# Agri Science Innovations

## Focus: Health, Safety and Environment Protection

**Prakash Apte**
*Managing Director, Syngenta India Ltd.*

**The problem before us today:**

- Global Food production is the highest ever and quality and safety is better than ever before, yet 14 mio people die of starvation every year & 800 mio people are clinically malnourished!

**And by 2025 we will have more than 8 billion people to feed:**

- Global population is expected to grow from 6.2 Bio to 8 Bio in 2025, while farmland available per capita is shrinking!
- Secure & sustainable supply of high quality food, particularly in the developing countries; is a basic requirement for continued human development!

**In India the situation is more acute:**

- During the last two decades of 20th century, the population increased by 50% but food-producing land has shrunk by 5 %.
- Demand for healthier food is increasing with the growing awareness, but the farm land is being nibbled at to meet other economic needs e.g. urbanization & industrial infrastructure

**The Challenge:**

How to meet the nutritional requirements of growing population with minimal impact on the environment?

**Our President, Dr. A.P.J. Abdul Kalam has aptly summarized the challenge … "By 2020 India will require to produce over 380 million tons of food grains in view of the population growth. Our agricultural scientists, technologists have to work for doubling the productivity of the available land with lesser area being available for cultivation with less water …"**

**Advanced Agricultural Science can help:**

Agri science has made great progress over last 50 years. This has enabled us to keep pace with the growing needs of increasing population. However, in recent years Indian Agriculture has not kept pace with the technological progress in other sectors of economy. In a country where about 2/3 rd of population derives its livelihood either directly or indirectly from agriculture; this imbalance could pose serious threat to our progress in the long run.

A country of India's size & diversity can not afford to ignore the threat to healthy development of human capital & sustainability of its environmental resources if the Agriculture is not modernised to keep pace with the aspirations of its people & globalisation of its economy.

**Agri science developments:**

Although Agri sector contributes over 20% to our GDP, we are lagging behind many other countries in adopting various new developments of Agri science

a) Reduction of losses due to pests & disease

b) New generation agrochemicals

c) Productivity enhancement thru better seeds

d) Genetically engineered crops

e) Post harvest technologies

f) Modern agronomic practises

**Crop Protection:**

It is estimated that in a tropical country like India, pests are responsible to losses up to 30% of the yield. Continued innovation/ discovery is required to reduce pest damage. Over the last 30 years, development in Crop Protection Products has helped in fulfilling these demands at a lower cost than ever before. Continuous innovation has led to development of Crop Protection products with:

- Lower use rates and better degradability leading to a lower environmental loading
- Improved human safety profile for farmers, workers and consumers
- High-biological efficacy
- Selective control of pests, diseases and weeds
- Increased safety to naturally occurring insects and organisms
- Control of a broader spectrum of pests
- Safer toxicological profile
- Novel biochemical and biotechnological solutions for resistant pests

The focus now is on selective pest control formulations, which are currently under development around the world. These new materials represent the beginning of a new era in both synthetic organic and natural origin pest control options. This era will be characterized by low use rate, highly effective, generally selective agents designed for tactical strikes. In most cases, these materials will require more management expertise, but will be far friendlier to the total environment including biological control organisms.

**New Formulation Technologies to address HSE Objectives:**

Extensive work is being carried out world wide, for developing new formulation technologies which would serve the objectives of easier application, labour saving, improved safety, reduced toxicity, minimization of environmental pollution, higher efficacy and reduced cost.

The areas of development include suspension concentrates, micro emulsions, granules, micro granules, water dispersible granules, concentrated emulsions; slow controlled release products, etc.

The changing public perceptions and customer attitudes favouring higher activity, greater efficiency and environmental safety, the industry has responded with more active and selective Pest Management Tools. Farming that ensures IPM tactics for safe and environmentally sustainable ways, will meet the enhanced requirement of safe food for the growing population!

The Crop Protection pipeline have never been more impressive and carries the promise for even better Pest Management Systems in the future to support the objective of feeding the growing population while protecting the environment in a responsible manner.

**High Yielding & Hybrid Seeds:**

Development of high yielding & hybrid seeds provides a very high degree of yield enhancement over the conventional varieties. However, growing these improved varieties requires meticulous farm management, increased fertilizer input & enhanced crop protection.

**Genetically modified Crops:**

Biotechnology when deployed to enhance the performance of crop varieties, opens up immense possibilities to increase agricultural output. Many countries, including China have progressed the application of this technology in their farm sector at much faster pace than India. Typical applications have been to induce pest or disease resistance in the plants to avoid application of agrochemicals. By now, scientists have developed safe application of this technology in Cotton, tomato, soyabean, potato & corn. Many other crops are under various stages of study.

As this technology develops further, it has the potential to provide further benefits in terms of reduced costs of cultivation thru soil & water conservation, pests & disease resistance, water / heat stress enhancement, enhanced output traits e.g. taste, processing ability, keeping quality, nutritional value etc.

