average windspeed, Survey of India for topological sheets (Sheet no. 58K_2, 58G_6, 58G_9 & 58G_13) & US Geological Survey for Satellite Imagery and Elevation information.
The Average windspeed at 1Km resolution was collected from Global Atlas for Renewable energy of IRENA. The Global Atlas for Renewable energy was sponsored by a 3 TIER organization. Slope map has been prepared by using Digital Elevation Model of NASA Shuttle Radar Topographic Mission at free of cost from USGS Explorer Website (Fig. 3)[10].

- The proposed methodology of study involved various activities such as base map preparation, LULC map preparation, digitization and image processing using software and interpretation of the outputs.

- First stage includes development of spatial data base with a definite scale and with help of satellite data. GIS and remote sensing technology is applied to prepare various thematic maps. Land use and terrain data use to eliminate geographical areas not suitable for wind developments. Multiple databases with land use and elevation data are evaluate for resolution, format, quality, and ease of use.

- The second stage involved preparation of digital elevation model (DEM) by interpolating contour map. DEM is use to prepare slope, aspect, flow accumulation and stream order.
- The third stage is the representation of environmental objectives as Boolean sets for vector layers and fuzzy sets for raster layers. At the end of the Multi-criteria Decision-making process, an overall index for wind energy potential will calculate by raster multiplication.

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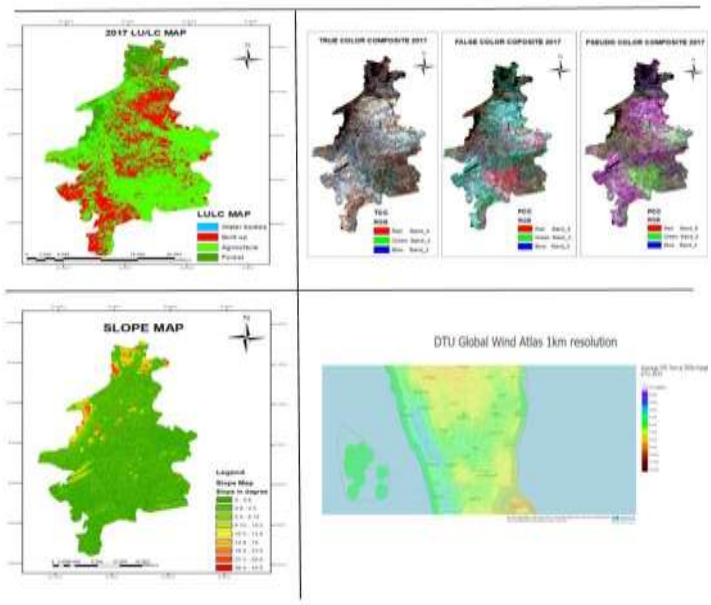

Fig. 3: From upper left: Landuse map; Color composition for Image processing; Slope map (in degree); Wind speed data (in m/s) of study area.

6. Identification of Criteria

Provide a statement that what is expected, as stated in the "Introduction" chapter can ultimately result in "Results and Discussion" chapter, so there is compatibility. Moreover, it can also be added the prospect of the development of research results and application prospects of further studies into the next (based on result and discussion).

- The developed criteria for the study area consisted of constraint factors including; Average Wind velocity, Terrain slope, Settlements, Transmission line access, Road access, hydrography and environmental science [11].
- So, these parameters were used for identifying suitable sites for wind farms in Melur Taluk. The constraint factors and their corresponding criteria were highlighted as being a Physical, Social and Economical. Areas containing settlements were excluded because of environmental concerns such as noise that might disturb of humans.

7. Boolean Logic

- Other excluded areas are Streams, Lakes, and Rivers. In the case of single-objective, a decision set contains two subsets: suitable (for allocation), and not suitable (for allocation). For that, the vector layers were geo-processed by Boolean operators (AND, OR, NOR), in order to perform such functions as, Buffer, intersection, union and clip within the ArcGIS software environment (Fig. 4).
- Buffer zones were created and the distance scores (assigned '1' for suitable and '0' not suitable) then added in the attribute table, thereby creating layers for each of the constraint criteria. Then, the buffer layers were integrated by OR operator or UNION tool of QGIS software environment.
- The product of the Boolean operations was used to convert the resultant layer into a binary raster format of 0 (excluded) and 1 (not excluded). The constraints for siting a wind farm, the accuracy in finding the

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most and the least suitable locations is dependent on how the information from all the constraint layers is combined to produce a single index of evaluation.

- This can be realized by assuming that all the layers are of different importance and therefore carry the same weight or Overall Average Weighting procedure. This is achieved by multiplying the attribute scores, by map layer weights, on a cell by cell basis.
- In ArcGIS, this is attained using the RECLASS and RASTER CALCULATOR function of the RASTER module. In order for the resultant map to be meaningful and consistent, map Weights had to add up to 100% and the attribute scores had to be chosen using a scheme that was the same for each map.

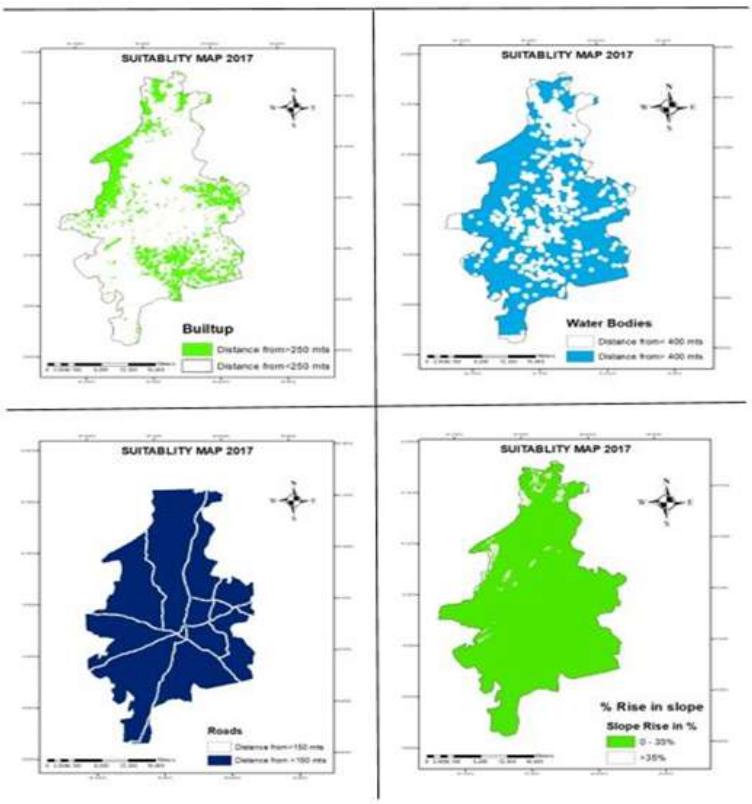

Fig. 4 : From Upper left: Settlement Buffer Layer;
Water bodies Buffer layers, Transportation Buffer layer, Elevation map

Results

Table 2. Attribute scores for the maps used in the wind farm site selection

SL.NO.	Implemented Layer	Criteria	Scale	Suitability
1.	Water Bodies	distance from <400m distance from >400m	0 1	Not suitable Highly suitable
2.	Rise in slope	0-35% >35%	0 1	Highly suitable Not suitable
3.	Roads	Distance from<150m Distance from>150m	0 1	Not suitable Highly Suitable
4.	Built up	Distance from<250m Distance from>250m	0 1	Not Suitable Highly Suitable

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The five criteria that are used in the study are the inputs to the Multi Criteria Decision Making in the open source GIS Software environment, which computes the suitability index (Fig. 5) shows the calculation results of the land suitability index at 80 m above the ground. The classification is done only for the "highly suitable" region as shown in the figure. The most suitable areas are occupying 15.79 percent of total studied area.
Suitability area- 107.472 km^2 (Table. 3.)

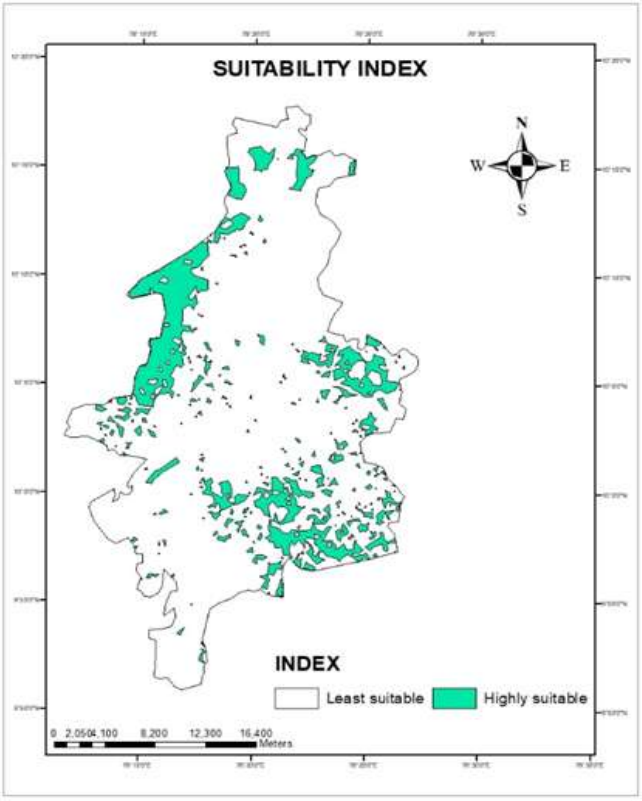

Fig. 5 Suitability Index map (Resultant) of Study Area

Table 3. Area Coverage (in %)

Implemented Layer	Area Covered	(%) percentage
Water bodies	2.6995	~0
Built-up	195.018925	29
Agriculture	403.326357	59
Forests	79.564928	12

Conclusion

The study established to determine the efficiency of geographic analysis tools in ArcGIS to identify the suitable sites for wind farm development in Melur Taluk, Tamil Nadu, India. The paper adopts the concept of weighted overlay to Multi Criteria Decision Making process.
In this study, the suitability index map will be technical support to the investors of wind farm development. This study indicates that 15.79% of the study area is identified as most suitable for wind farm establishments.

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RIVER WATER QUALITY ANALYSIS AND WASTEWATER UTILIZATION TECHNIQUES FOR UTTARAKHAND - A REVIEW

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Mukesh Chandra Kestwal**
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Abstract

A sanitation or sewerage system can be defined as the water treatment unit applied before dumping the waste water in water bodies. The need of sanitation system is not only for water treatment before final dumping but also to keep the urban areas neat and hygienic, waste water has to be transported out of urban areas because waste water containing organic waste may act as an invitation to epidemics due to presence of harmful pathogens. Moreover,the results of Water Quality Index (WQI) also reflect the excellent water quality with 'A-Grade' of all river water samples obtained after RBF process in comparison to normal river water samples having good water quality with 'BGrade' except the Srinagar site, where the river water sample was found to be unsuitable for drinking purpose with 'E-Grade'

Keywords:

Sanitation;
Water Quality;
Grey Water;
Waste Water;

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1. Introduction (10pt)

Importance of water is very well defined for human survival, river water is an important source of surface water which is being used directly for irrigation and domestic purposes (washing, bathing, cleaning etc.) since a very long time ago. After being completely used for human purposes, waste water (both organic and inorganic) from all the areas of use is collected and the liquid based waste products (i.e., human excrete, industrial waste, domestic waste) are unceremoniously dumped into the surface water bodies.

For at first it did not seem like much of a problem, as the ratio of volume of waste being disposed to the volume of water bodies was quite low, but as the human population has grown drastically over a period of time, so has the need for proper sanitation systems and waste disposal systems in this urbanization process.

A sanitation or sewerage system can be defined as the water treatment unit applied before dumping the waste water in water bodies.

The need of sanitation system is not only for water treatment before final dumping but also to keep the urban areas neat and hygienic, waste water has to be transported out of urban areas because waste water containing organic waste may act as an invitation to epidemics due to presence of harmful pathogens. By the early 19th century sewerage system became an important part of the urban areas. At first it was a major belief that the waste water containing human excrete is fit only for disposal sand that the natural environment was itself capable of consuming the waste but as the population increased natural methods were of no use.

Also, water contamination is a major issue in India as practically 70 for every penny of its surface water assets and a developing level of its groundwater saves are defiled by natural, lethal, natural, and

inorganic toxins. By and large, these sources have been rendered perilous for human utilization and additionally for different exercises, for example, water system and modern needs. This demonstrates that corrupted water quality can add to water shortage as it restricts its accessibility for both human utilize and for the biological community. Family borne effluents contribute a generous extent of water contamination in India. Untreated effluents from families dirty surface and groundwater sources. Neighborhood governments (city organizations, districts, furthermore, panchayats) have the duty of water supply and sanitation and should treat the effluents according to national water contamination models or insignificant national norms (MINAS) However, about 70 for each penny of the effluents are not treated and arranged off into the natural media untreated. Table 19.1 gives the synopsis insights of wastewater age what's more, treatment in India in 2008. Given below is a table demonstrates that urban areas, which have a populace of more than one lakh (Class-I), treat just around 32 for every penny of the wastewater produced. Note that out of the aggregate effluent treatment limit of 11554 MLD in the nation, around 70 per penny (8040 MLD) has been made in 35 metropolitan urban communities. Metropolitan urban communities treat around 52 for every penny of their wastewater. Delhi and Mumbai represent about 69 for every penny of the treatment limit of metropolitan urban areas. This shows that littler towns and urban communities have almost no wastewater treatment limit. Then, just 3.15 for each penny of the provincial populace approaches to sanitation administrations and 115 million homes have no access to toilets of any sort. As per CPCB report 2008 following percentage of water is being ejected and following is being treated. The numerical values are given below in table1:

Table 1: Classification of Class 1 and Class 2 cities as per CPCB 2008

Category	Number of Cities	Total Water Supply (MLD)	Wastewater Generation (MLD)	Treatment Capacity (MLD)
Class 1 city	498	44796.05	35,558.12	11,553.68(32%)
Class 2 city	410	3324.83	2,696.7	233.7(8%)
Total	908	48,093.88	38,254	11787.38(31%)

2. Wastewater: Treatment and Applications

A water treatment unit uses various chemical reactions and mechanical separation methods to remove harmful components present in waste water such that it harms the ecosystem in least amount possible when disposed into natures.

2.1 Wastewater treatment systems

2.1.1 Bio-refineries wastewater treatment

Ther are a very few processes for waste-water treatment. In any case, natural treatment forms alone are not adequate to meet fixing ecological directions (Pant and Adholeya, 2007). A legitimate decision of tertiary treatment can additionally lessen shading and leftover COD.

However, another approach is to utilize green growth. The upside of wastewater treatment utilizing green growth is that one can diminish the natural and inorganic burdens, increment disintegrated oxygen levels, alleviate CO2 contamination and create profitable biomass by successive utilization of heterotrophic and autotrophic algal species and the produced biomass can be an amazing wellspring of 'natural' manures. As reported in examines on eutrophication, green growth are known to flourish under

high centralizations of inorganic nitrates and phosphates that are generally dangerous to different life forms. This specific part of green growth can help remediate exceptionally contaminated wastewaters.

2.1.2 Municipal wastewater treatment using constructed wetlands

Developed wetlands (CWs) are a practical treatment elective for city wastewater, and various investigations on their execution in civil water treatment have been led. A decent outline built wetland ought to have the capacity to keep up the wetland water power, to be specific the pressure driven stacking rates (HLR) and the water powered maintenance time (HRT), as it influences the treatment execution of a wetland (Kadlec and Wallace, 2009). Indian involvement with built wetland frameworks is generally on a trial scale, treating various types of wastewater. One of the real imperatives to handle scale built wetland frameworks in creating nations like India is the prerequisite of a moderately substantial land zone that isn't promptly accessible. Subsurface (even/vertical) stream frameworks, by and large connected with around a 100 times littler size range and 3 times littler HRTs (by and large 2.9 days) than the surface stream frameworks (with around 9.3 days HRT, Kadlec, 2009), are along these lines being thought to be the more appropriate alternatives for the creating nations. Shorter HRTs by and large convert into littler land prerequisite. Bunch stream frameworks, with diminished detainment time, have been accounted for to be related with bring down treatment region and higher toxin expulsion effectiveness (Kaur et al., 2012a, b). Accordingly, cluster encouraged vertical sub-surface stream wetlands appear to have a suggestion for better adequacy under Indian conditions.

2.2 Wastewater application methods

Homestead laborers and their families honing wrinkle or surge squander water system methods are at the most elevated hazard. Splash/sprinkler water system prompts the most astounding potential store of the salts, pathogens and different toxins on the yield surfaces and influences adjacent groups. Dribble water system is the most secure water system strategy however experiences stopping up of the producers, contingent upon the wastewater add up to suspended strong focuses. Utilization of fitting channels, for example, rock, screen and plate channels in blend with trickle frameworks has been seen to hugely diminish the obstructing and coliform rate (Tripathi et al., 2011).

2.2.1 Post harvest interventions

Post-reap intercessions are a critical segment for wellbeing hazard diminishment of wastewater-flooded products and are of specific significance to address conceivable on-cultivate pre-defilement, and furthermore pollution that may happen after the harvests leave the ranch. The wellbeing dangers could be particularly brought down with appropriation of a portion of the minimal effort practices, for example, rehashed washings, presentation of the deliver to daylight and raising the harvests on beds, expelling the two outmost leaves of cabbage and furthermore, cutting over some range from ground level.

2.3 Grey Water: Source and Concepts

Waste water from urban areas can be classified into three main categories as: yellow water, grey water & brown water.

Yellow water consists mainly of urine from toilets, yellow water is considered as nutrient rich fluid (yellow water has high levels of nitrogen and phosphorus i.e., about 80% and 50% respectively of total nitrogen and phosphorus content in municipal wastewater which are afterward extracted for further use). Brown water mainly consist of feces, urine, solid and semisolid waste from toilets which are

obviously of organic nature. Grey water which is least contaminated with pathogens consisting of waste water after bathing, dish washing, laundry etc., with a very low content of organic matter grey water mainly contains components of soap, detergents etc. which wash away along with water.

Grey waste water can be recycled and reused for purposes like irrigation, toilet flushing, car washing etc. (for purposes that does not include direct contact or intake by humans) after various biological, chemical and mechanical treatment therefore it has to be kept separate from brown and yellow water to delete the risk of contamination. During last decades number of technologies called "ecological sanitation "techniques have been developed in order to make use of waste water and to control the wastage of clean water by reusing waste water after treatment , this has shown visible reduction in usage of fresh water supplied into urban areas .The goal is "sustainable sanitation "which refers to sanitation system that protect and promote human health , do not degrade the environment, is technically and institutionally appropriate , economically viable and most importantly socially acceptable (vacuumed toilets were introduced to completely stop use of water for flushing purpose but became socially unacceptable because people thought they were not hygienic enough also some complained that they made unpleasant voice while flushing and also they were expensive to be implemented over large area).

2.4 Grey Water: Treatment Techniques and Applications

The objective of grey water treatment and reuse varies as the area changes , some require to reduce the fresh water consumption and hence need to reuse grey water , some objectives are based on environmental concerns while some objectives are primarily based on hygiene, therefore various pilot project have been introduced and are being introduced based on priority of the particular area (e.g., the main drivers of grey water separation in Netherlands were reduction of water use & reduction of sewer overflow whereas in Sweden main objectives were nutrient recycling and reduction of emissions therefore they used urine separation systems). The problem with developing a required sanitation or sewerage and treatment system is that a number of factors have to be kept in mind such as if the project is practically applicable or not, economical factors, geographical factors etc. which makes the process quite complicated. One of the pilot projects introduced the idea of a "grey water dam" to store the grey water and further use it for electricity production.

Some methods of treatment of grey water are listed below-

1. Aerobic pre-treatment technique (suitable for waste water from bathrooms and laundry i.e., waste water not containing organic components.
2. Anaerobic treatment followed by aerobic pre- treatment (suitable for waste water from kitchens i.e., waste water containing organic waste)
3. Physical treatment (old treatment technique coarse filtration or membrane often coupled with disinfectant)

3. Acceptable Water Quality Standards and River Water Quality Analysis

3.1 Drinking Water

Uttarakhand rivers Gola, Kosi, Ramganga, Saryu and Lohavati rivers flows mainly in the region of Kumaon district, were analyzed. They are the main source of water for drinking and irrigation purposes the following data was obtained pre and post monsoon by the report in 2012 water was found to be unfit for drinking. Various hydro chemical feces also with reference to water quality index it was found unsuitable for drinking purposes. Moreover, when we look at irrigation purposes water system water nature of all the waterway water was discovered appropriate in both the seasons as indicated by the

consequence of Na adsorption proportion, Na rate and leftover Na2Co3. The present investigation uncovered that main considerations adding to weakening of water nature of the considerable number of waterways may be eutrophication, tourism, anthropogenic and eugenic forms. In this way, to reestablish the imperativeness and water nature of every one of these streams, legitimate water asset arranging project ought to be produced. The physic-substance parameters like pH, alkalinity, and turbidity were examined nearby. Alternate parameters, for example, hardness, add up to broke up solids (TDS), No3-, Cl2, fluoride, SOF-, Na, K, Ca, Mg, Fe and aggregate coliform (TC) and fecal coliform (FC) were investigated in research labs after specimen's conservation according to BIS 1991 and APHA (Eaton et al. 2005) rules.

Water Data of various water quality parameters which includes dissolved oxygen, BOD, TDS, concentration of nitrates for the year 2011-12 is explained in the following figure, and the values for the fluorides, chlorides, sulphates, copper, magnesium, phenolic compounds etc. are represented graphically in the next figures:

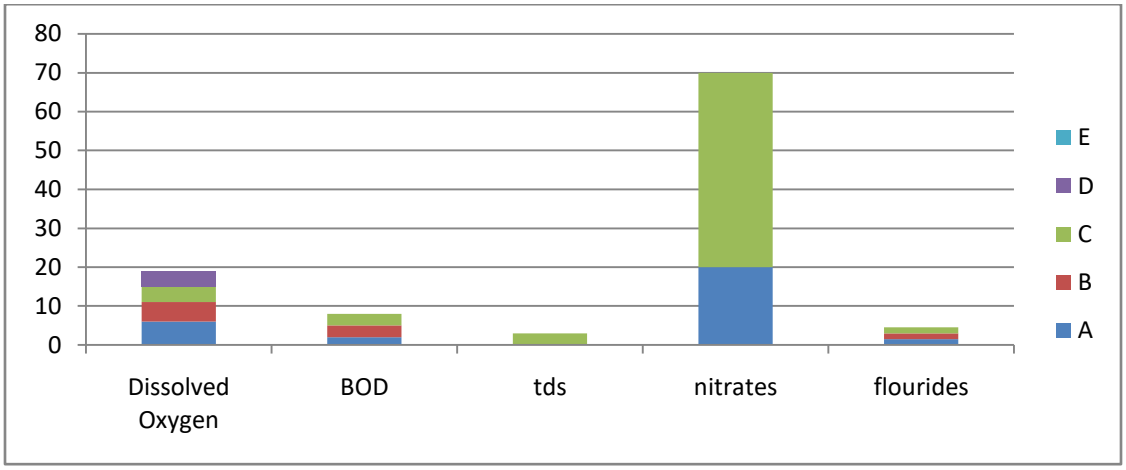

Fig. 1a: Graphical representation of water quality parameters for different classes categorized by CPCB

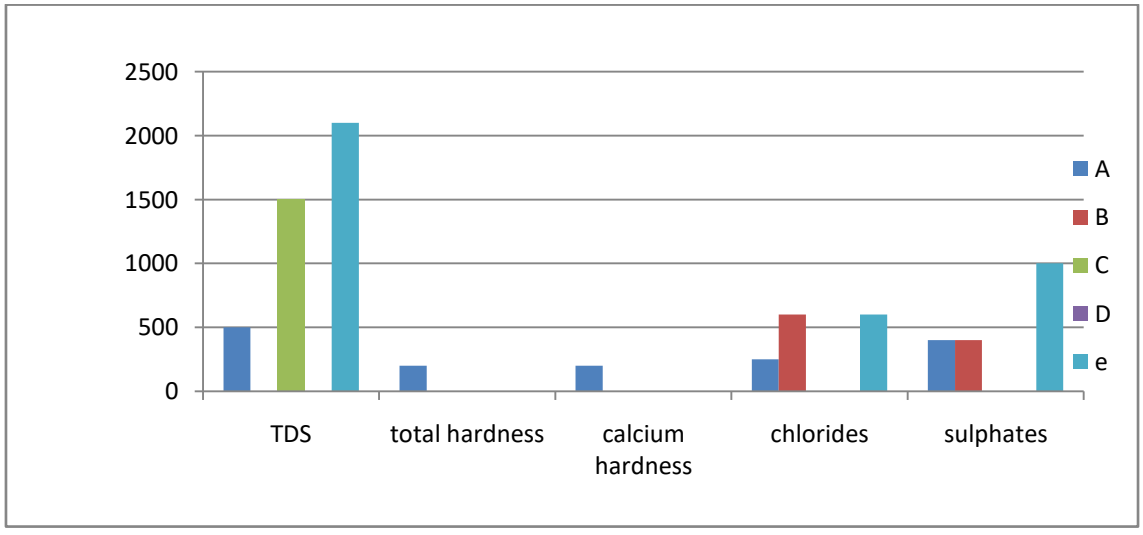

Fig. 1b: Graphical representation of water quality parameters for different classes categorized by CPCB

3.2 Irrigation Water

Utilization of water having high SAR level consistently can prompt the expansion in Na level over the time, which thusly can unfavorably influence soil penetration and percolation rates. For the cause of soil crusting, poor seedling and poor aeration excessive SAR levels is responsible.

SAR value can be calculated from the following equation:

$$SAR = Na^{+}/\sqrt{(Ca^{2+}Mg^{2+}/2)}$$

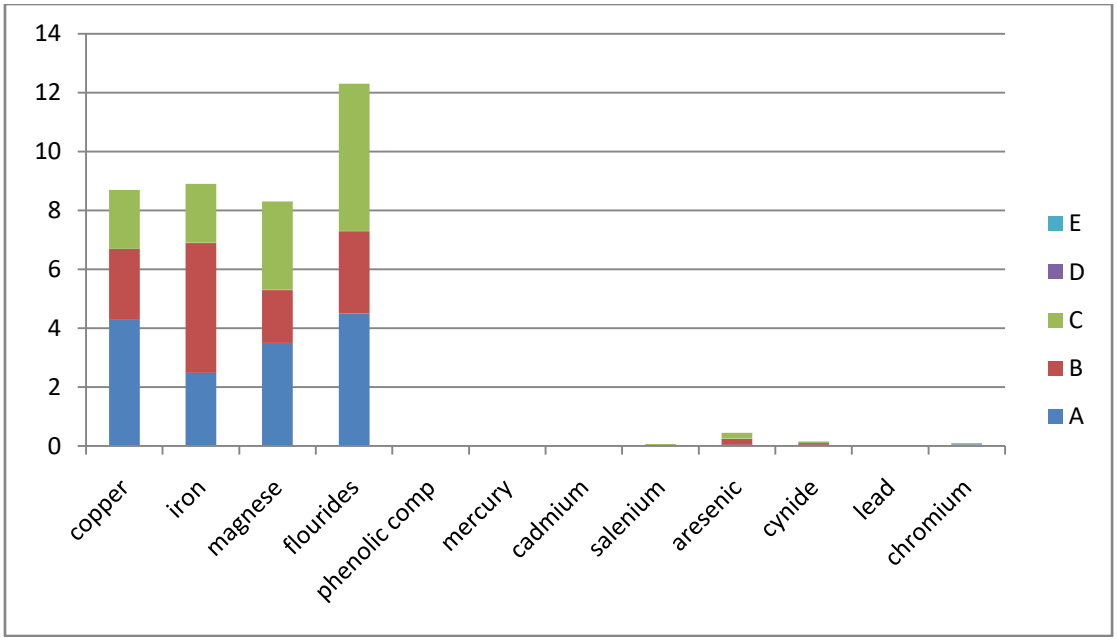

Fig. 1c: Graphical representation of water quality parameters for different classes categorized by CPCB

it is watched that water of all the five streams were superb for water system purposes. Leftover sodium carbonate -The sodium peril likewise increments, if the water contains a higher centralization of bicarbonate particles. As the dirt arrangement turns out to be more thought, there is inclination for calcium and magnesium to hasten as carbonates, expanding in this manner the relative extent of sodium as an outcome. In display case, RSC was utilized to measure impact of the Co3 and HCo3(Eaton 1950). RSC was ascertained utilizing the accompanying condition:

$$RSC = (Co_3^{+} + HCo_2^{-}) - (Ca^{2+} + Mg^{2+})$$

where, every ionic focus are measured regarding meq/l.

3.3 Water for bathing purpose

Table 2: Criteria and rationale analysis for water batching purpose

Criteria	Rationale
1. Fecal coliform - 500 (desirable) MPN/100ml - 2500 (maximum permissible) 2. Fecal streotococci - 100 (desirable) MPN/100ml - 500 (maximum permissible)	Ensures low sewage contamination fecal coliform and fecal streptococci are considered as they reflect the bacterial pathogenicity. The desirable and permissible limits are suggested to allow the fluctuation in environmental such as seasonal changes in flow condition etc.
pH: between 6.5-8.5	Provides protection of the skin and delicate organs like eyes, nose etc. which are exposed during bathing
Dissolved oxygen : 5mg/l or more	Ensures reasonable freedom from oxygen consuming organic pollution immediately which is necessary for production of anaerobic gases from sediments.
Biochemical oxygen – 3 mg/l or less	Ensures reasonable freedom from oxygen demand in pollutants and production of obnoxious gases.

4. Conclusion

By the above data it is clear that there is a severe need of proper water management and treatment in Uttarakhand region as by the report of CPCB 2008 it is clear that only a little percentage of water is being recycled moreover because of lack of proper water treatment the waste water being disposed into water body is affecting their water quality badly therefore in my opinion there must be proper grey water treatment plants so that the recycled water be used for irrigation , flushing and car washing like activities in day to day life and this will also reduce the daily demand of fresh water .

It can be said that water quality is more suitable for irrigation purposes than drinking, the impurity has also further increased from 2012-2017 and, this is because of increasing population, increasing tourism and most importantly improper waste water treatment. Therefore, the grey water management is one of the great importance in this region. Grey water being purified can be directly used for irrigation purposes and since there would be least waste disposal into the rivers and hence the river water can be used directly for drinking purposes.

In developing nations like India, the issues related with wastewater reuse emerge from its absence of treatment. The test in this manner is to discover such minimal effort, low-tech, easy to use techniques, which on one hand desist from debilitating our considerable wastewater subordinate occupations and then again secure corruption of our profitable characteristic assets. The utilization of built wetlands is presently being perceived as an effective innovation for wastewater treatment. Contrasted with the regular treatment frameworks, built wetlands require lesser material and vitality, are effectively worked, have no slime transfer issues and can be kept up by untrained faculty. Promote these frameworks have bring down development, support and operation costs as these are driven by regular energies of sun, wind, soil, microorganisms, plants and creatures.

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STRUCTURED RISK REVIEW TECHNIQUES IN HSE IMPACT ASSESSMENT, AND THEIR DESIGN IMPACT

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Keywords:

Health Safety and Environmental Impact Assessment; HSEIA; Structured Risk Review Techniques; HSE Studies; Risk Reduction Measures; RRM; Front End Engineering Design; FEED.

Abstract

Establishing respective management systems are important aspect to address Health Safety and Environmental (HSE) issues of the major expansion and/or modification works undertaken by Companies in their hydrocarbon processing facilities. Aim of this study is to understand the benefits and limitations of applying the Structured Risk Review Techniques as part of HSE Impact Assessment (HSEIA) in early design phase, interpreting how it enhances the design integrity in subsequent phases, and consequently to decide the way forward for next phase HSEIA process. To achieve this, a Case Study approach has been adopted in expansion of an Offshore Oil & Gas processing facility. A detailed review of identifying HSE risks using proven techniques, and associated HSE Studies have been performed; All preventive & mitigative measures derived as an outcome were incorporated in Front End Engineering Design (FEED) phase. Obviously, introduction of Risk Reduction Measures was achieved which in turn reduced the probability of occurrence & limit the extent and duration of hazardous events, further mitigated the undesired effects. Preventive measures such as inherently safer design in early stage of the project and asset integrity management as part of Loss Prevention principles were also been emphasized.

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1 Introduction

Establishing respective management systems [15] are important aspect to address Health Safety and Environmental (HSE) issues of the major expansion and/or modification works undertaken by Companies in their hydrocarbon processing facilities. HSE Impact Assessment [10], [12], [14] using structured review techniques & applicable HSE Studies [6] across all stages of project life cycle to identify the hazards, and the assessment of associated risks will help us to introduce Risk Reduction Measures (RRM).

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Risk Reduction Measures should include those items/aspects to reduce the probability of occurrence [1] & restrictiing the time of hazardous events, and mitigating its effects. Preventive measures such as inherently safer design in earlier stage of the project and asset integrity management [17] as a part of Loss Prevention [3], [4] activities shall also be emphasized.

1.1 Case Selection

An Oilfield COMPANY situated in Abu Dhabi (United Arab Emirates) Offshore is Exploring, Developing & Producing Crude Oil. To achieve additional production by developing a new Oil field and increasing output from existing oil fields, COMPANY (otherwise called as 'Facility Operator' herein) is proceeding with installation of new Crude Oil Heater. Additionally, to cater the future electrical power demand resulting from the field expansion, COMPANY is installing the fuel gas supply system in their existing facilities which includes:

- Fuel Gas Holder for Gas Turbine Generator
- Fuel Gas Compressors

The above-mentioned facilities as part of COMPANY's expansion are chosen as a Case Study. These facilities are subjected to HSE Impact Assessment by using structured risk review techniques & other HSE Studies, and discussions held on how the study recommendations were implemented in FEED.

COMPANY has outsourced the Engineering Contractor to carry out the Design, and arranged Project Management Consultant (PMC) to oversee the project. Approved Third party consultant and COMPANY's in-house team are deployed to carry out the HSE Impact Assessment (HSEIA) and other HSE Studies.

1.2 Objectives of the Study

Aim of this study is to understand the benefits and limitations of applying the structured risk review techniques in early design phase based on the impact assessment carried out, interpreting how it enhances the design integrity in subsequent phases, and consequently to decide the way forward for next stage HSEIA process. Hence, the following sequential approach is adopted for the Case Study:

1. Carrying out HSE Impact using appropriately selected Structured Risk Review and associated HSE Studies
2. Analyzing and implementing the preventive & mitigative measures identified as an outcome of HSEIA into FEED
3. Discussing the benefits and limitations of applying the Structured Risk Review Techniques
4. Deciding the way forward for the subsequent phase HSEIA process i.e., for Detailed Engineering, and Operations.

2 Methodology

For the chosen scope of this Case Study, it is significant to identify hazards [1], [2] in early stages, so that adequate time shall be given to analyze & evaluate the risks to determine the counter measures for managing them in FEED. Selection of structured review techniques is the key for achieving it. Identification of Major Accident Hazards is vital in early stage for concluding cost-effective Risk Reduction Measure (RRM). HAZID/ENVID/OHID (Occupational Safety Hazards Identification/ Environmental Aspects & Impacts Idenfication/ Occupational Health Risks Idenfication), and Hazard and Operability (HAZOP) Study (to find out process related hazards) are believed to be useful to achieve this objective.

At FEED stage, risk evaluation techniques such as QRA [5], [7], [9], [13], Bow-Tie (combination of FTA & ETA), FERA [8], [11], etc. are scheduled. With interpretation of International Standards and Code of Practices, the outcome of risk identification & review techniques, other HSE Studies are dealt as HSE Impact Assessment (HSEIA) in this context.

The outcome/ recommendations from the HSE Impact Assessment are implemented in FEED Phase of the project facilities. Site Visits are carried out to interact with Operations Team to validate the critical data/ inputs (pertinent to the existing facilities) used for FEED and to ensure that interpretation of those by Project Team are right.

The evaluation techniques [1], [2] are anticipated to provide outcomes which are themselves possesing uncertainities, and subject to the review of experienced design professionals consequently.

Face to face interaction sessions (study workshops, review & progress meetings, etc.), Desktop Reviews are administered with the multi-disciplinary team members (from COMPANY including Corporate HSE Team/ Technical Safety Team, Project Management Consultant, Engineering Contractor, Third Party HSEIA Consultant), Operations Team as they are perceived to be more skilled and experienced in applying these techniques.

Software applications such as PHA Pro 8.5 (for preliminary/ process hazards identification), Bow Tie XP, PHAST/ PHAST Risk 6.7 (QRA & FERA), ExSILentia (SIL) etc., are used for carrying out the relevant studies.

2.1 HSE Impact Assessment & its outcome

HSE & Loss Prevention Philosophy establishes the HSE/ Loss prevention [3], [4]requirements for the project scope and defines the HSE activities comprising of various risk review techniques [1], [2]to help reduce the risks associated with the project.

2.1.1 Overview of HSEIA Process

HSE Impact Assessment [10], [12], [13], [14]ensured that all hazards identified are assessed through HSEIA process (Environmental Impact Assessment, Ocuupation Health Risk Assessment, Control of Major Aaccident Hazards, HSE Management System review, etc.) and risk reduction measures are specified and HSE Critical Equipment and Systems (HSECES) are identified.

The following hazard assessments studies are carried out for the project scope aiming to identify the main hazards and to evaluate the associated risk levels are acceptable when compared with set risk acceptance criteria. COMPANY standards and Regulatory body's COPs & study methodologies are used to identify all hazards.

- Preliminary Hazard Identification using HAZID/ENVID/OHID Studies [1], [2]:Hazard Identification studies are performed qualitatively utilizing Management criteria to identify all Health, Safety and Environmental hazards and threats related to the project scope.
- Process Hazard Identification using HAZOP [1], [2]:Hazard and Operability Study is performed to identify in a systematic manner all hazards and operability issues of the design and operation of the expansion facilities.
- The following Major Accident Hazards (MAHs) are identified based on HAZID workshop:
    - MAH-01 Hydrocarbon liquid under pressure (oil heater)
    - MAH-02 Hydrocarbon Gas under pressure (Fuel gas system)

However, no additional Major Accident Hazards are identified through HAZOP process.

- Quantitative Risk Assessment (QRA) [5], [7], [9], [13]:QRA study is carried out quantitatively to assess and establish incremental risk levels for the proposed facilities in terms of Location Specific Individual Risk (LSIR), Individual Risk Per Annum (IRPA) and Societal Risk.
- Fire and Explosion Risk Assessment (FERA) [8], [11]: Outcome of the consequence analysis are used to perform FERA, which defined the Active Fire Protection, Passive Fire Protection, Fire Zone and Overpressure requirements.
- Escape Evacuation and Rescue Assessment (EERA): Based on the consequence assessment results, the requirements for personnel to escape are evaluated in case of an emergency.
- Design Review is conducted to evaluate the integrity of design of the systems from the possibility of delivery of performance with respect to capacity, quality, operability issues, maintainability issues, facilities for emergency shutdowns, and HSE.
- Safety Integrity Level (SIL) Assessment [6] is performed based on IEC 61508 & IEC 61511 guidelines, and identified the required SIL rating of Safety Instrument Functions based on layers of protection available.