**Too many questions?:**

The progress of modern agri technology has been affected due to lack of public confidence & too many questions asked out of context

- ❖ Do we need to use pesticides at all?
- ❖ Why not go for organic farming?
- ❖ Is GM food safe to eat?
- ❖ How will the new technology affect the environment?
- ❖ What will happen to wild plants, insects & birds?

- ❖ Will consumers be offered a reasonable choice?
- ❖ Will seed companies have too much power?
- ❖ Are we playing science ethically?

**Stewardship & building public confidence**

These questions indicate that there is need for the agri science industry to step up & broad base its stewardship efforts. There is need to let the consumers know that there are sustainable industrial practises followed in the research & manufacturing activities. Further it is essential to demonstrate to all stakeholders that sustainable agricultural practises are followed & integrated crop management techniques are imparted to farming communities. Finally it is essential to ensure none / negligible hazard is posed to water, soil & environment by adopting the new technologies. Thus the scientific community & Industry needs to take some long term confidence building measures.

- ❖ Address valid concerns & debunk red herrings
- ❖ Engage stakeholders in meaningful dialogue
- ❖ Establish norms for environment protection
- ❖ Ensure "CHOICE" is with the consumer
- ❖ Evolve rigorous (but not suffocating!) and transparent regulatory schemes
- ❖ Demonstrate Corporate responsibility

**Promise & predicament:**

Like all new developments in modern times, the promise comes along with the predicament. The society needs to muster all the scientific temper at its command & deal with the situation in a pragmatic way to balance the costs, benefits & risks associated with the portfolio of new technologies offered by Agri science. Progressive outlook and objective assessment will ensure that we make the right choices, which will go a long way to ensure safe food, healthy life & sustainable environment for our next generations.

The discovery of DNA structure has been a key development that has opened the doors to many new possibilities for our generation & I will like to conclude by remembering the words of James Watson who was a co- discoverer of DNA structure:

*Never put off doing something useful ..*

*for fear of evil that may never arrive !*

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**About Author**

**Prakash Apte**

**Managing Director, Syngenta India Ltd.**

- B.E. (Mechanical), University of Pune
- Post Graduate in Management Studies
- ✓ Worked with Larsen & Toubro and UHDE India Limited.
- ✓ Head of the Company's Agrochemicals Unit at Santa Monica Goa and was Project Manager for all the investments of this Division.
- ✓ Nominated as Sector Head for Crop Protection for Novartis.

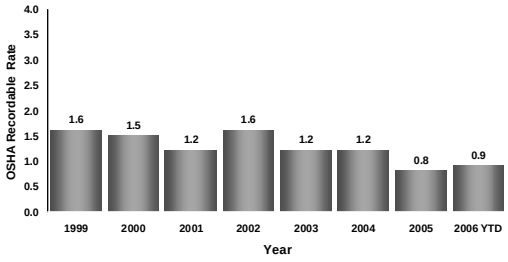
# Innovations in Safety and Environmental Performance