2.1.2 Outcome of HSEIA

The outcome of HSE Impact Assessment [10], [12], [13], [14]is briefed hereunder:

- All HSE hazards/impacts/aspects are systematically identified, inclusive of relevant risk / impact classification (e.g. High, Medium and Low) in accordance with regulatory requirements/practices that are agreed upon prior to the studies.
- It is demonstrated that all Major Accident Hazards have been identified and relevant control, mitigation and recovery measures are incorporated into the FEED design.
- It is demonstrated that significant environmental impacts have been identified, analysed and assessed [14]. The impacts are justified as '*de-minimus*'. Suitable inputs are taken forward to be implemented in design.
- It is demonstrated that Occupational Health Risks have been identified and the aspects pertinent to the scope are found to be '*de-minimus'* [14].
- The identified Medium and Low Risk Hazards/ Impacts/ Aspects are managed and controlled via the HSE Management System [15] and associated Procedures/ Work Instructions.
- Implementation plan developed that shows how the control, mitigation and recovery measures for Significant Environmental Impacts, Major Accident Hazards and High Occupational Health Risks will be implemented and managed throughout the remaining lifecycle of the expansion facilities (Detailed Engineering/ Construction/ Comissioning, Operations).
- Update of Emergency Preparedness and Response Plan [15] in Construction Phase with respect to the identified Major Accident Hazards.

- The HSEIA outcome provides guidance in the selection of equipment and design of the facilities to achieve its objectives. Recognizing that all accidental losses are preventable, the adopted philosophy focussed on avoiding damage to the human, environment, asset, and security. Following are the main hazards accounted in the FEED:
  - Presence of sour gas in the installation
  - High pressure hydrocarbon releases
  - High pressure toxic gas releases
  - Jet and pool fires
  - Explosion
- FEED design adopts the following methods of risk reduction to ensure basic HSE requirements are inherent [3], [4] in the design of the facilities, which included:
  - Minimizing hazardous inventories
  - Minimizing equipment, flanges and fittings

- Segregating hazardous and non-hazardous areas
- Optimization of plan layout
- Keeping the design and intended operating activities simple
- Using well proven technology and techniques
- Minimizing intervention requirements

Project Health, Safety & Environmental Review (PHSER) is performed to provide assurance to the COMPANY that HSE hazards have been identified, assessed and appropriate controls have been or will be implemented to reduce the identified HSE risks to a level that is acceptable or 'As Low As Reasonably Practicable' (ALARP) in design.

2.2 Implementation of Study outcome in FEED

Based on the outcomes of different HSE studies, the recommendations are incorporated in FEED stage deliverables/drawings and selected actions implemented are outlined as below:

- Evaluation of mitigation measures on Loss of Containment scenarios: QRA assessed the toxic & sweet fuel gas releases on loss of containment from Oil Heater & Fuel Gas supply systems. All necessary recommendations relevant to mitigate the toxic and hydrocarbon gas release are implemented in the design stage. QRA recommendations are closed appropriatelyin HSE Action tracking register.
- Compliance to project design specifications on Hydrogen Sulphide (H_2S) requirements: It is ensured that the design practice complies with the COMPANY's Management of H_2S procedure [15], in line with local regulating body requirements [14]. Based on the H_2S concentration in process stream indicated in the Piping & Instrumentation Diagrams (P&IDs) and Heat & Mass Balance (HMB), fixed toxic gas detectors are provided in H_2S prone areas (Fire & Gas (F&G) detector layout drawing).
- ESD (Emergency Shutdown) based isolation is provided for the heater to limit the inventory in LOC (Loss of Containment) case.
- Compressor discharge piping is provided with personal protection.
- F&G detectors are updated in 2D orientation layouts. F&G Philosophy accounts early alarms to personnel in process areas and buildings to facilitate safe escape, muster & evacuation. F&G Detector Layout, Cause and Effect Chart are developed.
- Fire Zoning concept [3], [4] is adopted for new Oil heater, Fuel Gas Supply System and referred in the Fire Zone Layouts. FERA assessment reconfirmed the requirement of the new Fire Zone and accordingly the facility is designed.
- Fire Water Demand Calculation and Adequacy Study Report is confirmed that the existing Fire water system is adequate to cater the firewater requirement of the expansion facility.
- Passive fire protection layouts are updated with the outcome/requirement of the FERA assessment.
- ESDVs (Emergency Shutdown Valves) are located outside the Fire Zone impact distance of 12.5 kW/m^2 thermal radiation effect zone as possible. However, BDVs (Blow Down Vavlves) & ESDVs, which are not possible to keep outside the Fire Zone impact distance and hence provided with suitable Passive Fire Protection.
- Fire Hydrant and Monitor Location layout is developed with sufficient inter distance to operate the firefighting equipment in case of fire.
- For Fuel Gas Supply System, Primary Fire Protection for compressor area is achieved by Deluge water spray protection for all the three compressors simultaneously.
- Requirement of Hydrocarbon gas detection at existing gas turbines enclosures ventilation air intake are included in the design.
- H_2S Toxic gas & Hydrocarbon gas detectors are considered in process buildings' HVAC air intake with sufficient voting logics, accordingly automatic shutdown is considered.
- All relevant outcomes and logics are incorporated in the F&G layouts for buildings, and F&G Cause & Effect charts.

3 Results and Discussion

Identification of Major Accident Hazards is vital in early stage for concluding cost-effective Risk Reduction Measure (RRM). HAZID and HAZOP [1], [2] are deemed useful to achieve this objective.

The evaluation techniques [1], [2] are anticipated to provide outcomes which are themselves possesing uncertainities, and subject to the review of experienced design professionals consequently.

QRA [5], [7], [9], [13] shall be performed when adequate valid data available in order to get good results. In early stages of project lifecycle, there will be uncertainities in input data (and hence in model also), in general. In the subsequent phases of design, these uncertainintes need be validated to conclude the firm design. Otherwise, the feasibility of adapting alternative techniques to be optioned for validating the outcomes.

3.1 Benefits of structured review techniques

The following key benefits are obtained in view of applying the structured risk identification & review techniques:

- ✓ Systematic process of identifying HSE impacts, and establishing prevention & mitigation measures.
- ✓ Identification of critical risk controls and an assessment of their effectiveness.
- ✓ Graphical depiction of the risks by means of contours which gives easy understanding and interpretation.
- ✓ Closing the loops between outcome of Risk Assessments carried out in FEED Phase and the existing Management Systems.
- ✓ Balanced risk overview for the Facility Operator's system between internal & external stakeholders.
- ✓ Simple and straightforward methodology and demands only minimal trainings for involved multi-disciplinary team members.
- ✓ Increased awareness and understanding of the safety risk existing within organization.
- ✓ Flexibility to adopt this methodology across wide range of industries and at any phase of project lifecycle.

3.2 Enhancement of Design Integrity through structured review techniques

The following are the learning outcomes of the subject Study pertinent to the enhancement of Design Integrity through structured risk reviews:

- It is obvious from this Study that the structured risk review techniques are most suitable for the projects following the standard lifecycle process, however all the projects are not necessarily required to undergo all the risk reviews / HSE studies especially the projects with minimal HSE impact, i.e. '*de-minimis*' projects supported with justification.
- Providing clarity on careful selection of structured review techniques & associated HSE studies (such as SIL, etc.) for next phases of project lifecycle (Detailed Engineering, Operations, etc.).
- Integrating the incremental risk from the expansion facilities with the existing facility's risks [16] while moving into Operations Phase will give clear picture to Facility Operator for further proceedings. For example, Integrated QRA study will help in proper future land use planning (to locate the accommodations, fabrication shops, warehouses, etc.).
- The results of QRA & FERA study results will facilitate COMPANY to site the process buildings within the existing facilities [16] in such a way those are protected from potential vapor cloud explosion (with the rated overpressure and phase duration) hazards from current expansion facilities.
- Construction & Commissioning nodes of HAZID/ENVID/OHID workshops (conducted in early stages) provide primary inputs for framing tendering requirements for subsequent phase of the project.
- Outcomes from HSE Studies/ Reviews & associated activities emphasize Facility Operator to focus more on 'HSE in procurement' during EPC (Engineering, Procurement & Construction) Phase. A review of all items (especially HSE critical equipment to be procured during EPC Phase) must comply with HSE requirements with respect to fabrication, certification, installation and operation.
- During EPC Phase, performance standards shall be developed for identified HSECES to ensure continued integrity of the HSECESs through appropriate task related to design, construction, commissioning, pre-commissioning etc.

- The importance of documenting the potential risk escalation scenarios to avoid 'design sleepers' as part of deviation management. This is mainly to support ALARP demonstration, and helps project team to manage the risks especially during Commissioning phase.
- This Case Study emphasizes the significance of selection of competent team members, and their various roles, experience and good engineering judgement for FEED and detailed engineering phases, in specific.
- Importance of allowing sufficient time for closing out the actions before the subsequent phase of the project, and proper cascading of the items related to subsequent phases of the project are of paramount importance to enhance the integrity of the facility.

3.3 The Way Forward – Subsequent phases of HSEIA process

Apart from above discussions, this Study gives us the 'the way forward' for the subsequent phases of HSEIAs (particularly for Detailed Engineering & Operations) as follows:

- When moving into subsequent phase, HAZID/ENVID/OHID screening shall be conducted as a review. If no major hazards/ impacts and aspects are introduced, detailed studies like COMAH, EIA, OHRA may not be required.
- This Case Study accentuating on importance of updating the FEED HSEIA [10], [12], [13], [14] report during Detailed Engineering especially when engineered facilities are undergoing "substantive changes" such as:
    - Changes to the types or quantities of hazardous materials.
    - Process changes, particularly changes in HSE Critical Equipment & Systems (HSECES).
    - Changes to the nature of hazards and threats that could initiate a major accident.
    - Changes that would result in additions to or subtractions from the list of identified major accident scenarios.
- To avoid duplication of application of the risk review techniques and impact assessment across various phases, and to improve the implementation of its outcome in workable manner, the following options shall be taken into consideration with involvement of Facility Operator's Technical Safety Team members:
    - One time full-fledged EIA can be decided based on the ENVID Screening carried out earlier stages of the project. The same approach may have to be extended to OHRA with careful consideration. If no major changes are anticipated in the impacts and aspects of subsequent phases, then a comprehensive Occupational Exposure Monitoring & Health Surveillance Plan, and Environmental Management & Monitoring Plan would suffice to manage the risk to ALARP ('As Low As Reasonably Practicable').
    - To ensure effectiveness of HSECES during Operations phase, the Bow-Ties shall have to detail the tag level information, whereas the Performance Standards generated for the mentioned phase shall detail Testing, Inspection and Maintenance task required during Operations, and hence those are grouped by Type/ Make.
- If the expansions/ modifications are similar type of earlier installations, then re-evaluation of installations' original design may be adequate enough to determine the Risk Reduction Measures (RRM).
- In the case of usage of complex risk reviews, the uncertain data have to be subjected to validation for deciding the Risk Reducion Measures (RRM).
- Though the Hazard Identification and Risk Asessment (HIRA) related activities depends on scale of the expansions and/ or modifications the COMPANY is undergoing, the design phase (FEED, Detailed Engineering) of the project shall have to review the Risk Reduction Measures (RRM) in accordance with the significace of identified (new) issues.
- The conclusions, recommendations, close-outs of various studies/ reviews and activities adapted during design phases (FEED, Detailed Engineering) shall have to be reviewed, verified and approved by Independent Competent Person for assuring the effectiveness of the controls implemented.

- A comprehensive Tracking register comprising of all study outcomes/ recommendations (including the actions carrying forward for next phases) shall be maintained, close-outs to be done with the evidence of supporting documents.
- The need for written 'Fitness Statement' shall have to be established as a commitment from the Project Management that all hazards, impact and aspects have been identified, assessed and mitigated through the adopted structured risk review techniques and other safety studies without any significant pending items.

4 Conclusions

This Case Study constitutes a detailed structured risk review framework [1], [2], [14], [15] that contributed in identifying/assessing all HSE risks associated with the hydrocarbon process facilities falling under the chosen scope. Preventive & Mitigative measures [3], [4] identified as an outcome of various hazard identification & review methodologies are implemented in the FEED phase of the project. The recommendations are definitive, affirmative with clear directions for the FEED stage project to progress. A dedicated Project Health Safety Environmental Review (PHSER)has been conducted and found that all the recommendations have been adequately closed with supporting evidences. The Deliverables & Documents impacted due to the outcome of the reviews during the FEED stage of the projects are also discussed in brief denoting how the study recommendations are absorbed into the design of the facility with suitable samples. It is of great significance to note that suitable and sufficient risk reduction measures [3], [4] are mostly achieved during the FEED phase of project lifecycle.

From this study, the benefits and limitations of applying the Structured Risk Review Techniques [1], [2] in early design, interpretions on how the review techniques enhance the design integrity [17] in subsequent phases, and the approach for consequent phase HSEIA process [10], [12], [13], [14], [15] are attained as valuable outcomes.

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A STUDY ON POST COMBUSTION CARBON CAPTURE (PCCC) RETROFIT OPTION FOR COAL BASED POWER PLANTS IN INDIA

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ABSTRACT: Beingthe prime source of Indian Electric Power, Coal based electrical power is giving rise to increase ingreenhouse emissions and thus imposed with the emission control targets from international protocols and nation/state level legislations, posing a challenge to its sustainability. In this paper, an effort made to address the

issue of 'Sustainable Thermal Power Generation' as per global norms developed within United Nations Framework Convention on Climate Change etc. Best retrofit is investigatedfor hypothetical 200MW coal based thermal power plant. Feasibility of 'Post combustion retrofit measures' in Coal based power plants along with the CBM (Coal Bed Methane), ECBMR (Enhanced Coal Bed Methane Recovery) and EOR (Enhanced Oil Recovery) options with a viable business model are suggested for coal and oil rigging sites, if present, near power plant.

Keywords: Post combustion CDM, pollution, global warming, Coal based thermal power plant.

1.0. Introduction:

It has been one of the prevailing challenges for the human kind, to sustain energy surplus derived from various energy resources. Development of modern societies have been very rampant and harnessing of resources like coal and other fossil fuels for power generation is disturbing the tradeoff between the actual benefits derived from Power and the aftermath of environmental effects like pollution and global warming due to greenhouse gas emissions.. Intergovernmental Panel on Climate Change (IPCC)**[14]** under United Nations Environment Program (UNEP) prepared 'Special Report on Emissions Scenarios' (SRES) in the year 2000, regarding the futuristic climate change of the world from 1990 to 2100. It was predicted that global warming might result in increase of energy demand for space cooling and in decreased energy use for space heating under working group-II. It further predicts the dare difficulties in power transmission and distribution to meet huge energy demands under adverse climatic changes introduced by constant feeding of global warming gases mainly carbon dioxide and methane from vehicles and Coal based thermal powers. Global warming would wipe out millions of the humans by 2050 and affect the health of the surviving population. In contrast, India's coal energy generation has been raised by 11% (from 33% to 44%) between years 2000-2013 and is predicted to see 5% rise (44%-to-49%) by 2040[39] [43]. These give a clear indication of energy demand rise and have direct relation with carbon emissions, thus with global warming.

To cope up with this inevitable rise in carbon emissions in relation to fossil fuel usage, various international protocols such as Kyoto Protocol, The Paris Agreement, etc., have recently been revised and accepted by various countries across the globe. By signing the Paris Agreement, adapted with COP21 (Conference Of Parties) in October 2016, India marked the new beginning of the Environmental laws like the Environment Amendment Rules 2015 and the taxes that would affect all in the boundaries of the country to meet the International level of reducing global temperature by 2^{o}C pre industrialization level (1750 AD). The same lead for series of legislative reforms with regard to pollution control and would mean future cap on day-to-day generation schedule as a Power Generator.

1.1. The Problem:

Following are the challenges faced by Indian coal based power sector:

a. From the perspective of a power producer, excessive pressure of the government to run the established plants at higher PLF and set up new plants to reach the power target given by the government, however by meeting extreme stringent norms of emission again enforced by the same, has put the thermal power sector perplexed by contradiction of expectations by the government. [8] [39]

b. Another serious issue is the availability of the Scheduled Generation (SG) on daily basis from RLDC, based on which daily generation targets are set. Due to the increased expectation of the government, many public and private companies are setting up power plants in and around the region of the established power plants. Imagine a case where the coal producer itself declares setting up of thermal plants! The Power Purchase Agreement (PPA) of the established power project versus a newly set up plant are in a jinx due to this. Deviation settlement mechanism (earlier called as Unscheduled Interchange) signed by ISGS (Inter State Generating Stations) with CERC (Central Electricity Regulatory Commission), in an effort to maintain grid discipline has furthered worsened the operating load of the plants. This rule induces parity with those who have not signed the accord.[40]

c. In addition to already existing confusion, the tariff rates are also revised to the extent that they are based on the Heat rates and as received coal. Calorific values at the coal stack yard which is boggling the already troubled and confused economy of power sector. Availability of imported coal and Indian coal is another issue. Duty and CESS are adding burden to the existing power costs. Allocation of coal blocks to captive power plants and private parties are adding further problems. [29] [30]

d. Renewal energy sources as alternatives with tax sops, have come to the crushing extent, the very survival of the existing power plant has been the major issue. [41]

e. Confusion to Maximize or minimize Plant Load Factor(PLF): Increasing PLF, leads to continuous operation of boiler set at maximum rated output, which leads to increase in carbon emissions. Reduction of PLF leads to power scarcity. Thus, power producers have no other options than diversifying capital investments in new ventures to meet the target. Hence, this lead the power producers are provoked to import more amounts of coal, as Indian coal consumption has already been signed surpassed PPA. As-received coal criteria, envisaged by the new PAT rules of government has further thronged the sector to abyss. When coal is received in the coal yard it cannot be directly fired in to the boiler, it has to be stored to be used up gradually. The loss in calorific value due to storage is not accounted for. This has added to already existing problem. [42] [43]

f. Initiative by Ministry of Environment, Forest and Climate change which came up with an Environment amendment rules 2015 aimed at protecting environment and hence enforce new limits for release of pollutants from industries. [8]

g. With the outlay of IPCC under UNEP which stressed the requirement of increased power requirement to meet future targets and implications of post Kyoto regime, Government of India had given by 2032, a total outlay of 128000 MW power requirement from 56% coal ,16% gas ,11% nuclear, 17% renewal source. [39]

All these legislations and Initiations on the renewable energy front, have threatened the very survival of the existing thermal power plants. This raises question of survival of thermal power stations. However, the fact that we can coexist propels us to come up with new technologies like Clean Development Mechanisms (CDM) like Post Combustion Carbon Capture (PCCC) and reap the benefits of it. It further helps us to utilize the captured Carbon dioxide to be used for ECBMR at Coal mining and EOR at Oilrigs. This further helps us to go for Carbon trading and come up with a business model for the coal based thermal plant. In this paper, comparative study of various Carbon capture technologies (Wyoming Institute, Canada) have been done and concluded with best retrofits. A suitable business model for a coal-based plant proposed based on PCCC retrofit as an option.

2.0 Material and Methods: IPCC WG3 Technical Report 2014 was studied as the first hand reference to the issues related to Pollution and global warming. Primary approximate data of Indian Coal specifications and emissions were collected from various other sources and partly from authors. Case studies of different PCCC technologies with carbon dioxide sequestration techniques were derived from various sources. Exclusive survey of New papers like Economic Times [30] and current affairs on CDM and CBM policies of government have been probed with implications from Renewable energy scenario of our country. Tariff calculations have been applied to a hypothetical 200 MW plant based on petition filing by Power companies [29] [30] and findings available on CERC website and studies of Reference [35]

Table 1: Fixed cost calculations

A. Fixed Cost Calculations
1.Return on Equity:
Capital cost= 200*1.0979 Cr/MW = 219.58 Cr INR
Debt/Equity = (70%/30%)

Equity = 219.58 *0.30= 65.874 Cr INR Debt = 0.7*219.58 = 153.706 Cr INR ROE= 15.50*65.87 / 100= 10.21047 Cr INR
2. Interest on Loan: 13.5*153.706 /100 = 20.75031 Cr INR
3. Interest on Working Capital: Working capital = 0.1*219.58 =21.958 Cr INR Int on capital= 0.1* 21.985=2.1958Cr INR
4.Depreciation: 5.28% =0 (as fixed by commission)
5.O&M Cost: (INR 22.581 lakh/MW) = 22.581*200 = 45.162 Cr INR
6. Total fixed cost (1+2+3+4+5) = 78.31858 Cr INR
7. Total Power Generation=200*365*24*0.85*1000/1000000 =1489.2 MU
8.Fixed Cost per Unit = 78.31858 /1489.2 = **0.052591** INR/KWhr

Table 2: Variable cost Calculations

B. **Variable Cost Calculations**
1.Cost of oil consumption: = specific oil consumption*cost of oil/litre = 0.5*43934/1000 = 0.021967 INR/KWhr
2. Heat Contribution of oil : = GCV*Sp oil consumption = 9078*0.5*0.001=4.5 Kcal/Kwhr
3. Heat rate of Coal = Station HR-HR of oil = 2396.43-4.5 =2391.93 Kcal/Kwhr
4. Specific coal consumption =Heat combustion of Coal/GCV =2391.93/4565 = **0.523 Kg/KWhr**.
5.Cost of Special Coal consumption: = special coal * cost of coal =0.523971* 3025.73/1000 = 1.58539 INR/KWhr
6. Total Variable Cost: = Cost of Sp.Oil consumption + Cost of sp.Coal consumption = 0.021967+ 1.58539 = 1.6073 INR/KWhr
7.**Variable cost/unit at bus bar** =Total Variable cost /(1-APC)

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=1.6073 /(1-0.0668) =1.722 INR/KWhr
C. **Total Cost /Unit**
Nominal Tariff = A(8) + B (7) = 0.052591+1.722 = **1.774591 INR/KWhr**

Sorbent selection studies and secondary data have been compared with studies done by Juan C. Abanades et.al (2004) with that of Maciej Radosz et.al (2008) [12] [13].

3. Parameters of model sorbents [12]:

i. Cost of sorbent/kg of CO_2 removed: COS

$$\text{COS} = \frac{F_0}{F_R} \times \frac{F_R}{F_{CO_2}} \times b \times M_S \times \frac{C_S}{M_{CO_2}}$$

$$\text{COS}_{\text{capture avoided}} = \text{COS} \times \text{R}_{a/c}$$

Whereas: $R_{a/c}$ = ratio of $/tonne avoided to $/tonne captured

F_0=Make up rate of the sorbent ($/mol of CO_2)

F_R= Recirculation rate of sorbent.

F_0/F_R =Sorbent Recycle ratio ($/mol of CO2)

F_{CO2}=Removal rate of CO_2

b= cost per mole of CO_2 absorbed.

M_S= mass of sorbent required to absorb 1 mol of CO_2 in kg/Mol

C_S= Cost per kg of CO_2 captured in $/kg

M_{CO2}= Molar value of CO_2

Final selection criterion is : $(\text{COS})_{\text{any sorbent}} < (\text{COS})_{\text{MEA}}$

ii. Yield fraction of sorbent r_N or Cycling sorbent fraction S_N:

$$S_N = 1 - \sum r_N = \left[\frac{1}{\frac{F_0}{F_R}+1}\right]^N$$

Table 3 Parameters of Model sorbents

Material	COS $/ton	F_0/F_R $/mol of CO2	N $/mol of CO2	C_S $/kg	F_R/F_{CO2} $/mol of CO2
MEA	2	0.000 152	4561	1.25	3.57
$CaCO_3$	2	0.0552	13	0.005	3
K_2O	1.88	0.001 89	367	0.155	3
Na_2CO_3	1.88	0.002 48	280	0.105	3

Li_2CO_3	5.588	0.000 0835	8299	4.47	3
Active carbon	4.2	0.000 75	925	0.5	1
Zeolites	1.7	0.000 375	1849	1.0	1
Hydrotalcites	1.88	0.000 020 7	33505	2.0	1
Fe_2O_3	1.88	0.003 32	209	0.026	3
Cobalt	1.89	0.000 010 5	66001	33.43	2
Copper	3.76	0.000 18	3858	1.812	2
Nickle	1.89	0.000 040 8	16986	8.636	2
Manganese	1.90	0.000 21	3270	0.592	2

iii. **Vessel dimensions of Activated filter PCCC filters and DP across filters (**Maciej Radosz et.al (2008)) [13]

a. Vessel dimension calculation: $Q = \rho \times A \times v$

$$D = \sqrt{\frac{4 \times Q}{3.14 \times v \times \rho}}$$

Q = flue gas flow Kmol/s
A= Area of the vessel head on the flow m^2
D= Diameter of the vessel m
v = flue gas superficial velocity m/s

b. Differential Pressure across filter:

$$\frac{\Delta p \times \rho}{(\varepsilon \times v \times \rho)^2} \times \frac{D_p}{\Delta L} \times \frac{\varepsilon^3}{(1-\varepsilon)} = \frac{150}{N_{Re}} + 175$$

D_p = Sorbent Particle diameter
Δp =Differential Pressure across the bed in Pa
ρ = Density of flue gas in kg/m^3.
ε = void fraction of bed.
v = superficial velocity in m/s
ΔL= length in m.
μ =flue gas viscosity in Pa-s
where Reynolds Number N_{Re} is $N_{Re} = \frac{D_p \times \varepsilon \times v \times \rho}{(1-\varepsilon) \times \square}$

iv. **Economics:** Tertiary data of Economics of PCCC, its specification parameters and effects on tariff cost change are calculated based on application of primary and secondary data. Economics and ROI calculations have also been partly from intuition and the studies of Maciej Radosz et.al (2008). [13]

a. PCCC filter effect on Electricity cost change: Change in electricity charges% is given by

$$\frac{CO_2 \text{ emission rate per yr} \times \text{recovery} \times \text{purity} \times (\text{Capture cost} - \text{credits})}{\text{power plant capacity} \times 8760 \times \text{electricity selling price}}$$

b. Gain based on CDM:

CO_2 credits earned per year = CO_2 captured per year*recovery* 1 CO_2 Credit in INR Sale of CO_2 to ECMBR Project at nearby Coal Mines

Additional Profit from sale of CO_2 = (CO_2 captured per year*recovery) * 1 CO_2 Credit in INR

If CO_2 is supplied to self-funded ECBMR projects, then additional credits obtained by CH_4 capture at mines per year.

Special credits for CH4 capture = 21* CH_4 captured per year*1 CO_2 Credit in INR

Total gain would be sum of all 3 above:

I. Cost based on CDM: Total Cost on CO_2 captured **=** **(**CO_2 captured per year*recovery) * cost/ton captured in INR.
II. Total Profit/Loss based on CDM: Total Profit or gain = (2) – (3)
III. Return on Investment: ROI= Total Gain/Investment Cost

The following inferences can be drawn-out from afore said cost estimation methodologies:

A: Well established coal based Electrical power generation company can easily abide by present Environmental laws and regulations to sustain a business

B: CDM with Activated charcoal is the best sorbent for PCCC. AGREEMENT between studies of Juan C. Abanades et.al (2004) and Maciej Radosz et.al (2008) [12] [13]

$$(COS)_{\text{ANY SORBENT}} < COS_{\text{MEA}}$$

C: Monetary aspects and impacts of PCCC on unit electricity cost is the least if **B** is applied

D: Business portfolio in the form of Coal bed methane and Enhanced Oil recovery methodology is viable
E: Coal based power with CDR (Carbon di oxide Reduction) can coexist with Renewable energy power

The unit electricity charge found is 1.774591INR/KWhr for hypothetical 200MW. CO_2 released per year estimated as 1.205595 Million tons for 100% loading and plant operating continuously for 1 year for 30% carbon in Indian coal. Sorbents for PCCC may be selected based on less COS value, low F_0/F_R ratio and high N values **(**Juan C. Abanades et.al (2004)) [12]. 1% change in electricity charges is introduced if net difference between the capture cost and credits is 40.4 INR /ton (C).750 tons of activated charcoal is estimated in 75 vessels with 25 vessels each in adsorption, heating and cooling modes of 2 minutes each and total cycle of 6 minutes. This provides for 90% CO_2 capture with N_2 selectivity as with references from Maciej Radosz et.al (2008) [13] Vessel dimensions are calculated as diameter 3.702 m and length 2 m. Differential pressure of 0.01476 ksc has been calculated as per Ergun equation (Maciej Radosz et.al (2008))[13].This is the additional load across Induced draft fans if these are retrofitted. Accordingly rerating of fans can be done. IPCC WG3 Technical summary 2014, TS 3.2.2, page 69clearly demarcates this statement: "*De-carbonization is easy to achieve in energy sector /electricity than in buildings, transport and industry sectors*". Hence, the drive for study and the time is too short for Power sector to act. It is surely going to have impact on India and could shake the monolithic empire of coal based power sector.

The study, thus done from the global context of pollution, greenhouse effects and its mitigating strategies has wide implications for a country like India and its backbone of economy mainly the Power sector and Energy sector. By 2030, the coal based Power companies would need to implement Carbon Dioxide Reduction (CDR) methodologies to meet the global requirement of 450ppm of Equivalent Carbon dioxide concentration and 2^{o}C (pre-industrial limits viz.1750 AD) global surface temperature rise by 2100 AD. One such mitigating measure is by implementing PCCC technologies like the activated charcoal PCCC as elaborated in this study.

3.2. Challenges and Solution: The limitation of this study are the issues like operational safety, integrity of carbon dioxide storage, risks of transportation, scaling up of infrastructure, low rate of return on investment vis a vis high carbon investment. More needs to be done in this area with further research as per IPCC WG3 Technical Summary 2014. The implementation of this concept is the dire need of the hour and initial pilot plants in power sector is yet to be taken up on the mass scale. Though EMA (Ethyl Amine Absorption) has proven its worth and has acted as benchmark process (Juan C. Abanades et.al, 2004) [12]and case studies donehere**,** it is still costly as per studies done as per (Maciej Radosz et.al , 2008)[13] **(**B). Hence, with thorough investigation, given Indian context, it is envisaged that activated charcoal filter with low pressure low temperature selective capture of CO_2 with N_2 is a viable option given the replacement time of 10 yrs. and can act as best retrofit and satisfying the criterion set as per B.

3.3. The Business Model: All these necessitates business model integration and coming up with a sustainable business model (A and E). This idea is represented pictorially for better comprehension. The costs that are thus tabulated in this study, indicate that carbon capture alone would not be useful for the Coal based power company. This needs to be clubbed with ECBMR options with 33 captive coal blocks or EOR to earn the special credits. Joint Venture with coal India limited and Equipment manufacturing for PCCC technologies are necessary, given the cost of technology, which foreign companies would like to lavish upon. This could also have a huge bearing on the "cheap power per unit and to all "dream of our government. Mere reduction in tax on CDM earning from 30% to 10% [30] would not help the cause.

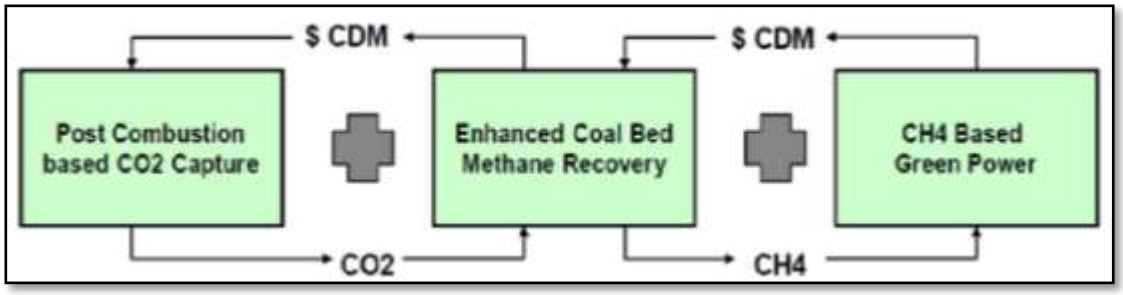

Figure 1 Cash Flow Wagon

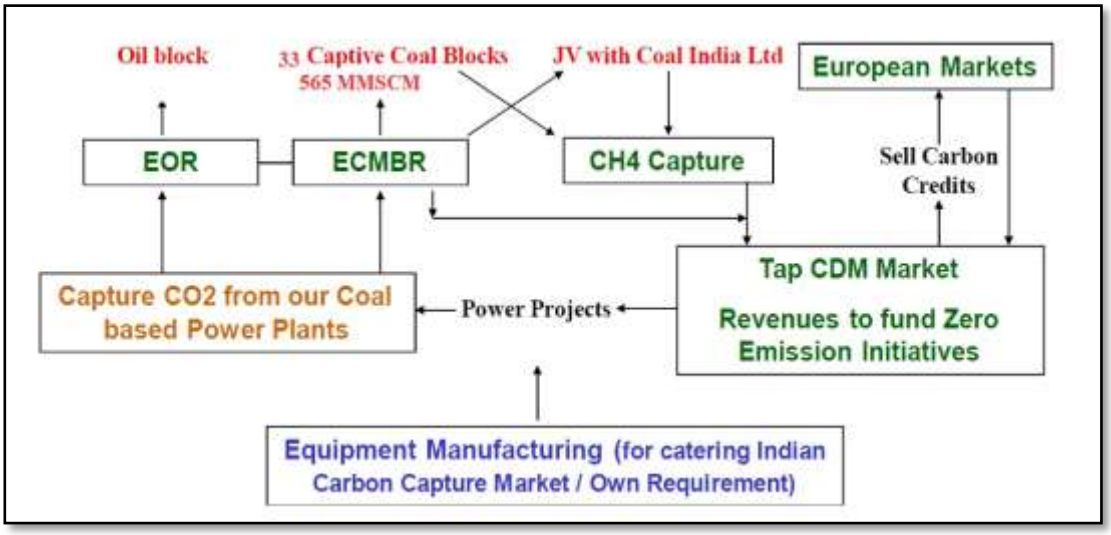

Figure 2 Business Model Integration

By applying aforesaid methodology to hypothetical case of 200MW, total gain from CDM option with ECBMR/EOR have been calculated approximately as 71.2 Cr INR considering the present Exchange rates of currencies and prevailing carbon market of average 5 Euros per ton of CO_2 captured (D). These figures indicate representative figures and indicate the potential of CDM. Additionally, it creates a divide between a huge challenge ahead with regards to commitment of the nation to support a global cause and the very survival of the Coal based Power sector in India. Only future actions would clear the cause of parity.

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SING SOLAR THERMAL TECHNOLOGY: SEEBECK AS AN AUXILIARY FOR POWER GENERATION

Mayank Rautela*
Saransh Vijayvargiya*
Sagar Prajapat*
Surajit Mondal**

Abstract

The existing R&D project known as "Solar Thermal Pyrolysis" is a great success till the time focus is on extraction of oil from jathropa seeds which is its main objective. But, this project lacks an insulator. So, majority of the heat which could have been used was getting wasted. On calculating heat loss, it was found that very high amount of heat was being given out. In order to utilize this waste heat, an auxiliary was the first thought.Rather than using a Waste Heat Recovery (WHR) equipment, production of current seemed to be a better alternative. So, using the principle of the Seebeck Effect was the first choice.It allows for generation of current through creation of 2 junctions i.e. hot and cold. The surface of the receiver which was emitting a lot of waste heat was used as the hot point and the ambient air was used as the cold point. Due to the temperature difference the voltage is generated and so, current is produced. Seebeck circuit can be made by using various combinations of metals, therefore an experiment is performed in order to use this waste heat to generate current.

Keywords:

Seebeck Effect;
Power Generation;
Solar Thermal Technology;

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1. Introduction

Thermoelectric are based on the Peltier Effect. The Peltier Effect is one of the three thermoelectric effects; the other two are known as the "Seebeck Effect and Thomson Effect". Whereas the last two effects act on a single conductor, the Peltier Effect is a typical junction phenomenon. Thermoelectric coolers are solid state heat pumps used in applications where temperature stabilization, temperature cycling, or cooling below ambient are required. There are many products using thermoelectric coolers, including CCD cameras (charge coupled device), laser diodes, microprocessors, blood analyzers and portable picnic coolers. This article discusses the theory behind the thermoelectric cooler, along with the thermal and electrical parameters involved.

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An experiment to produce bio-oil is being done on the premises of the UPES by providing heat using solar concentrator and receiver system. The surface of the receiver gets heated upto around 300°C leading to large amount of heat loss from the surface of the receiver. This waste heat may be trapped and be used for generating current using the principle of Seebeck effect.5 So, by using the various seebeck materials the generation of current is done.

THERMOELECTRIC EFFECT6

1. PELTIER EFFECT

When DC voltage is applied to the module, the positive and negative charge carriers in the pellet array absorb heat energy from one substrate surface and release it to the substrate at the opposite side. The surface where heat energy is absorbed becomes cold; the opposite surface where heat energy is released, becomes hot. Reversing the polarity will result in reversed hot and cold sides.

2. SEEBECK EFFECT

The conductors are two dissimilar metals denoted as material A and material B. The junction temperature at A is used as a reference and is maintained at a relatively cool temperature (Tc). The junction temperature at B is used as temperature higher than temperature Tc. With heat applied to junction B, a voltage (E out) will appear across terminals T1 and T2 and hence an electric current would flow continuously in this closed circuit. This voltage thus derived is known as the Seebeck EMF, can be expressed as:

$$E_{out} = \alpha (T_h - T_c)$$

Where:

• $\boldsymbol{\alpha = \frac{dE}{dT} = \alpha (A - B)}$

• α is the differential Seebeck coefficient or (thermo electric power coefficient) between the two materials, A and B, positive when the direction of electric current is same as the direction of thermal current, in micro-volts per degree Kelvin.

• E out is the output voltage in micro-volts.

• Th and Tc are the hot and cold thermocouple temperatures, respectively, in degree Kelvin.

[5]Richard T.L, challenges in recovery of waste heat, science, Vol.32, pp. 736-9 (2010).

[6]Lehmann J.; Thermoelectric innovation: Science and technology Earth scan: London, UK, 2009.