**Dr. Stuart Hill**
*Huntsman EHS Director, APAC*

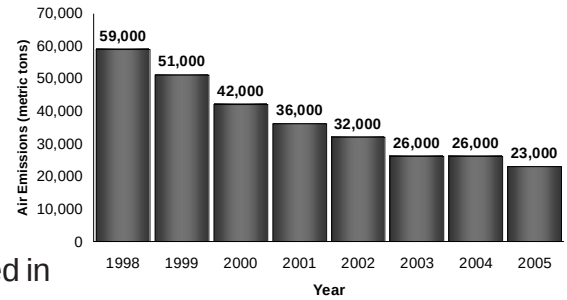
## Huntsman Corporation

Overview

## Huntsman Safety and Environmental Performance



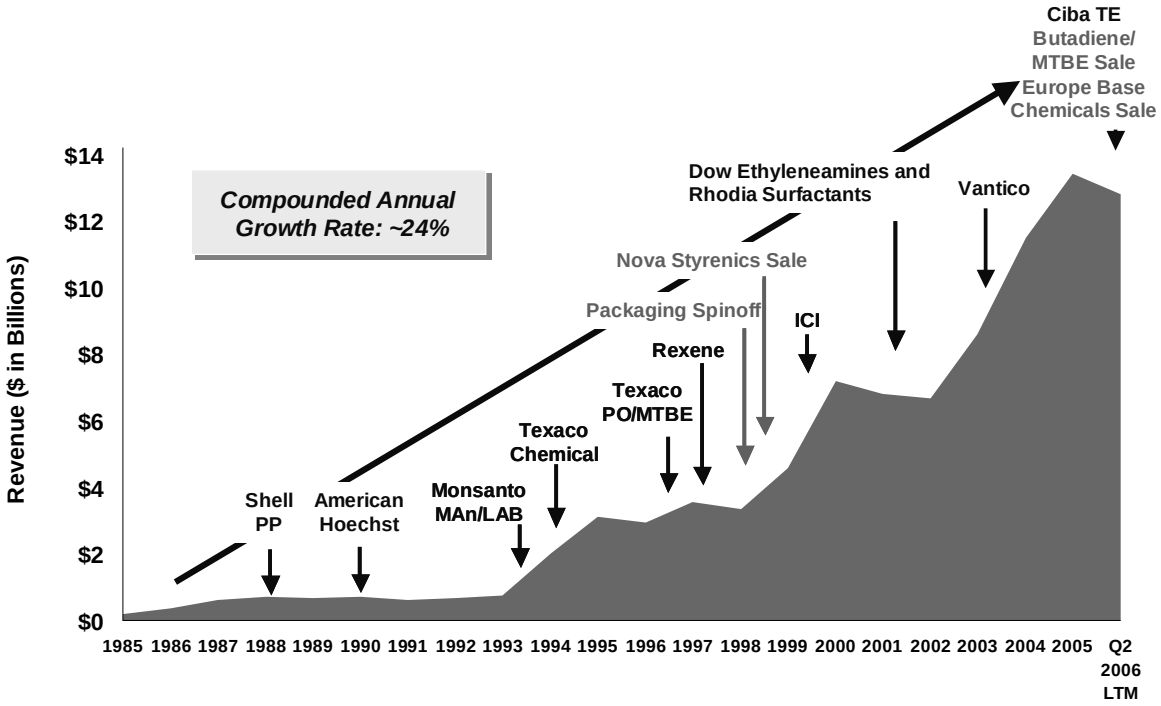

OSHA Recordable Rate = number of cases requiring more than first aid x 200,000 / number of hours worked.




* Huntsman Advanced Materials not included in 1999 - 2003 Data

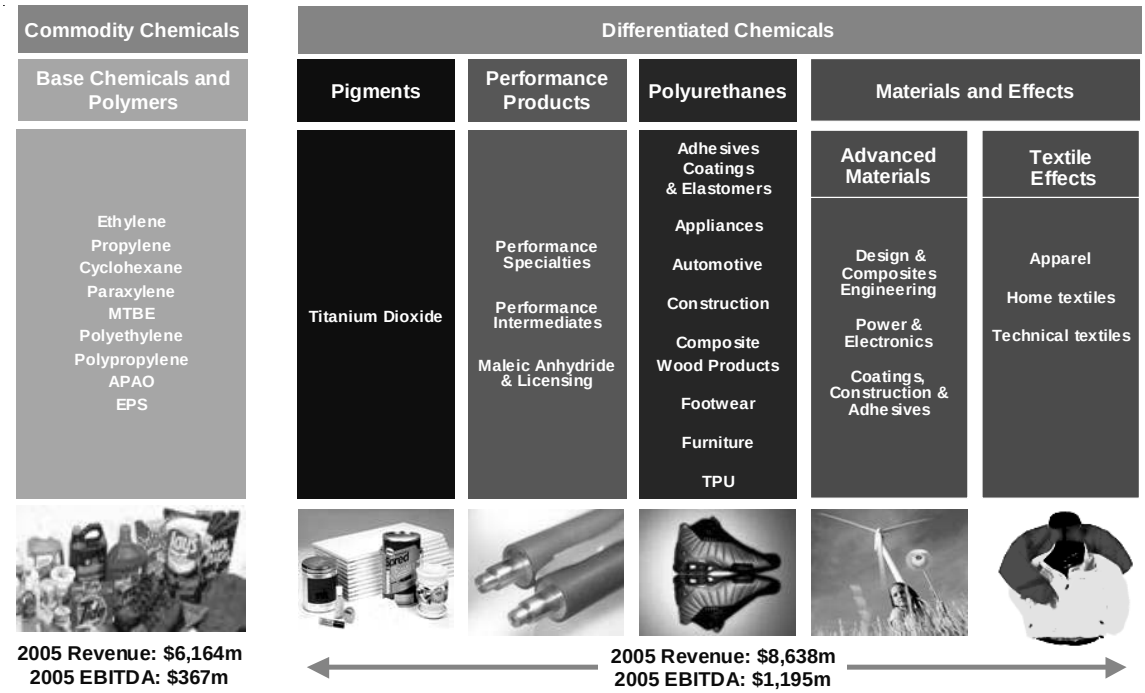
** Total air emissions (excl. $CO_2$)