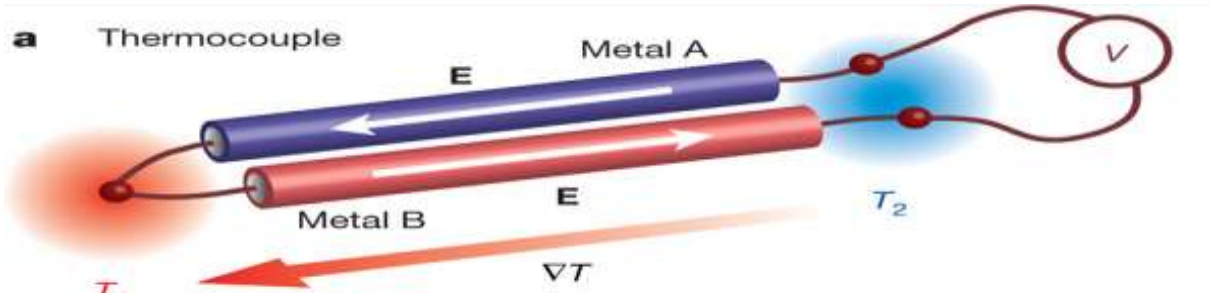

Fig. 2.1(a) Layout of Seebeck Effect7

The potential difference between the junctions is called the Seebeck voltage or the thermo electric emf which is of the order of a few micro-volts per degree temperature difference (μV/ K).

Seebeck Series: The magnitude and direction of thermo emf in a thermocouple depends not only on the temperature difference between the hot and cold junctions but also on the nature of metals constituting the thermocouple.

(i) Seebeck arranged different metals in the decreasing order of their electron density. Few metals forming the series are as below.

"Sb, Al, Fe, Cd, Zn, Ag, Au, Cr, Sn, Pb, Hg, Mn, Cu, Pt, Co, Ni, Bi"89

(ii) Thermo electric emf is directly proportional to the distance between the two metals in series. Farther the metals in the series forming the thermocouple greater is the thermo emf. Thus maximum thermo emf is obtained for Sb-Bi thermo couple.

(iii) The current flow at the hot junction of the thermocouple is from the metal occurring later in the series towards that occurring earlier, Thus, in the copper-iron thermocouple the current flows from copper (Cu) to iron (Fe) at the hot junction.This may be remembered easily by the hot coffee.

3. THOMSON EFFECT

William Thomson, who described the relationship between the two phenomena, later issued a more comprehensive explanation of the Seebeck and Peltier effects. When an electric current is passed through a conductor having a temperature gradient over its length, heat will be either absorbed by or expelled from the conductor. Whether heat is absorbed or expelled depends on the direction of both the electric current and temperature gradient. This phenomenon is known as the Thomson Effect.

[7]Rowe D.M., Handbook of Thermoelectric , CRC press: Vol.1, pp55-75(1995)

[8] Soltes E., Elder, Seebeck Effect, Thermoelectric processes, CRC Pres: pp63-95 (1996).

[9]Brown R., Holmgren J., Fast electron flow and heat loss upgrading, National Programme207; Energy alternatives, Richland, WA, USA (2006).

3.1 ESTIMATION OF OVERALL HEAT LOSS10

When sunlight falls on the concentrator it gets reflected on to the receiver where the Pyrolysis process takes place. So due to absence of insulation or any other sort of insulation material on the surface because of which there is significant heat loss from the surface.

We calculated the heat loss in order to find out the actual amount of heat which is feasible for the Seeback effect.

Q Total = Q convection + Q radiation

Q convection = h × A × $(T_s - T_a)$

= 60 × $(\frac{\pi}{4})$ × d^2 × (603 – 303)

= 14130 d^2 Watts.

Q radiation = $\varepsilon \times \sigma \times A \times (T_s^4 - T_a^4)$

= 0.67 × 5.67 × 10^{-8} × $(\frac{\pi}{4})$ × d^2 × (603 – 303)

= 3691.36 d^2 Watts.

Q total = 14130 d^2 + 3691.36 d^2

= 17821.36 d^2

= 17821.36 × 3.85

= 264157.11 Watts

= 264.157 KW

Thus, we have 264 KW of heat loss from the surface of the receiver. This heat lost can be used for the application for Seeback Effect as per our proposal.

[10]Emmos H.W., Atreya, The science of heat and mass transfer, Indian academy of sciences, Vol.5, pp.259-268 (1994).

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3.2 MOTT - JONES THERMOELECTRIC POWER EQUATION11

$$VAB = \Delta VA - \Delta VB = -\frac{\pi^2 k^2}{6e}\left[\frac{x_a}{E_{FAO}} - \frac{x_b}{E_{FBO}}\right](T^2 - T_0^2)$$

Where, VAB = available emf, which is the difference in ΔV for the two metals.

k = Boltzmann's Constant = 1.3807 × 10-23 J / K

e = Charge of electron = 1.6 × 10-19 Coulomb

x = a numerical factor in Mott – Jones thermoelectric power equation that represents the effect of the energy dependence of electron scattering in metals.

EFO = Fermi Energy at 0 K.

3.3. OBSERVATION AND EXPERIMENTAL RESULTS

A. When Iron And Copper Wire Are Used As A Seebeck Combination

i. Single wires

Data for Iron Wire:-
Length of Iron Wire, LA = 1 m
Thickness of Iron Wire = 2.5 mm
Resistivity of Iron (Fe), ρ_a = 9.71 × 10^-8 Ωm
Area of Iron Wire, AA = $\frac{\pi\times(2.5\times10^{-3})^2}{4}$ = 4.90625 × 10-6 m2
Resistance of Iron Wire, RA = $\frac{\rho l}{A} = \frac{9.71\times10^{-8}\times1}{4.90625\times10^{-6}}$ = 0.019791082 Ω
x_a = 0.99 and E_{FAO} = 11.1 eV
Data for Copper Wire:-
Length of Copper Wire, LB = 1 m
Thickness of Copper Wire = 0.511mm

Resistivity of Copper (Cu), ρ_b = 1.68 × 10^-8 Ωm

Area of Copper Wire, AB = $\frac{\pi\times(0.511\times10^{-3})^2}{4}$ = 1.9625 × 10-7 m2

Resistance of Copper Wire, RB = $\frac{\rho l}{A} = \frac{1.7\times10^{-8}\times1}{1.9625\times10^{-7}}$ = 0.081959221 Ω

x_b = -1.7 and E_{FBO} = 7 eV

[11]Kasap Safa, Thermoelectric Effects in Metals: Thermocouples, Special custom: p. 68, 2001.

Total Resistance, R = RA + RB = 0.019+ 0.082 = 0.101 Ω

I. OBSERVATION TABLE A

S.NO	TIME	TEMPERATURE (K)			OUTPUT		
		Surface Temperature (K)	Ambient Temperature (K)	Temperature Difference (K)	Voltage (μV)	Current (mA)	Power (× 10-6 W)
1.	10:00 – 10:15	433	304	129	400.82	3.34	1.343
2.	10:15 – 10:30	438	305	133	416.62	4.08	1.699
3.	10:30 – 10:45	446	305	141	446.44	4.35	1.942
4.	10:45 – 11:00	450	306	144	459	4.50	2.065
5.	11:00 – 11:15	456	307	149	479.30	4.70	2.252
6.	11:15 – 11:30	464	307	157	510.34	5.00	2.551
7.	11:30 – 11:45	470	308	162	530.4	5.20	2.758
8.	11:45 – 12:00	475	308	167	551.28	5.39	2.971
9.	12:00 – 12:15	481	309	172	572.6	5.61	3.212
10.	12:15 – 12:30	488	310	178	598.84	5.87	3.515
11.	12:30 – 12:45	492	311	181	612.75	6.01	3.682
12.	12:45 – 13:00	497	313	184	628.36	6.16	3.870
13.	13:00 – 13:15	504	313	191	657.90	6.45	4.243
14.	13:15 – 13:30	511	314	197	685.22	6.72	4.604
15.	13:30 – 13:45	521	315	206	726	7.11	5.161

16.	13:45 – 14:00	528	315	213	757.01	7.43	5.624
17.	14:00 – 14:15	533	316	217	776.70	7.62	5.918
18.	14:15 – 14:30	537	315	222	797.45	7.82	6.236
19.	14:30 – 14:45	537	314	221	800.08	7.86	6.288
20.	14:45 – 15:00	532	312	220	782.83	7.68	6.012
21.	15:00 – 15:15	525	311	214	754.25	7.39	5.573
22.	15:15 – 15:30	519	311	208	727.87	7.14	5.197
23.	15:30 – 15:45	513	310	203	704.38	6.91	4.867
24.	15:45 – 16:00	504	309	195	668.40	6.56	4.384

Total Power, P = (1.343 + 1.699 + 1.942 + 2.065 + 2.252 + 2.551 + 2.758 + 2.971 + 3.212 + 3.515 + 3.682 + 3.870 + 4.243 + 4.604 + 5.161 + 5.624 + 5.918 + 6.236 + 6.288 + 6.012 + 5.573 + 5.197 + 4.867 + 4.384) × 10-6

= 90.983 × 10-6 Watts

II. GRAPHS

a) Temperature Difference (ΔT in K), Output Voltage (V in μV) and Time

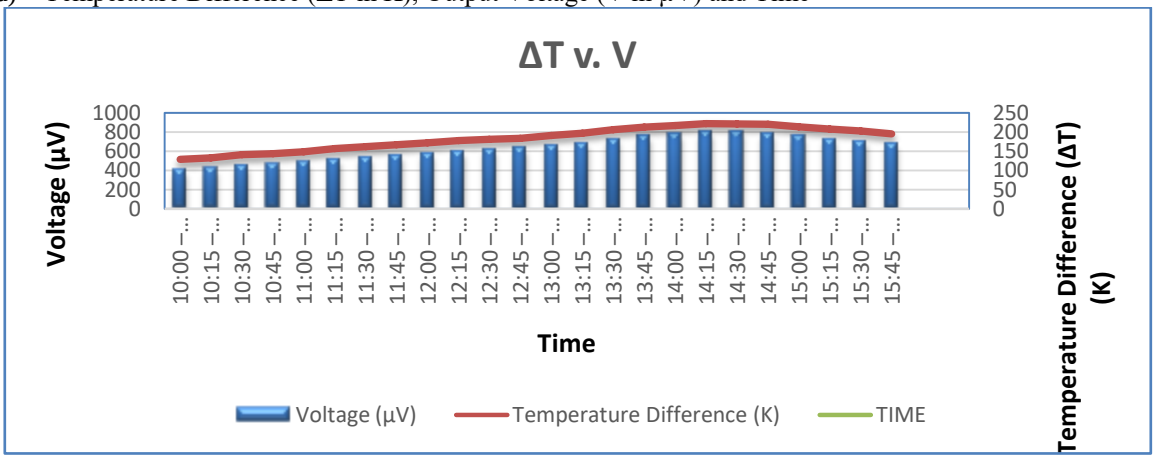

Fig. 3.3 (a)

b) Output Voltage (V in μV), Output Current (I in mA) and Time

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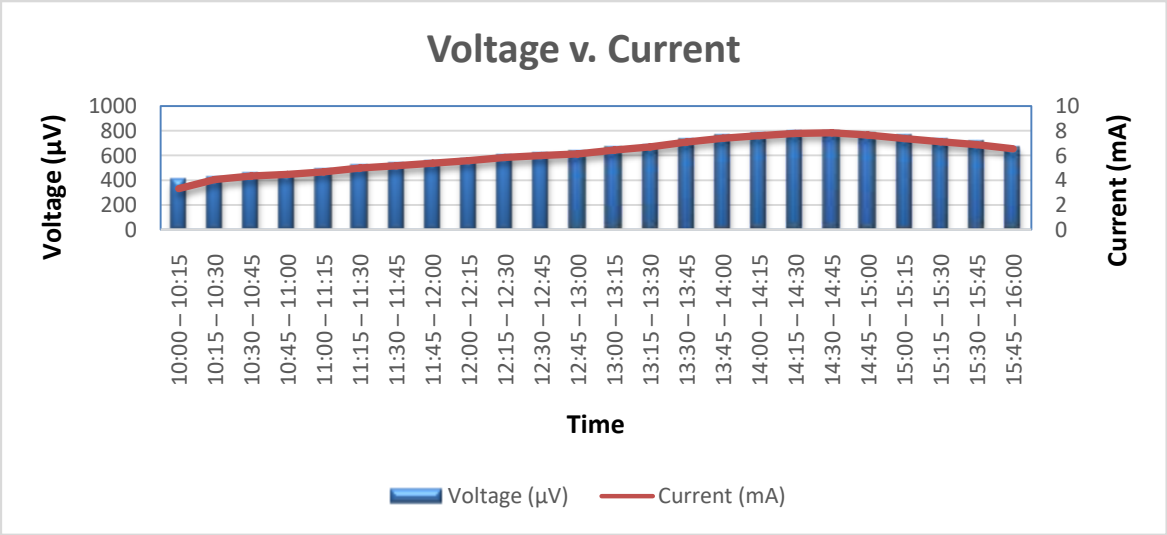

Fig. 3.3 (b)

c) Output Voltage (V in µV), Output Power (P in Watts) and Time

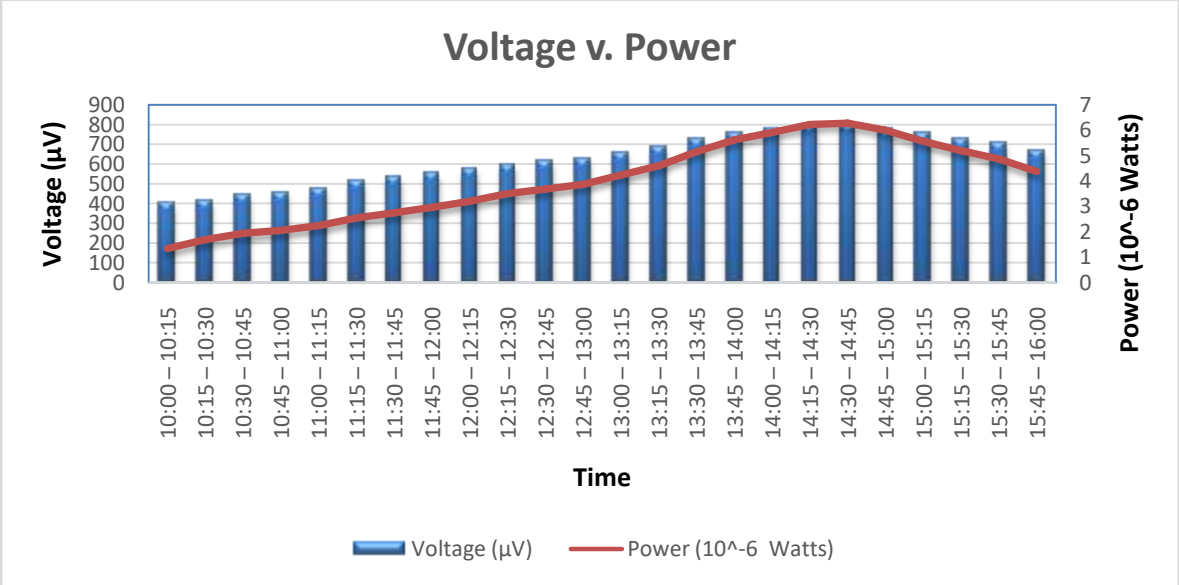

Fig. 3.3 (c)

ii) Stacking of wires
Data for Iron Wire:-
Length of iron wire, LA = 1.5 m
Number of iron wires used for stacking = 15
Thickness of iron wire = 2.5 mm

S.NO	TIME	TEMPERATURE (K)			OUTPUT		
		Surface Temperature (K)	Ambient Temperature (K)	Temperature Difference (K)	Voltage (μV)	Current (mA)	Power (×10-6 W)
1.	10:00 – 10:15	438	309	129	583.51	3.32	1.93
2.	10:15 – 10:30	446	309	137	626.33	3.56	2.22
3.	10:30 – 10:45	450	309	141	648.02	3.68	2.38
4.	10:45 – 11:00	458	310	148	688.2	3.91	2.69
5.	11:00 – 11:15	464	311	153	718.02	4.08	2.92
6.	11:15 – 11:30	467	311	156	734.92	4.18	3.07
7.	11:30 – 11:45	472	312	160	759.69	4.32	3.28
8.	11:45 – 12:00	479	312	167	799.90	4.55	3.64
9.	12:00 – 12:15	486	312	174	840.80	4.78	4.02
10.	12:15 – 12:30	491	312	179	870.40	4.95	4.31
11.	12:30 – 12:45	494	313	181	884.52	5.03	4.45
12.	12:45 – 13:00	499	313	186	914.56	5.20	4.75
13.	13:00 – 13:15	504	313	191	944.91	5.37	5.07
14.	13:15 – 13:30	511	313	198	987.95	5.62	5.55
15.	13:30 – 13:45	521	314	207	1046.64	5.95	6.22
16.	13:45 – 14:00	528	314	214	1091.11	6.21	6.77
17.	14:00 – 14:15	537	315	222	1145.35	6.51	7.45
18.	14:15 – 14:30	543	315	228	1184.60	6.74	7.98

19.	14:30 – 14:45	542	313	229	1185.61	6.75	8.00
20.	14:45 – 15:00	538	312	226	1163.25	6.61	7.69
21.	15:00 – 15:15	535	312	223	1143.75	6.50	7.43
22.	15:15 – 15:30	529	310	219	1112.63	6.33	7.04
23.	15:30 – 15:45	522	311	211	1064.34	6.05	6.44
24.	15:45 – 16:00	515	311	204	1020.33	5.80	5.92

Resistivity of iron (Fe), ρ_a = 9.71 × 10^-8 Ωm

Area of single iron wire, AA = $\frac{\pi \times (2.5 \times 10^{-3})^2}{4}$ = 4.90625 × 10-6 m2

Resistance of single iron wire = $\frac{\rho l}{A} = \frac{9.71 \times 10^{-8} \times 1.5}{4.90625 \times 10^{-6}}$ = 0.029686624 Ω

Total resistance of 15 stacked iron wire, RA = $\frac{1}{15 \times 0.029686624}$ = 2.246 Ω

x_a = 0.99 and E_{FAO} = 11.1 eV

Data for Copper Wire:-

Length of copper wire, LB = 1.5 m

Number of copper wires used for stacking = 30

Thickness of copper wire = 0.511mm

Resistivity of copper (Cu), ρ_b = 1.68 × 10^-8 Ωm

Area of copper wire, AB = $\frac{\pi \times (0.511 \times 10^{-3})^2}{4}$ = 1.9625 × 10-7 m2

Resistance of single copper wire = $\frac{\rho l}{A} = \frac{1.7 \times 10^{-8} \times 1.5}{1.9625 \times 10^{-7}}$ = 0.122938831 Ω

Total resistance of 30 stacked copper wire, RB = $\frac{1}{30 \times 0.122938831}$ = 0.271 Ω

x_b = -1.7 and E_{FBO} = 7 eV

Total Resistance, R = RA + RB
= 2.246 + 0.271
= 2.517 Ω

I. OBSERVATION TABLE D

Total Power = (1.93 + 2.22 + 2.38 + 2.69 + 2.92 + 3.07 + 3.28 + 3.64 + 4.02 + 4.31 + 4.45 + 4.75 + 5.07 + 5.55 + 6.22 + 6.77 + 7.45 + 7.98 + 8.00 + 7.69 + 7.43 + 7.04 + 6.44 +5.92) × 10-6
= 114.69 × 10-6 Watts

II. GRAPHS

a) Temperature Difference (ΔT in K), Output Voltage (V in μV) and Time

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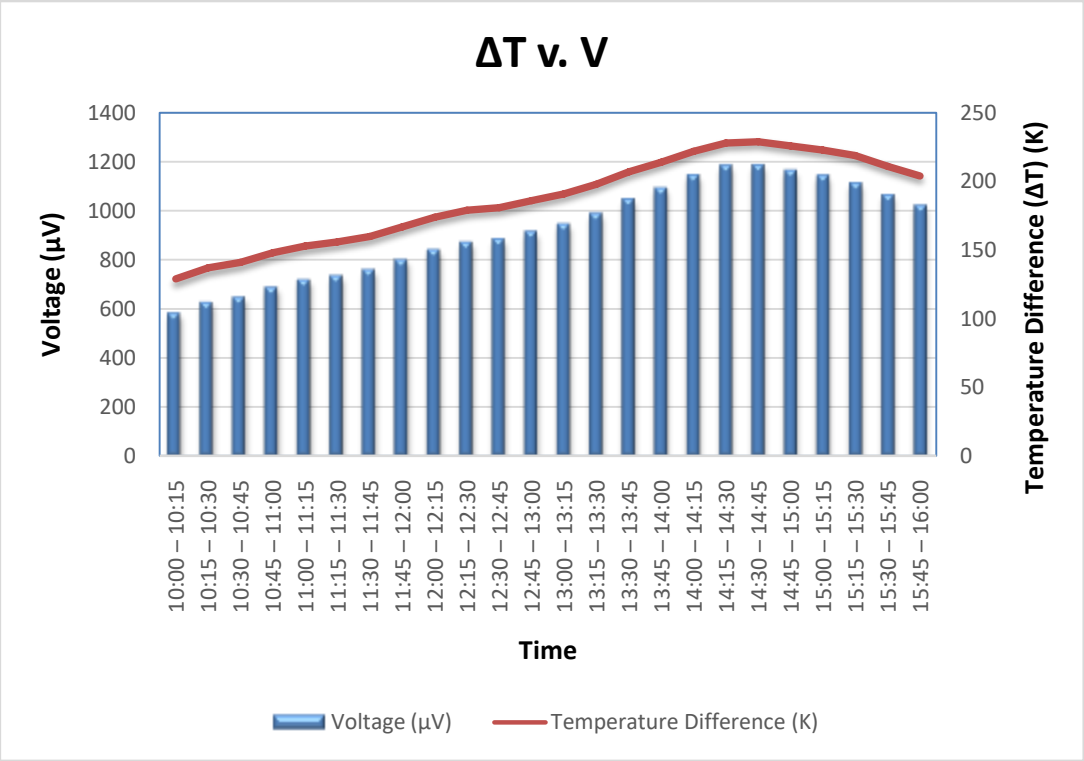

Fig. 3.3 (j)

b) Output Voltage (V in µV), Output Current (I in mA) and Time

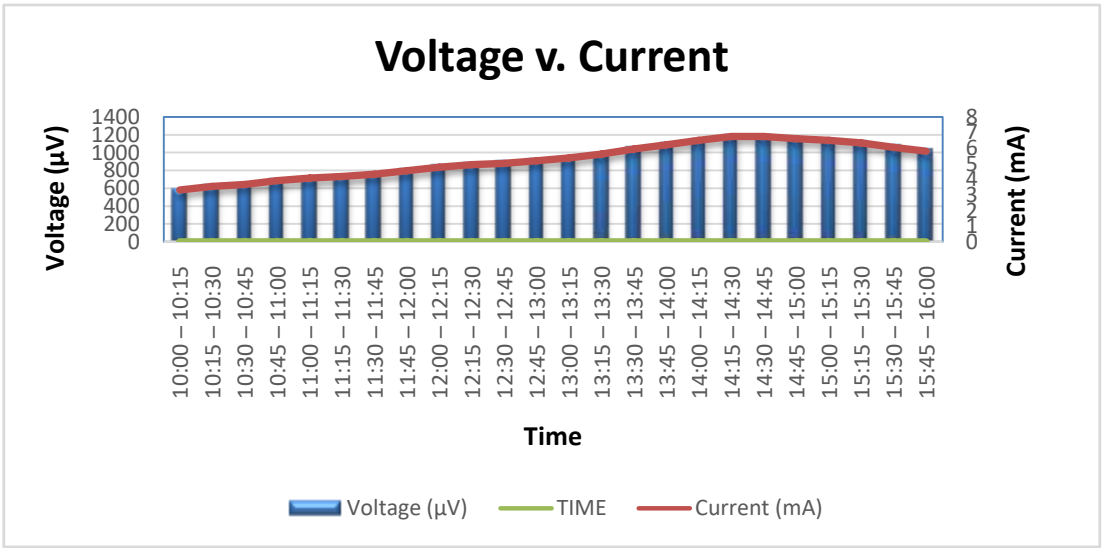

Fig. 3.3 (k)

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c) Output Voltage (V in µV), Output Power (P in Watts) and Time

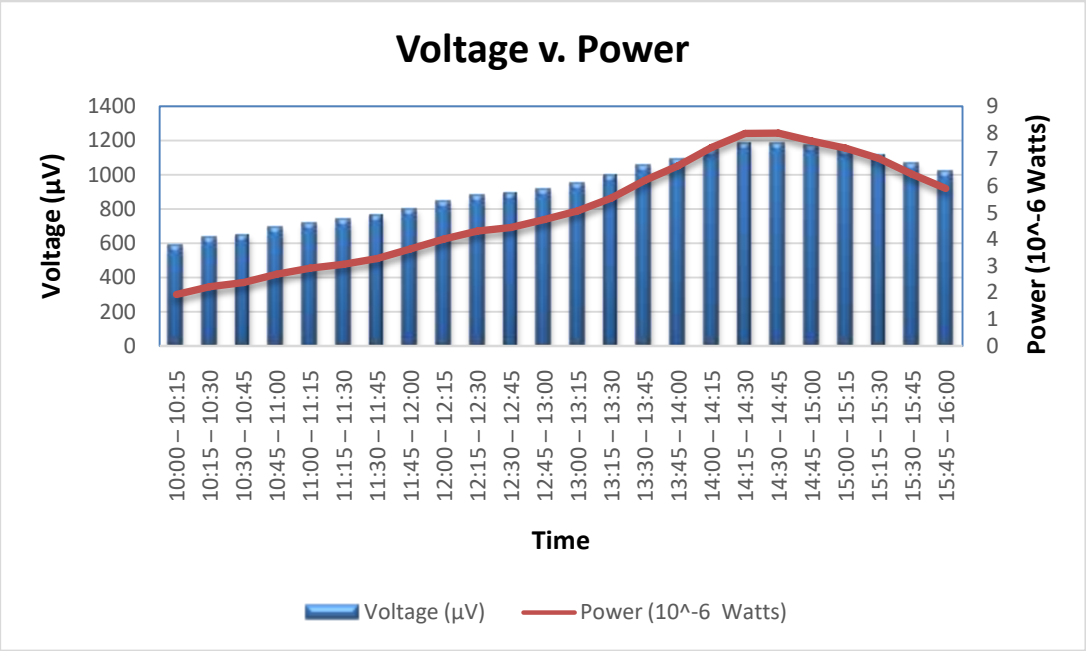

Fig. 3.3 (l)

ii. Stacking of Wires

Data for Aluminium Wire:-

Length of aluminium wire, LA = 1.5 m

Number of aluminium wires used for stacking = 4

Thickness of aluminium wire = 0.6 mm
Resistivity of aluminium (Al), ρ_a = 2.65 × 10-8 Ω-m
Area of aluminium wire, AA = $\frac{\pi \times (0.6 \times 10^{-3})^2}{4}$ = 2.826 × 10-7 m2

Resistance of single aluminium Wire = $\frac{\rho l}{A} = \frac{2.65 \times 10^{-8} \times 1.5}{2.826 \times 10^{-7}}$ = 0.141 Ω

Total resistance of 4 stacked aluminium wire, RA= $\frac{1}{4 \times 0.141}$ = 1.773 Ω

x_a = 2.78
E_{FAO} = 11.6 eV

Data for Copper Wire:-
Length of copper wire, LB = 1.5 m
Number of copper wires used for stacking = 4
Thickness of copper wire = 0.511mm
Resistivity of copper (Cu), ρ_b = 1.68 × 10^-8 Ωm
Area of copper wire, AB = $\frac{\pi\times(0.511\times10^{-3})^2}{4}$ = 1.9625 × 10-7 m2
Resistance of single copper wire = $\frac{\rho l}{A} = \frac{1.7\times10^{-8}\times1.5}{1.9625\times10^{-7}}$ = 0.122938831 Ω
Total resistance of 4 stacked copper wire, RB = $\frac{1}{4\times0.122938831}$ = 2.049 Ω
x_b = -1.7
E_{FBO} = 7 eV

Total Resistance, R = RA + RB
= 1.773 + 2.049= 3.822 Ω

CONCLUSION

The live project consists of bio-oil production using solar concentrator and receiver system. This system has a lot of waste heat that is being given off. As per our calculations it is approximately equal to 264.16 KW. Before beginning with any project the first step to it is, the feasibility study. So, we conducted the feasibility referred by various parameters via this literature review and these have been thoroughly analyzed. So, we were of the opinion that our proposed Seeback Effect will be actively extracting waste heat from the ongoing live project. The auxiliary that was proposed by us which would be able to extract this and convert it into usable form, working on the principle of Seeback Effect, has been successfully created and tested. So, the project has turned out to be successful as there is a generation of current by using the waste heat.

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Disaster Management: A critical insight with special emphasis on Canadian Disaster management

Dharani Kumar K
Dr.Nihal Anwar Siddiqui
Abhinav Srivastava

Abstract (10pt)

This paper will diagram the issues and the most recent experimental decisions about environmental change and serious climate occasions. This paper will give data about the connection between a shifting atmosphere and recurrence and seriousness of compelling climate occasions particularly in the northern scopes. It will examine strategies, means, instruments which will lessen the undesirable effect of great climate occasions and connected characteristic catastrophes on mortal populaces and base, with specific accentuation on the Global circumstance. At last, it seems ahead at the proceeding with requirement for exploratory, designing, radical and authoritative activities and procedures that will encourage moderation in a varying atmosphere.

Keywords:

Weather, Disaster loss, Climate change, Temperature

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UPES,

Introduction : Catastrophe mitigation and readiness in a climate change

Hotter temperatures will step by step cause glacial ice to liquefy [1]. Joined with development of sea water because of hotter water hotness, ocean heights could rise to a level that will undermine beach front ranges and little island countries [1]. Also, with more thermodynamic vitality in the worldwide framework, there will probably be an expansion in events of great climate occasions, prompting dangers to social security and belongings harm. Environmental variation can be contended to be the maximum prevalent and sweeping ecological problem ever managed by the global group.

[3]In the year 1988, the Intergovernmental Panel on Climate Change (IPCC) was shaped by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP). It united an expansive scope of government and non-government specialists to gather and survey the latest accessible experimental learning and to figure out what is known and not thought about the atmosphere framework and environmental change.

Somewhere in the range of 2000 researchers added to the latest report, the 1995n Second

assessment report, which reasoned that, "The equalization of proof recommends a perceptible human impact on worldwide atmosphere [3].

1. Disaster management and its implications

[6]Debacle administration is the dedicated towards to diminishing nursery gas fixations underneath 1990 stages with the point of moderating the degree of environmental alteration. Be that as it may, along with the diminishments in nursery gas emanations consented to in Kyoto there might keep on being changes in atmosphere under which Canada people will need to adjust. For Canada's situation, in view of our high scope area, the effect of the progressions might be especially serious [6].

Global powers have sorted out the residential science appraisal procedure round Canada's Climate Program Board (CCPB). The CCPB has arranged information on the condition of the knowledge, effects of environmental modification on Canada, and relief and adjustment reaction alternatives. The four government regular assets divisions (Atmosphere, Regular Resources, Cultivation and Agri-Food, and Fisheries and Oceans) consented to cooperate on combined undertakings and execute a system for reasonable improvement learning and innovation in the characteristic asset parts [2].
[10]An outline of the experimental data and information shows that Canada's normal temperature is around 1°C hotter since 1885, and there has remained a perceivable increment in the recurrence of wintertime tempests all through the twentieth period .In 1997, around 89%of aggregate nursery gas emanations (GHGs) in Global were inferable from conveyance and fuel generation and utilization [10]. [12]In Canada, 1999 is turning out to be the most sultry year on top score: the normal nationwide hotness for the initial 6 months was 2.7°C overhead ordinary and parts of the Northwest Territories experienced temperatures more than 5°C above typical [12]. [14]On account of its size and high scope area, Global is anticipated to encounter more prominent temperature fluctuates than maximum areas of the ecosphere. As a beach front and northern state, and as a renewable strength maker in the ranger service, horticulture and fisheries divisions, Global is added helpless than greatest to harm from environmental modification [14].
[8]During the Kyoto Protocol, Global consented to lessen discharges of nursery gasses to six percent underneath 1991 levels by somewhere around 2009 and 2012. In next report in 1998, the Commissioner of Environment and Sustainable Development inspected the government

execution exertion on key worldwide natural understandings for the period between the Rio de Janeiro (1992) and Kyoto (1997) gatherings [8]. [13] The review identified a deficient execution exertion, described by an absence of co-appointment among government offices, an absence of elected commonplace co-operation and a general administration structure that needed responsibility. In a meeting promptly taking after Kyoto, government, commonplace and regional pioneers consented to restore the execution exertion [13].
At that end, the national administration elucidated the particular parts of Environment Canada and Natural Resources Canada, made a Federal Climate Change Secretariat and federations that have approved the Pact (175 starting July 1999) and is the incomparable power of the Treaty. Environment Global (EG) builds up the worldwide and provincial general course models in Global and looks into environmental modification, counting environmental variation effects and adjustment investigation. It additionally drove the effort on the Global Country Learning, the primary nationwide evaluation on environmental modification effects and adjustment. Regular Properties Global principals national administration study on vitality proficiency, elective energizes, renewable vitality and the part of timberlands in environmental change. What's more, the inter-departmental Program of Energy Research and Development organization assistances coordinate the vitality Research projects of 12 divisions.Meanwhile April 1997, PERD has expanded his backing for exploration identified with vitality effectiveness and environmental change.

2. Disaster Losses

[14]Accumulation of dependable worldwide or even national debacle misfortune measurements is a famously troublesome assignment to some degree on the grounds that there are no institutionalized ways to deal with such gauges and Monetary misfortune Figures now and again incorporate backhanded costs, for example, loss of exchange, while others incorporate just direct harms[14]. What's more, some misfortune evaluations might be expanded to meet all requirements for government monetary financial help. [4] While reservations about the information ought to be remembered, there are great signs that aggregate worldwide financial misfortunes have been ascending at an amazing rate following the mid 1960s. Normal direct financial misfortunes in consistent moneys have ascended from around $ one billion US for every one year in the 1960 to over fifty billion dollar every one year in the 1990 period. Consolidated misfortunes because of characteristic and human-instigated calamities were evaluated by Munnich Reinsurance for 1993 at sixty five billion dollar and for 1996 at 180 billion dollar [4].
[8] The tremendous 1996 misfortunes incorporated the Kobe city, Japan seismic tremor assessed at about 80 billion dollar. Just two to five billion dollars of the sums were from humanoid mischances, the rest from common debacles. Albeit just 20% of these financial misfortunes were in low wage nations, the effect communicated as rate of their GNP was nearly 5 times that of high salary nations [8].The Center for Research on Epidemiology of Disasters (CRED) evaluates a sum of nearly 2 billion individuals were influenced by common risk catastrophes between

1986-1995. This is around 33% of the present worldwide populace (albeit a portion of the general population influenced may have been checked a rare times having been gone by additional than one fiasco throughout the 10 years). Figures influenced have increased a normal of six % every year in the course of recent decades, triples the worldwide populace development rate

[5] Calamity passing above the previous decades were assessed by CED at 750,000 around the world. While both monetary misfortunes and numbers influenced have been surging ever higher. A sixty-fold increment in straight financial debacle misfortunes from 1966 to 1993 far overwhelms the multiplying of aggregate worldwide GNP amid the identical time frame. It is likewise a distant speedier rate of expansion than the development of the universe's populace from around 3 billion to 5 billion amid the identical time frame [5].
On the off chance that it is viewed as that the expanded seismic tremor fiasco misfortunes is by and large corresponding to the worldwide increment in populace and uncovered framework, why are atmosphere related misfortunes expanding ordinarily all the more quickly? It is hard to figure out if there is a more noteworthy rate of financial advancement in territories influenced by surges and tempests, than those influenced by quakes in any case, in numerous portions of the earth, these are fundamentally the equal areas, and also it is far-fetched that disparity improvement could represent the huge contrasts in amount of progress. Along these lines, the substantially more quickly expanding rate of misfortune from climatically related fiascos, for example, from surges, tempests and dry seasons may without a doubt propose that these last perils might increment in recurrence and seriousness.

3. Synopsis of Past Changes

Worldwide misfortunes in climate related fiascos have risen immensely in the course of recent decades, three times as quickly concerning seismic tremor debacles and a comparable pattern is clear in worldwide scenario. Three variables seem to have created this expanding calamity

a) Increased populace and development of manmade buildings, structures presented to the risks.
b) Changes in area use influencing surge and dry season recurrence.
c) Increases, at any rate territorially, in recurrence of substantial rainfall and extreme extratropical storms.

The comparative significance of these 3 elements is hard to decide from accessible information. Catastrophe relief measures, particularly cautioning and readiness frameworks for surges and storms, and more secure building plan for seismic tremors, high winds and snow loads, especially in monetarily created nations, have restricted the expansion in numbers.

4. Projections of extreme weather events for Canada.

The northern topographical area of Canada and its tremendous outward zone casing cold tundra, inside fields and broad shorelines will open the nation to dissipations of most sorts of climate frameworks making a great likelihood of associated grievous occasions. [7] While

predictions are famously troublesome, maximum studies have anticipated that Carbon dioxide identical focuses in the environment will two fold from pre-mechanical times to the center of the following century. Without real mediation under the UN Framework Convention on Climate Change, the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) demonstrated the accompanying projections for Canada [7].

[9]When all is said in done, for each 1degree C increment in worldwide temperature, around 5% more precipitation will happen because of an accelerating of the vanishing procedure. Extremes of the hydrological cycle (surges, dry seasons), ought to thusly turn out to be more regular. Substantial precipitation occasions could increment in recurrence by additional than half and the power by as much as half. What are currently twenty year return occasions could get to be 10-year occurrences. A more prominent recurrence of substantial rainstorms and avalanches is foreseen, particularly in western Canada [9].

[15]Late information demonstrate quite expanded backwoods flames, and dangers to numerous timberland zone groups. As much as thirty half of the boreal timberland land range could be influenced in the following fifty years. In Canada, the quantity of lightning flames could increment by forty four %,and region smoldered by seventy eight % winters are prone to be hotter and damper; summers hotter and drier [15].In a few districts, this could bring about lessened snow packs to nourish streams and water stockpiling stores in summer, potentially prompting force and water supply deficiencies, and in addition expanded woods fires, creepy crawly infestations and harvest harm. In different districts, compelling winter snowfall occasions are anticipated to increment in recurrence.

[11]Proof for watched changes in dry season recurrence is not predictable or persuading, but rather dry season recurrence and seriousness in real grain developing locales of Canada could increment later on. The mean ocean level has ascended somewhere around 10 and 25 cm over the previous century. Projections of future rates of expansion in a warming world are 2 to 5 times these past rates with a mid-range projection of a 0.5 meter ascend by 2100 [11]. [18]Appraisals are that the world populace presented to beach front flooding would twofold from 46 to 92 million with a 0.5 meter ocean level ascent. In Canada, this would influence groups on every one of the three coasts [18].