# Huntsman Growth Story




## Who is Huntsman?

# Mainly differentiated businesses



**Who is Huntsman?**

## Social responsibility

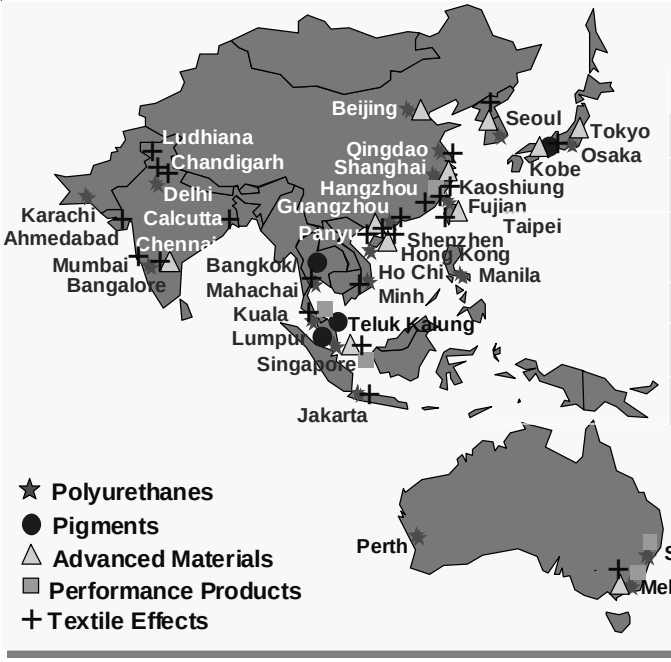
### Improving our communities

- Hunger
- Homelessness
- Education

### Combating cancer

- Huntsman Cancer Institute and Hospital
  - www.hci.utah.edu

## New Huntsman in Asia




| Division | # Assoc. | # Sites |
|---|---|---|
| Polyurethanes | 280 | 13 |
| Advanced Materials | 380 | 14 |
| Performance Products | 190 | 2 |
| Pigments | 240 | 2 |
| Textile Effects | 1,045 | 25 |
| TOTAL | 2,100+ | 56 |

## Environmental, Health & Safety Management

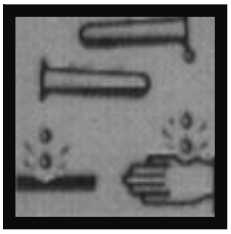
HAZARD

- The potential of a substance, activity or article to cause harm.

RISK

- The likelihood that a substance, activity or process would cause harm in the actual circumstances in which it is used.

  - ➢ EHS Management is eliminating hazards and minimising and managing risks



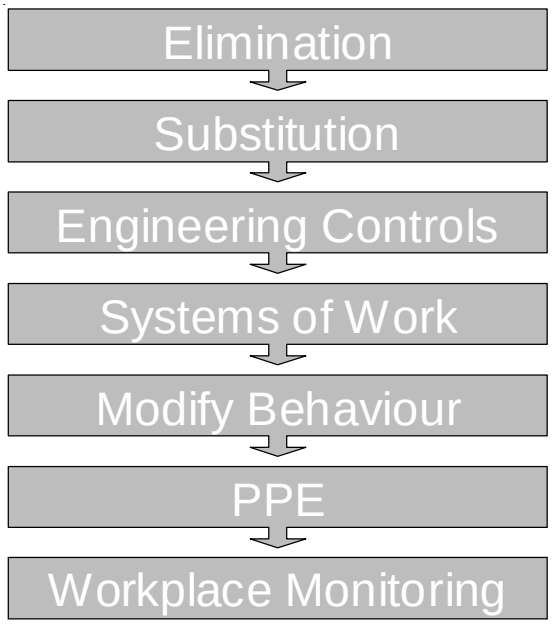


## What is Innovation?

- Innovation - Bring in novelties; make changes in….
- Novelties – new or unusual thing or occurrence (Concise Oxford Dictionary)

  - ➢ EHS Innovation is continuous improvement in management of EHS hazards and risks

## Hierarchy for controlling hazards




- Do away with the hazard
- Replace the hazard with something less dangerous
- Prevent contact (guards, ventilation)
- Control hazard using instructions & procedures
- Training, auditing
- The last line of defence
- Monitor workplace & worker to assess impact of exposure

## This Contribution

- Does not attempt to discuss all innovations and future developments
- Gives an overview on EHS management processes based on personal experience within the chemical industry
- Emphasizes the role of people and their behaviour in achieving innovation and EHS excellence.

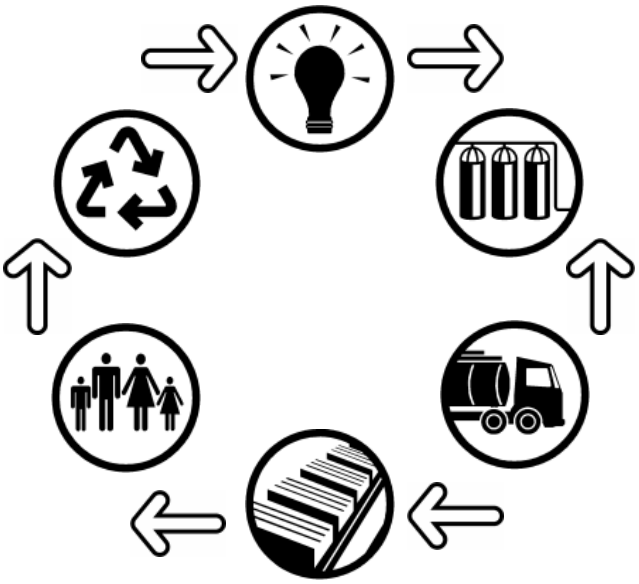
## Changing Regulatory Environment

- Trend from Prescriptive Regulation to Self-Regulation, e.g.,
- UK: Factory Act (1819) to Health & Safety at Work Act (1974)
- ISO 14001; EMAS; OSHAS 18001; ANSI/ AIHA Z10-2005
- Responsible Care®
- Chemical industry's premier voluntary EHS performance improvement initiative
- Huntsman was an original signatory to the Responsible Care Guiding Principles

- Created in 2001.
- Consists of 47 individual standards.
- Support implementation of Huntsman EHS Protection Policy and Responsible Care® Guiding Principles.
- Provide structure for local EHS management systems to ensure uniform EHS management
- Support high level of performance across Huntsman
- Corporate Audit program reviews compliance with Standards.

## Product Stewardship
## Life Cycle Approach

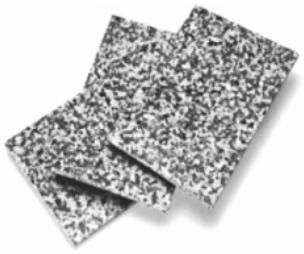
### Product Lifecycle



**An integrated business process for identifying, managing and minimizing the EHS impacts at every stage of a product's life cycle.**

## Polyurethanes Recycling & Reuse

- Energy Recovery
- Material Recycling of Production Waste
- Chemical Recycling of Production Waste

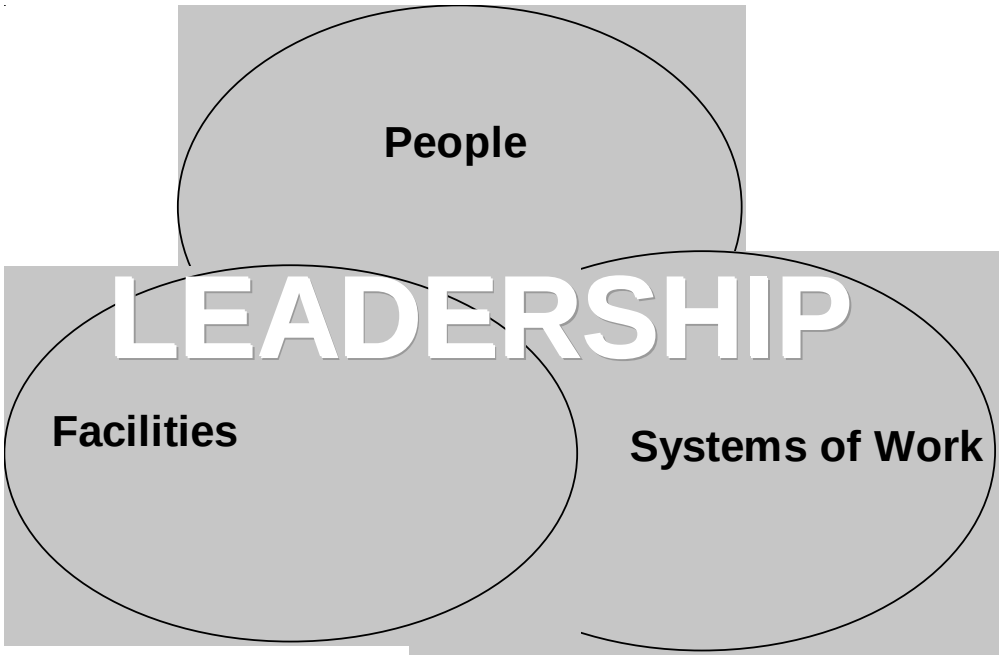


## Walk the Talk

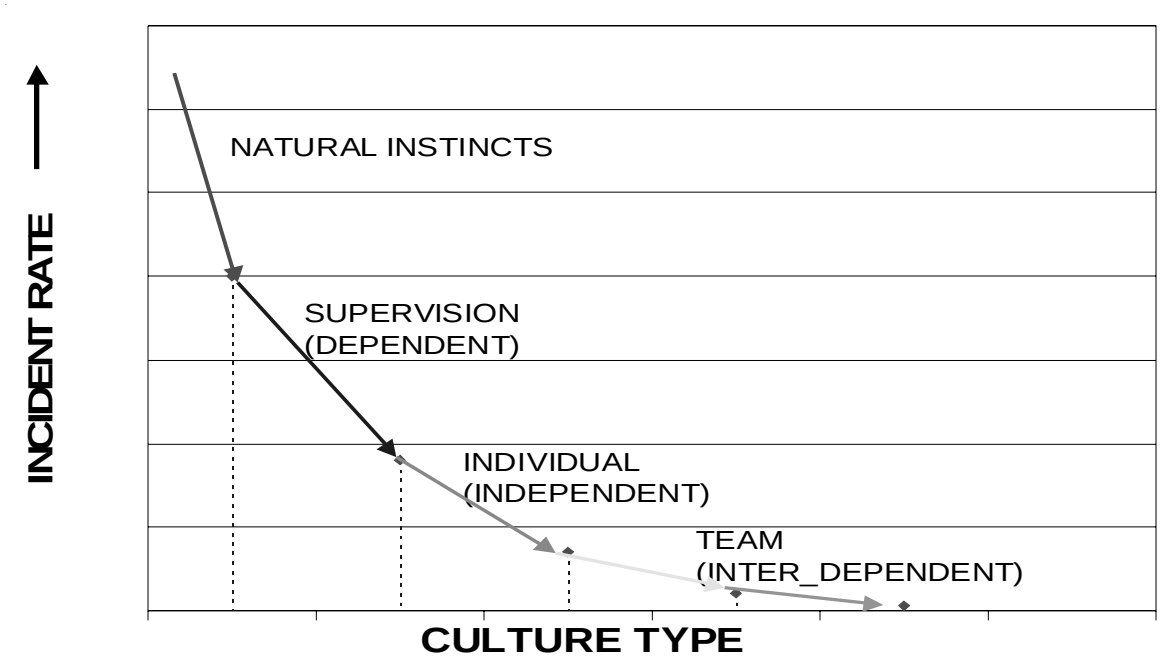
***Safety in action***

- An initiative by ISOPA to improve health & safety across European polyurethanes industry
- Partnership between customers and suppliers
- Aims to raise awareness and promote best practice and lead to a positive change in behaviours
- A series of recommendations and core modules have been prepared for safely using polyurethane chemicals & emergency response
- Core programme is tailored to individual customer situation by supplier representatives