Conclusion-

Individuals are not by and large intrigued by "crises" in typical times what's more, have a tendency to deny that there could be issues. In an emergency, governments see their part as "rescuer" or "assistant". Promptly taking after a crisis or emergency, the political level is all the more positively arranged to rolling out improvements to the crises or hazard administration framework. Crisis readiness experts who wish to roll out improvements to the crises or hazard administration framework ought to consider having all the foundation done for coveted changes ahead of time with the expectation of acquiring endorsement from the political level when

conditions are correct - that is, promptly taking after a debacle. There will be extensive financial and social advantages in expanding and enhancing catastrophe readiness and alleviation endeavors. As the rising pattern in the recurrence and seriousness of climate related occasions and the related devastation, harm, damage and death toll unmistakably shows, enhanced catastrophe readiness and moderation is a basic in a evolving atmosphere. It is currently by and large acknowledged that some type of progress in our atmosphere is really happening and will keep on occurring for various decades regardless of arrangements for decreases in nursery gas outflows and levels. One angle to which we should adjust is the expanding recurrence and seriousness of great climate occasions and the related characteristic fiascos. There are two primary purposes behind the basic of adjustment. In the first place, the effects of environmental change, and subsequently, its peril to society, can be adjusted by adjustments of different sorts. Second, adjustment is thought to be a vital approach choice or reaction procedure to worries about environmental change correlative to diminishing net outflow of nursery gases. Maybe now the significance of the expression "moderate" or "relief" and a portion of the hazard administration and fiasco administration terms ought to be cleared up, since they are utilized to some degree diversely by the environmental change and the crisis readiness groups.

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SAUSSUREA COSTUS: BOON FOR THE HIMALAYAN COMMUNITIES (A REVIEW)

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Dr. Shefali Arora

Abstract
Saussurea costus one of the important plant of saussurea genus known as a snow- lotus, from *Asteraceae* family reported as a critically endangered species of sub-alpine zone of Himalaya. Mature plants rooted out for its highly precious roots which is in great demand in local as well as in international market causing rapid deterioration by population number in wild habitat. *In situ* and *ex situ* conservation of species required on front-foot by reserving the forest area in small patches and cultivation on gram panchayat land. This review paper focusing on the identification to cultivation of the *Saussurea costus*.
Keywords: Saussurea costus; Asteracea; Endangered

Introduction

The Himalaya "name of dignity". Geographical position of the Himalaya itself like a bless for India and due to known as "six seasons' country". It covers many secrets itself with snow very beautifully. It is a habitat for number of floral and faunal species. Altitudinally, the Himalaya can be divided into six eco-climatic zone: Sub-tropical (below the 1500m), warm temperate (1501-2500m), Cool temperate (2501-3000m), Sub-Alpine (3001-3500m), Alpine (3501-5500), Nival (above the 5500m). The extremely cold climate of the Himalaya creates a unique identity in each of its species. Due to the dense forest cover, The Himalayan forest known for the medicinally important plant varieties. Number of species of Gymnosperms and Angiosperms reported from this region. Many fabulous and rare plant species endemic to the Himalaya and serves as the crude drugs or as the parts of different health care system. Extremely harsh conditions help in develop secondary metabolites to survive in such conditions. However, to fulfill the requirement of increased human population, many species are going to be demolish and under threatened category. One of the endangered species of Himalayan forest is *Saussurea costus* from Asteraceae Family.

About *Asteraceae* Family

The word Aster means 'compact, flowering heads of the plants contains florets vary from species to species. This family also known as '*Compositae*'. The *Asteraceae* family (Sunflower family) is one of the largest plant family found almost throughout the world containing the greatest number of species with about 24,000 – 30,000 species and 1000 genera out of which approximately 177 genera and 1000 species found in India. Every life forms found in this family such as annual, biennial, perennial herbs, shrubs, undershrubs, climber, trees and some aquatic also. There are number of plants of this family found very useful in traditional health care system.

Genus – *Saussurea*

Saussurea genus commonly known as saw-wort and snow lotus. It is a genus with 250-300 species and found in alpine region of Himalaya. Most of the exotic species of Himalayan region come under this genus such as- Saussurea obvallata commonly known as brahmkamal, Saussurea abrormis, Saussurea bhutkesh, Saussurea linearifolia, Saussurea candolleana, Saussurea albescens etc.

Taxonomic Details

Kingdom :- Plantae
Phylum :- Tracheophyta
Class:- Magnoliopsida
Order:- Asterales
Family:- *Asteraceae*
Botanical/Scientific Name:- *Saussurea costus*
Synonyms:- *Aucklandia costus*
Vernacular name:- Kuth

Parts Used:- Root of the mature plants used in many formulations or as a crude drug by different health care system or by local inhabitants.

Distribution:- Native to India, Endemic to Himalayan region such as Jammu and Kashmir, Himachal Pradesh, Arunachal Pradesh, Sikkim, Uttarakhand and Pakistan.

Habitat:-*S. costus* is a species of cool temperate-sub alpine forest of Himalaya with altitudes ranging from 3001-3500m. It is found in slopes of mountains.

Flowering and Fruiting:- During August-September

Seed Collection:- During September- October

Population Structure

As the mature plant is taken out for its root, *S. costus* is a critically endangered species in its natural habitat and mentioned in Appendix I of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) after the amendments of 1985. It is a drug of export quality and exported to china, japan and other European countries. After the depletion in its wild habitat, commercial cultivation had been started in 1930-40 in Jammu and Kashmir, lahul-spiti and Garhwal as its natural habitat.

Botanical Description

S. costus is Herbaceous plant, 1-3m in height, erect, robust, pubescent with a simple stem. Leaves thin membranous, irregular margins, glabrate in lower surface, basal leaves large while upper leaves small with short petioled. Stalkless head of flower, axillary or terminal; bluish-purple in color, hard and rounded, flowers raise in cluster of 2-5; fimbriate anther tail. Root stout, inverted cone shaped up to 40-60 cm long, greyish brown with characteristic odour.

Ethnobotanical Description

The inhabitants of Himalayan region depend on the forest products from the ancient time. The traditional knowledge is inherited to cure different diseases. Tribals of the Himalaya used the root of *S. costus* to cure the asthma, cough, cholera, leprosy, rheumatism, stomachache, toothache, typhoid fever, hair wash, diarrhoea, dysentery, nervous disorders, irregular menstrual problems etc. either as a single drug or in combination with another drugs. It is also used as deodorant, antiseptic, liver malfunctioning, high blood pressure, leaves used to protect wollen clothes, in some regions. Besides these, different Indian system of medicine like Ayurveda, Siddha and Unani and Chinese system used this plant as a main composition of drugs.

Medicinal Properties

S. costus is used as an Anti-inflammatory, Anticancer, Antimicrobial, Antiparasitic, Anti-ulcer, Imunomodulator, Hepatoprotective etc. in traditional as well as advance system of drug delivery. Roots of *S. costus* contains 'saussurine', a medicinally active alkaloid. Essential oil of *S. costus* is in high demand for different formulation and basic preparations.

Phyto-constituents of S. Costus

Phyto-constituents of any plants are the composition of ingredients found in that plants. Saussurea costus is rich in Costunolide, dehydrocostuslactone, costic, palmitic, linoleic acids, β-sitosterol, sesquiterpenoides, Saussureal, steroids, pregnenolone, daucosterol, syrine, a lignin glycoside, 1-hydroxypinoresinol-1-β-d-glucopyranoside, 12-octadecadienoic acid, (Z,Z)-9,12-octadienoic acid-2-hydroxy1,3-propanedinyl ester, lappalone and 1, 6-dihydroxycostic acid, Saussureamines A, B, C, D and E, dihydrocostunolide and sesquiterpene aldehyde.

Cultivation of S.costus

Cultivation of S.costus required Sandy- loam soil with high moisture % and rich in organic carbon. Germination and survival of seedlings is best with the climate of cool temperate to sub-alpine region of the Himalaya. The planting can be done by direct and nursery method but productivity is higher by nursery preparation. The seeds aresown in April or May in nursery. When the seedlings are almost 15 cm long, it is transplanted in field. 5-6 irrigations are sufficient between May-September. Although the land should be irrigated, when seeds are sprouting. It is very important in cultivation of S. costus that it should be grow without chemical fertilizers and pesticides as the species medicinally important in market. Harvesting Usually done in 2-3 years until well-grown mature root tubers are developed. However, yield is obtained from 3 years old crop. Root is harvested in early September or October or early spring. The roots should be cleaned with waterand dried for further processing. 2-3 quintal of dry tuberous roots can be obtained after 2-3 years of planting. The market rate is Rs.100-150 per kg of dry roots orvaries accordingtoquality and market availability. A marginal farmer can earn a good income by cultivation of S. costus. Intercropping also can be done with small duration crop.

Conclusion

The genus saussurea is endemic to the Himalayan region. Species of this genus play vital role in phytosociological attributes of Himalayan forest. Extinction of this genus in wild habitat can show severe effect on biodiversity of the Himalayan region. To fulfill the requirement of increasing population it is better to cultivate them in agricultural land. Gram panchayat can play an important role in Ex situ conservation of the S.costus. by identification of the species, assessment of life cycle, patching in adjacent forest.

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Assessment of Human Behaviour during accidental fire Hazards

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(Sagarkumar Vaghasia) [***]

Abstract

Fire has been affecting humans in various ways throughout the history but a common person know very less about the actual nature of fire or in most of the cases we had poor understanding about human behaviour in the situations of fire. The objectives of this research paper is to study and to characterise human behaviour in the situation of fire which will be helpful in giving evacuation models.
The questionnaire have been prepared and primary data were analysed to determine the characteristics of the group. It was found that the chances of panic were high in situations of fire. Respondents who were having fire safety training had taken more precaution during investigation phase but after confirming the changes in fire trend more aggressiveness had been shown by the people to fight against the fire. Sense of helping others in situations of fire was predominant, but it was found relatively higher in feminine gender, old people with fire who got appropriate fire safety training.

Keywords:

Fire Safety, Hazards, Human Behaviour

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1. Introduction (10pt)

Fire have killed many people for centuries, destroying part or even whole cities. Studies in the field of human behaviour in case of fire had started in a true sense during 1960-70 [1, 2, 3, 4, 5, 6, 7, 8]. Human behaviour can be described as a manner in which a person conducts himself. It refers to the full range of physical and emotional behaviours due to which humans engage socially, biologically, intellectually, etc. and are influenced by authority, culture, emotions, values, attitudes, ethics, rapport, coercion, persuasion and/or genetics (APA psychology glossary). Each human has a distinct behaviour, which affects the decisions taken by individual in a particular situation. In situations of fire it is generally observed that all occupants of the

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building decided to evacuate immediately. This behaviour is well known, but there is no significant research done in the field of human behaviour and the type of choices taken in such situations.
Some of the evacuation models have tried to consider this delay in the evacuation time by allowing the programmer to introduce the delay at the initiation of the evacuation simulation. The time delay introduced is based on the understanding and assumptions of the programmer, not based on the scientific data and evidence for a particular situation. For quantifying the time delay and incorporating it in the simulation models, it is essential to understand behaviour of the occupants. These behavioural patterns need to be quantified and incorporated in evacuation models for estimating the time delay. Researches in the field of human behaviour has shown that the actions performed by any individual in a specific situation is based on his behavioural decision making process, and not merely a coincidence or a result of change in environment by the situation only [9]. This decision making process is unique for every individual as all the individuals have a different behavioural pattern. The results can be same for many individual persons but the deduction to the decision by the process will be unique. The process of the decision making can be broadly divided in four stages 1) Perceiving the clues, 2) Interpreting the gathered information and risk evaluation, 3) Making the decision about the actions based on the interpretations, and 4) performing the action [10].
The stages of the decision making are influenced by a numerous factors depending on the individual, surrounding environment, past experience, type of emergency etc. Stage 1 of perceiving cues is basically receiving of the information from various available sources. The receiving data has very limited option as the modes of getting information of fire is limited e.g. smoke, rising temperature, alarm, instruction from other people etc. Stage 2 of the process is interpreting the information and results in either ignoring which will delay the process or exploring, which in result will give further information on the situation. As we move on to the stage 3 the possibilities of the decision is dependent on the individual behaviour. The person make an analysis of the situation which decide the future course of action depending on the situation. The person can instruct others if he has adequate knowledge. Stage 4 of the process is how the person will perform the action after he has come to a decision like evacuation procedure, help in fire fighting, warn other about the situation or wait for others to rescue him.

2. Research Method

The study consist of collection of primary data, collection and characterization of samples in the form of questionnaire, compilation of data and report. The study of behaviour was done using a questionnaire which was prepared in google-forms and was circulated on various social media platforms. The google form included various questions in which people had responded. People replied to the questionnaire and the responses were recorded in a excel sheet. The collected from these responses was segregated and analysed to determine the characteristics and behaviour of the respondents.

3. Results and Analysis

3.1 Overall characterization

The study consist of collection of samples where questions were answered by the total 334 respondents consisting 11% of women and 89% of men. They were between the age of 16 and 63 years with an average of 30 years old. It was found that 34% person were having training in fire safety. More than 80% of the respondents had university education which exceeded the national scenario. It was found that 34 % of the respondents were unaware of the evacuation plans of the buildings where they work or live. Considering the ability of the respondents to recognise the emergency exit was found that 91% state that they were capable of identifying it, but that percentage drops considerably when they were asked about the buildings they attend, because only 67% declare to have the information regarding the same.

3.2 Influence on the reactions of the relation of the respondents with the building

It was assumed that the behaviour of the occupants in a fire incident would have been different if they were in other building except where they live or work, and the data collected verifies the assumption, as 27%

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(Figure 1) of the respondents said they would have the same behaviour, while only 67% (Figure 1) stated that it would be different if they were in their own building.

3.3 Knowledge of the evacuation plans and emergency exitsIt was found that 211 (63%) (Figure 3) responded positively and were having the knowledge of the evacuation plans of the buildings that they live in or work

On the other hand it was found that 91% (Figure 3) said that in case of emergency respondent identify the emergency exits, that percentage drops significantly when considering the knowledge of evacuation plan of respondents in their building they attend, since only 63% declared to have this knowledge. Preference of exit in situation of fire was asked and 90% (Figure 4) of the respondents spotted for the emergency exit while only 5% choose for the regular path of access. Respondents were also asked to give preference of exits based on the risk factor involved, during the fire situation. It was clearly observed that respondents preferred "Exit that are far and safe" with 83% in comparison to (Figure 5) "Exits that are close but high risk" with only 13%, while 4% preferred to "Stay where you are and wait for others".

3.4 Chance of panic referred by the respondents

Analysis of various incidents showed that the occurrence of panic is very common and the effects of panic are widespread, but some researchers believe that is not the case in most of the situations [11]. According to the data obtained from the survey, 79% (Figure 6) of the respondents believe that in a fire situation there will be chances of panic.It was found that case of panic in such situation was always been present and ther researches also support the chances of panic in case of fire, and that it is mostly irrelevant of other characteristics of the human behaviour [12]

3.5. Spirit of helping others in a situation of emergency

In situations of fire helping others is very crucial. especially when considering. It was revealed that 81%emploee showed intrest in helping disabled and aged occupants (figure 7). This additional analysis showed that 76% of the respondents with fire safety training consider that there was spirit of helping others in case of fire situations. While 83.3% female respondents, and 76% of male respondents having fire training considered the spirit of helping others. Considering the education qualification of respondents it can be seen that 81% of the graduates and higher qualification believe in helping others.

3.7 Ways to know about the fire referred by the respondents

In consisted of recognizing how people come to know about the occurrence of fire, and how they become alert about the presence of the fire. From the analysis it was found that the "Smell of smoke" about 47%, followed by the "Alarm", with 26%, while the third was concerned with the "Visualization of smoke", with 19%, the "Strange noises" and "Unusual movements of the occupants" were both with 3% and "Others", with 2% (figure 8). Analysing the data collected from respondents about the three most common responses from the overall analysis, based on various characteristics of the respondents. It came found that the most common answers were same among masculine gender, but it differs for females as "Smell of smoke", with 42.1%, followed by the "Visualization of smoke", with 39.4%, while the third was concerned "Alarm", with 15.7%. Also it is not verified when the analysis is done considering respondents having the training, revealing a deviation in the results of the analysis in the number of people responding to "Smell of smoke", decreased to 35%, followed by the "Alarm", increasing to 35%, while "Visualization of smoke", decreased to 13%, the "Unusual movements of the occupants" and "Strange noises", both had slight increase to 4.3%. It should also be taken into account that even with changes in response there was no change of the sequence of the factors when considering the trained people with rest of the group.

3.8. Action of the respondents to the alarm

Identifying the reactions of the occupants after being aware that something unusual is going on, not knowing if it corresponds or not to a fire. From the analysis of the responses it was observed that 27% refer

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"Investigating what was happening"; while 26% indicate "Warn others" followed by "leave the place on his own initiative" with 25% and 18% preferred to "Contact authorities like fire brigade", then finally to "Wait to be told what you should do" and "Continue to do what he was doing" both with 2% (figure 9). Upon detailed analysis of the data on the basis of age, it was verified that people above the average age of 29 years preferred "Investigating what was happening" with 29% followed by "Warning others" with 23% and closely followed by at the third position "Leave the place on your own initiative" with 22%. 19% respondents preferred to
"Contact authorities like Fire brigade" and "Wait to be told what you should do" with 7%. No person in the above average age group preferred to "Continue to do what you were doing". In contrast to this people below average age of 29 preferred to "Warn others" and "Leave the place on your own initiative" with 27%, followed by "Investigating what has happened" with 26% and "Contact to authorities like Fire brigade" with 17%. "Continue to do what you were doing" and "Wait to be told what you should do" with 2% & 1% respectively. It was observed that the respondents above average age, preferred to investigate the situation due to long experience, but at the same time it was found that the percentage of people preferring to wait for instruction to proceed further had also been increased.
Taking fire training into consideration it had verified that there was a considerable increase in the respondents preferring to "Leave the place on your own initiative" by 6% while "Investigating what was happening" decreased by 7%, and no significant difference in other choices. It was found that respondents with fire training would leave the place and reduce casualties, instead of trying to investigate and put more lives in danger, as generally instructed action to be taken upon hearing the alarm.

3.9 Interpretation of the alarm signal

From the general analysis of the data received from the respondents, it has been observed that 31% of the respondents preferred "In the uncertainty it's considered as fire" followed by "Real fire" with 28% and "Exercise of Evacuation" with 24%. "False alarm" and "Others" are both with 7% and 3% with "Operations of Maintenance" (figure 10). Evaluating the influence of age, when considering the respondents below the average age of the group there was no considerable change in the responses. But in case of respondents above the average age of group, it was found that "Exercise of Evacuation" was first with 30%, followed by "In the uncertainty it's considered as fire" and "Real fire" with 28% and 27% respectively. "Other" with 6%, "Operations of Maintenance" with 5% and lastly "False Alarm" with 4%. It can be concluded that there is significant change in the behaviour of respondents above average age of group, in interpreting the signal of the alarm, but there is no significant change of interpretation of alarm signal when considering respondents with age below the average age of group, in comparison with the general interpretation of the group.
Only taking into account respondents with fire training "Exercise of Evacuation" and "In the uncertainty it's considered as fire" are both with 29%, but with increase of 5% and decrease of 2% respectively. Percentage of respondents with "False Alarm" increased by 4% to 11% while no significant change in the response was observed for "Operations of Maintenance" and "Other".

3.10 Reactions of respondents due to the presence of smoke

To understand the effects of low visibility on behaviour of occupants, due to smoke, on the selection of evacuation pathways it was found that 78% of respondents had most frequent reaction of "Try another way to get out of the building", followed by "Investigate to fight the fire" was 26%, all other responses were included in residual percentage (figure 11). Respondents having undergone fire safety training had different reactions, when compared to the analysis of overall responses. 56% of those with fire safety training gave the response that they will "Try another way to get out of the building", while on second place with 32% respondents chose to "Investigate to fight the fire". When considering respondents without fire safety training, the most given reply was to "Try another way to get out of the building", with 70%, and in second place "Investigate to fight the fire", with 23%.