## Essentials for EHS Excellence



## EHS Culture Development

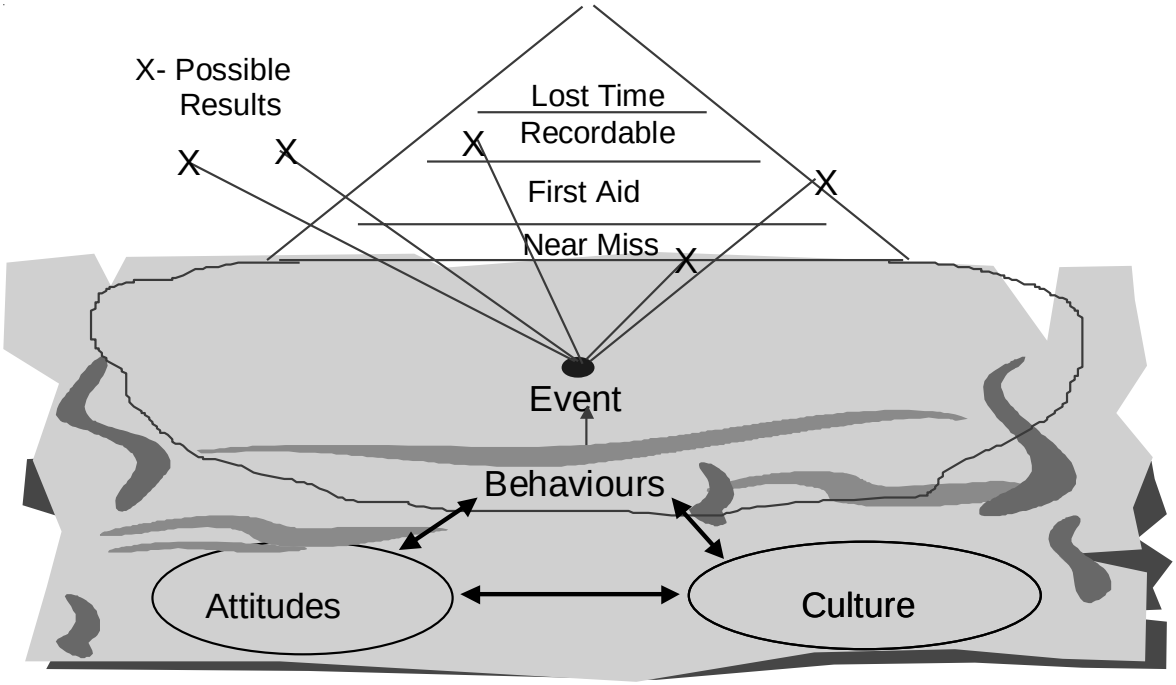



## What is Behaviour

## *An Observable Act*

- *Things we do and how we do them (observable)*
- Our thoughts and emotions in action and reaction

## Incident Iceberg




## What Influences Behaviour – The Individual

Cause

***The reason for the behaviour***

Behaviour

***The observable act***

Consequences

***Anything which follows behaviour***

## What Influences Behaviour – The Individual

**CONSEQUENCES**

**CONTROL BEHAVIOUR**

## Behavioural Safety

- Safe Behaviours
  - Things which we do in a way that satisfactorily considers safety, health and the environment
    - For example: wearing safety glasses when mixing chemicals
- At-Risk Behaviours
  - Things which we do in a way that does not satisfactorily consider safety, health and the environment
    - For example: running down stairs without holding the hand rail

## Behavioural Measurement Techniques

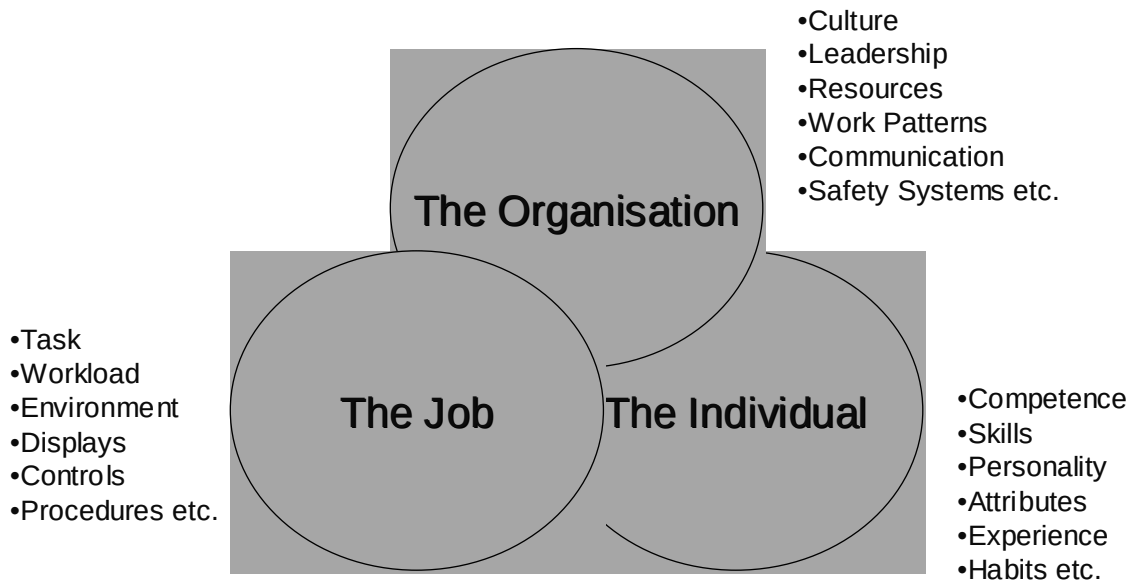
- % Safe Behaviours

Number of safe behaviours observed X 100
Total number of behaviours observed

For example: Wearing of safety glasses – associates were observed wearing safety glasses sixteen times, and not wearing them six times.

16 safe behaviours observed X 100 = 72.7 % Safe
22 total behaviours observed

## What Influences Behaviour



## Examples of things that can be done to influence behaviours & reduce failures

- The Job
  - HAZOPs
  - Risk Assessments (customer, warehouse, site, office)
  - Manual Handling / Ergonomic Assessments
  - Preventative Maintenance
  - Procedures
  - EHS Committees
  - ISO 9000 & 14000
  - Job Safety Analysis

## Examples of things that can be done to influence behaviours & reduce failures

- The Individual
  - Training & Competence (training matrix and calendar)
  - Awareness (posters, health promotion)
  - Behavioural Observation and Feedback
  - Job Rotation
  - Contractor Involvement
  - Tool Box Talks
  - Driver Training Programs

## Examples of things that can be done to influence behaviours & reduce failures

- The Organisation
  - EHS Policy and Standards
  - Goals and Objectives (personal and site)
  - Key Performance Indicators
  - Resources (global audit teams, EHS professionals, consultants, capital expenditure process)
  - Response to Incidents (investigate, act, share)
  - Communication & Learning Processes (sharing good practice and praising success)
  - Management Leadership (walk the talk)

## Summary

- EHS Innovation equates to continuous improvement
- Innovation must be built on firm foundations
  - Systems of Work
  - Facilities
  - People
- People are the most important element of any EHS innovation program
- Addressing behaviours in a positive way impacts the EHS performance and culture of an organisation

**Dr. Stuart S. Hill**
**Director (E.H.S.),**
**Huntsman (ASIA Pacific) Pvt. Ltd.**

- Graduated from Bradford University, UK
- PhD in Chemistry, Bradford University, UK

✓ Started career with ICI in the field of R & D.

✓ Joined Huntsman in management position in the year 1999 for its international business.

✓ Worked as Environmental Engineer for several projects in Holland, UK and Shanghai.

# Plastics And Safety, Health And Innovation

**Dr. D. D. Kale**
*Reliance Industries Limited*

## Introduction

Mankind has always looked around to use natural materials for the comfort in the life. Thinking of safety is always inherent in the mind of every living being. Thus wood for housing, protection, carts and many other uses; cellulose for paper or clothing as well as variety of oils for cosmetic or medicinal uses have played a major role in the evolution of lifestyle for many years. These materials have always been used with many many innovative ideas depending upon the environment and inputs from other spheres of life/ developments. The innovation and lifestyle always go hand in hand. In recent years the plastics have played a major role in the present lifestyle. Plastics have been used extensively in medical field. The IV fluid bags, blood bags, disposable syringes or statures are classical examples where plastics have been used. The famous artificial foot developed by Dr Sethi has been used by one of the famous dancers of India and it has plastic used in it. The plastic containers or boards to replace wood have helped the environment preservation. The wire and cables coating has proved the safety in their use. The corrosion proof plastics are really very useful for the environmental protection. Thus plastics are inherent part of safety, health and environment. The history and innovation in this field, therefore, need to be looked into with different angle.

## Historical background

Today we are experiencing plastics and electronics revolution. Imagine life without mobile phones, computers, washing machines, polyester dress materials, credit cards, DVD players and so on which are 'high tech' items. The plastics indeed have played a major role in making these materials available to common man at affordable price.