3.11 Reactions by respondents when faced with direct contact to the fire

To evaluate the difference in behaviour of respondents with respect to coming directly in contact with fire in comparison to hearing an alarm, see smoke, or been warned by others, they were asked a question on the

subject. It was observed that 47% of respondents react by "Try other way to get out of the building", then with 25%, second response was "Ask for help" and third was "Fight the fire" with 17%. 6% of the respondents preferred to "Try and go through the fire" and lastly with 5% was "Other" as a choice. Considering age as the characteristic factor, additional analysis showed no significant change in the response of respondents except slight increase in the percentage of the person to "Ask for help" in case of the age group above the average age. Considering gender, female respondents preferred "Try other way to get out of

the building" with 47%, then by increase of 4% was "Ask for help" with 29% and third was "Fight the fire" with 13%, a decrease in
the percentage by 4%. 8% of the female respondents preferred "Other" as a choice while only 3% preferred to
"Try and go through the fire" (figure 12).Regarding respondents with fire training, it was seen that the most given respond i.e "Try another way to get out of the building" with 54%, followed by "Ask for help" with 25% while "Fight the fire" was third with 12%, and no considerable change was seen in other choices (figure 12).

3.12 General Questions

Respondents were also asked some general question to get an idea of the general behaviour of the respondents. The questions were related to fire drill, use of extinguishers and their views on the safety procedures. When asked "According to you fire drills are necessary in residential buildings?", 90% respondent answered "Yes", while 6% said "No" and 4% preferred to "No Answer" (figure 13). When further analysis was conducted for respondents having fire training the response were found to be similar to as for general population, thus there is not much effect in choice by the training, as most of the population finds it useful to conduct fire drills in residential buildings. When asked "According to you what is the use of fire extinguishers?", 53% of the respondents preferred the answer "To control the expansion of fire", followed by "To put out the fire" with 38%, while 7 % said "To help in exit of person", while only 2% said "To be used by authorized persons only". When considering respondents with fire training, It was observed that there was a decrease by 5% in respondents preferring "To control the expansion of fire" with 48%, followed by "To put out the fire" increased by 8% to 46%, while 5% said "To help in exit of person" with a decrease of 2%, while only 1% said "To be used by authorized persons only"(figure 14). Based on the results of the analysis it can be said that respondents with fire training preferred to put out the fire, using the knowledge of the training.
Respondents when asked about their views on safety procedures, respondents replied with "Must and be followed as instructed" with 60%, followed by "Useful and necessary" with 29%, "Need more improvement" with 9% and "Too strict and impractical" with just 2%. Considering the responses on the bases of fire training and age, it was verified that there is no significant difference in the percentage of respondents opting the choices (figure 15). When asked about use of electronic items near petrol filling station it was seen that nearly 20% of respondents don't think it is dangerous to use these gadgets. Similarly when asked "According to you type of clothing hinders a person's speed of evacuation?" 71% agreed about the same, thus verifying the studies indicated in researches (Jake L. Pauls, 1986). During the evacuation studies, it was concluded that type of clothing a person wears can affect the speed of the evacuation by nearly 5%.

3.12 Further Study and Application

It was observed in the study, that the data collected does not represent overall population of the Indian society. So to generalise the data and come to a definite conclusive result more data from respondents is required which can represent the society as whole. To get the significant amount of data required to conduct the behavioural analysis of the Indian society, more surveys need to be conducted, and microanalysis of the data collected needs to be carried out.
To determine the general characterization of the population for incorporating it in evacuation models, it is necessary to extend the analysis to a larger group. The data should be collected for various buildings like hostels, hospitals, educational institutions, residential buildings, malls, public assembly areas, refineries,

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industries etc. The behavioural pattern of the any individual can vary depending on the location, mental state, physical capabilities, previous exposure etc. The data required can be collected by conducted by surveying occupants of various such buildings or facilities. To characterize the behavioural pattern of the occupants, surveys, drills etc. should be conducted for various occupants in various buildings. The behaviour of different occupants in similar buildings will be different even though type of work, layout etc. as same. Thus collecting the data for various buildings and facilities with different occupants will provide a general characterization of the occupants in that particular type of environment.The behaviour can be quantified in various parameters as defined above. These parameters will act as input for the evacuation models for the building, in the designing phase. This will help in optimization of resources required for safe evacuation of the building, as well as estimation of the evacuation time including the time delay due to occupant behaviour.

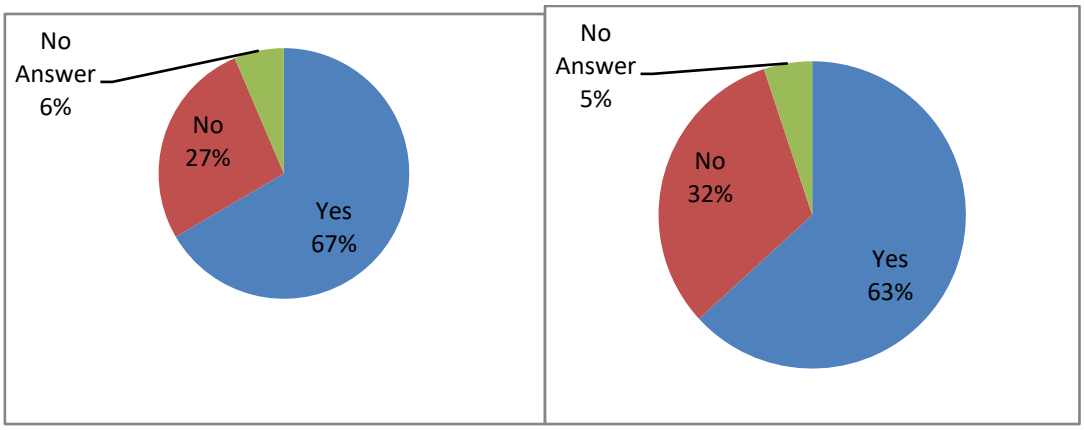

Fig.1. Difference in reaction if in own building, Figure 1 Information of evacuation plan and emergency exits

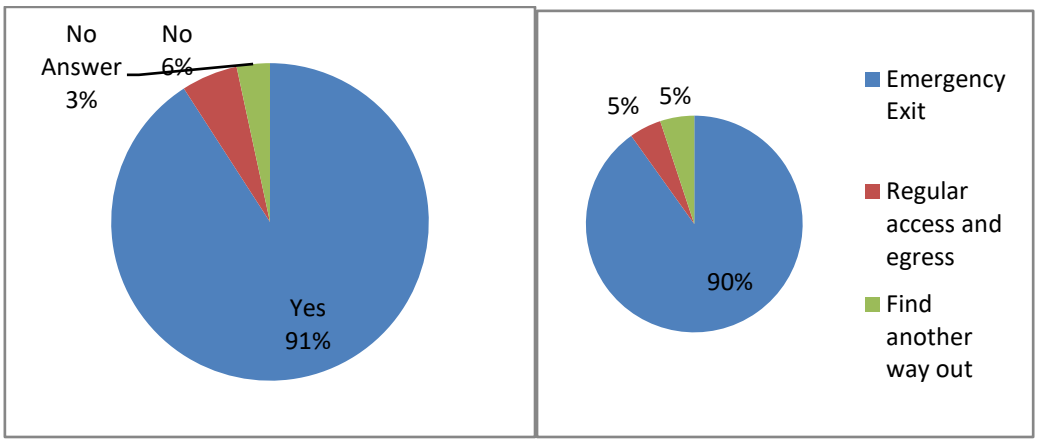

Figure 2 : Identify the emergency exitsFigure 3 : Preference of exit in case of fire

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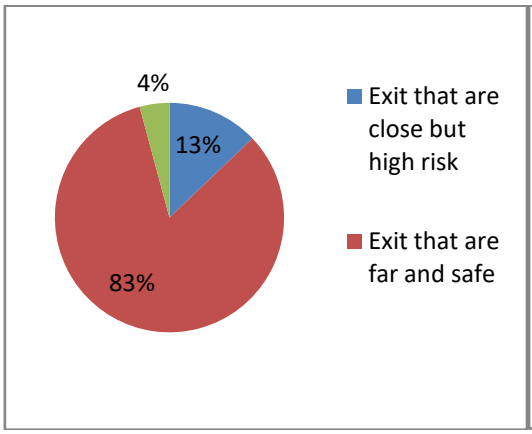


Figure 5. Exit preference in case of fire

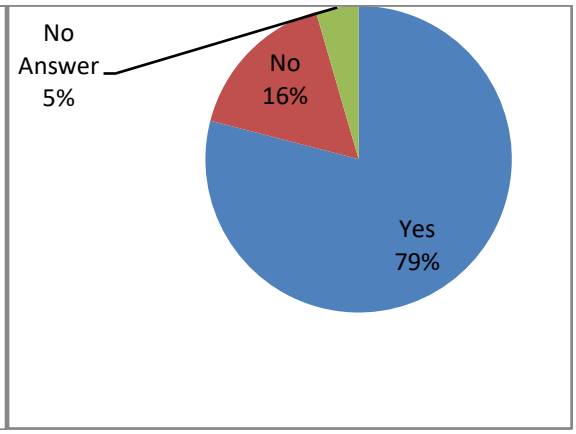
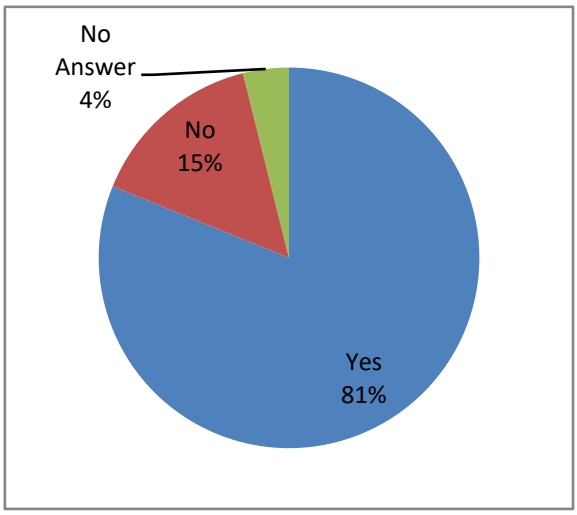


Figure 6 Chance of panic



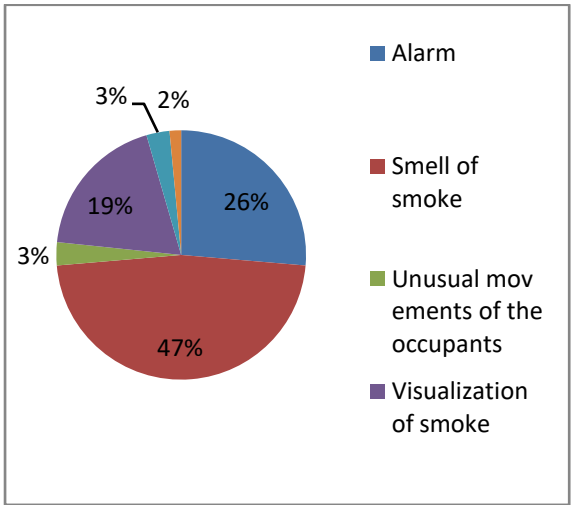


Figure 4 : Feeling of helping others *Figure 5 : Ways of Alert*

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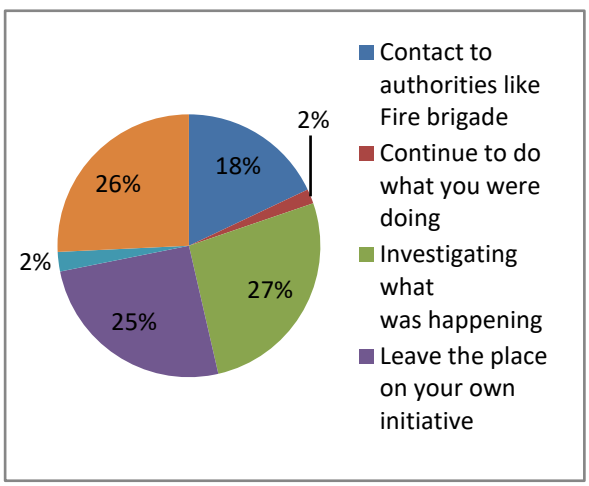


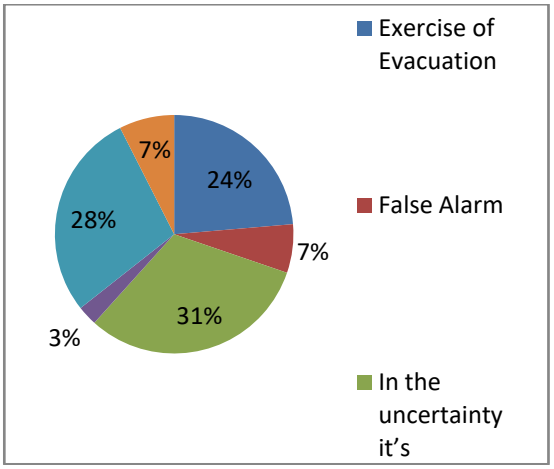
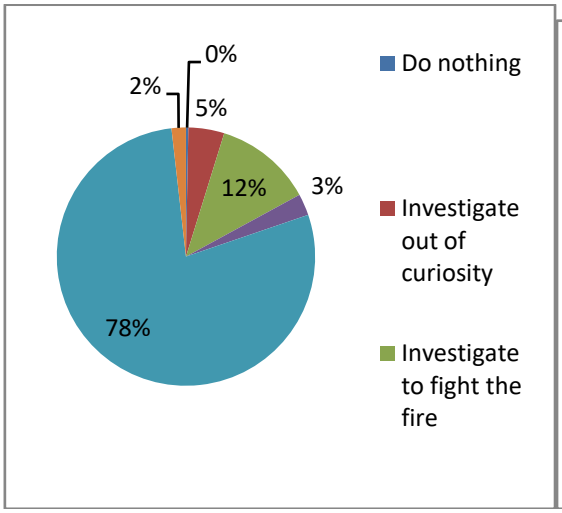


Figure 6 : Action of the occupant to the alarm Figure 7 : Interpretation of the alarm signal



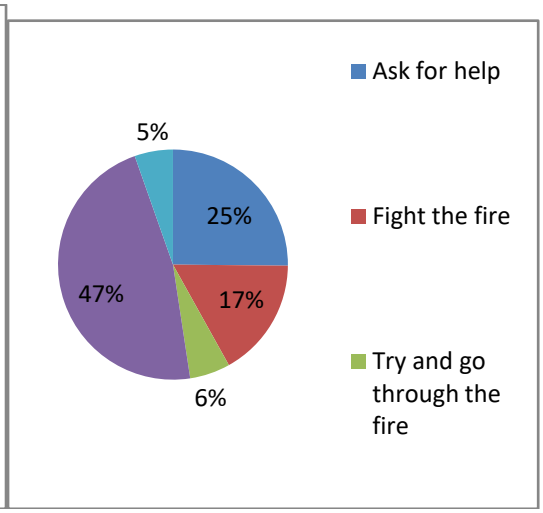


Figure 8 : Reaction to the smokeFigure 12 : Reaction to the fire

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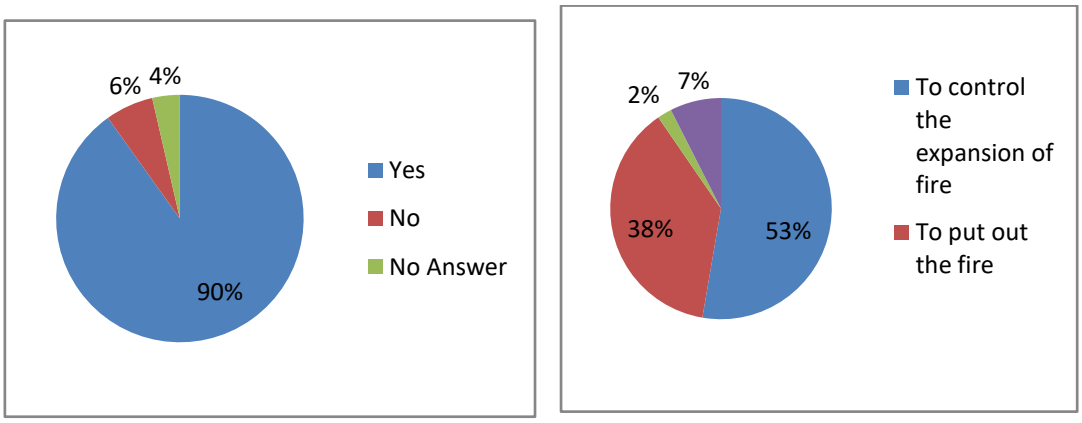

Figure 14 : Use of Fire extinguishers

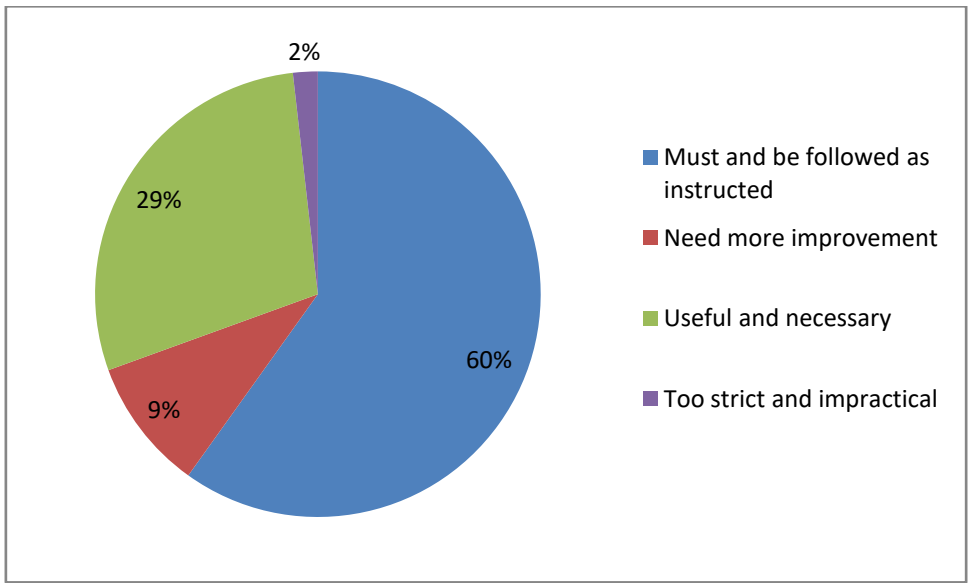

Figure 159 : Views on safety procedures

4. Conclusion

The chances of occurrence of panic were high in situations of fire. Effect of age was considerably high in the evacuation process. Respondents with fire safety training had taken more precaution during investigation phase, whereas after having information of the situation their reactions become aggressive. Sense of helping others was relatively higher in feminine gender, old people and respondents who attended fire safety training. Gender of the occupants affects only in very few decisions during evacuations. There was little relevance of the fact that the occupant knows the building or not and their reaction during a fire. Alarm was not considered as the reliable source to be alerted for the fire. Assumption by respondents that alarm is not the signal for evacuation but it was the signal for occurrence of fire. High influence on reactions towards firefighting by occupants having fire safety training during a fire. The follow up of this study is to develop an Artificial Intelligence (AI) which would collect the data of occupants in a building by image processing. The

AI would determine the safest path for the occupants in the building using evacuation simulation, fire and smoke progression in the building, and behaviour of the individual occupant. To make this model capable enough for general use, study should be extended to various kinds of buildings like hotels, hospitals, educational institutions, refineries, offices etc. so that significant data and information can be collected.

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