If one looks at the history of organic chemical industry, modification of natural rubber, cellulose, shellac, cashew nut shell liquid (CSNL) etc were the major issues of research and manufacturing. However, once the polymeric or macromolecular nature of cellulose was understood, the growth of this industry is phenomenal.

First synthetic polymer, phenol-formaldehyde resin, was commercialized in 1909. Today the plastic consumption is several million tones per annum. This growth is within last 100 years. Amongst all these plastics, the growth of polyethylene, polypropylene, polystyrene, rubbers and PVC are noteworthy as these plastics occupy a very important place in common man's life.

## RUBBERS and POLYSTYRENE

Use of rubbers in tires, waterproof jackets or for coatings was of immense importance at the beginning of the twentieth century. Adolf Hitler had recognized that his rubber supply from Malaysia/ Singapore region would be seriously affected if war broke out. German scientists through innovative ways produced Polyisoprene, styrene-butadiene rubber and many other materials synthetically. The raw material for these organic materials was coal as crude petroleum source was not developed in Europe around those times. These innovative efforts and the technological advances taking place in later years have lead to the development of gasoline and petrochemical complexes based upon synthetic gas. Today such plants are commercially run in South Africa (Sasool ). Interestingly, the gas to liquid (GTL) technology has been adapted on Qatar. On June 6,2006, H H Sheikh Hamad Bin Khalifa Al Thani, Emir of the State of Qatar officially inaugurated the US $ 950 million, Oryx GTL plant which will produce 34000 barrels per day of liquid product consisting of diesel, naphtha and LPG. The base is Fisher-Tropsch process.

Using polystyrene in manufacture of transparent cassette covers and decorative coatings has come through only through innovative efforts coupled with imagination.

## PVC/Polyethylene/Polypropylene

PVC and Polyethylene have grown very rapidly over last few decades. Where does the ethylene come from? The distillation of crude oil into various fractions yields fractions of high boiling points. These fractions are cracked into low boiling point fractions for gasoline use. The bye-products of this operation are ethylene, propylene and C4 fractions. The catalytic reforming

yields benzene, toluene and xylenes (BTX). These six materials and methane/methanol are the seven fundamental blocks of the organic chemical industry which produces several products such as dyestuffs, pharmaceuticals, pesticides and many more. The petrochemical industry uses only 10 % of crude oil and plastics use only up to 3-4 %. Innovations are to develop the value added products from the bye-products and plastics have provided the lead.

Both polyethylene and PVC found immense uses in world war II. The main innovations came after the war was over. In the case of PVC, the manufacturing of commercial PVC was possible only after the introduction of plasticizer and thermal stabilizers. The production of PVC was 1 million pounds in 1936 while in 1985, it became 6 billion pounds. Such a growth is not without many innovations.

**PVC and Environment**

During manufacturing of PVC, exposure of plant personnel to vinyl chloride monomer (VCM) led to the lungs disorder. If the concentration of VCM is less than 500 PPM, it is acceptable limit. The innovative efforts in analytical and process control science made it possible to evolve a system which could monitor the concentration of VCM to less than 1PPM. Now there are no health problems to workers around the PVC production units across the globe.

Leaching of plasticizer, di-octyl phthalate, DOP, into water has resulting removal of PVC for use in water tanks. The alternate plasticizers and copolymers are in the vogue.

**Polyethylene/Polypropylene**

Polyethylene was invented accidentally by ICI scientists while studying the high pressure reaction between ethylene and formaldehyde. The white powder on the walls of reactor had melting point of around 110 C and insoluble in water. Its chemical formula was same as that of ethylene and density was less than that of water. The new product was low density polyethylene, LDPE. The reaction pressure was 2200 psi and temperature was 250 to 350 C. The innovations in fabrication of reactors to withstand such reaction conditions made it possible to commercialize this polymer. During war, it was found that this polymer served as an excellent waterproof and inert coating material on the signal cables. After the war, this application became less important.

The developments in polyethylene can be grouped due to innovations in materials and in processing techniques. The structure of LDPE was found to be highly branched. Innovations in controlling the branch length and the distance between the branches led to the technology of producing linear polyethylene at pressures as low as 300 psi and temperatures as low as

150 C. The resulting product melted at 130 C and had density of 0.96 gm/cc as against 0.915 of LDPE. It became known as high density polyethylene, HDPE. Innovations in copolymerization led to development of linear low density polyethylene, LLDPE which has density comparable with that of LDPE.

The real progress in the commercial growth of polyethylene took place due to innovation in the processing technologies. The development of film blowing techniques made available the thin film of uniform thickness of few microns. This opened up the markets for the food industry as an excellent material for packaging. The films were transparent, light weight and had very good barrier properties. It also opened the agricultural market sector for mulch films.

All of us are very familiar with the milk we receive in pouch. The one liter, half liter and smaller packs are used primarily in India. Until about 25 years ago, milk was packed in glass bottles of 250 mL and 500 mL capacity. The weight of 500 mL bottle was about 425 gm. Thus for packing every 500 mL of milk and delivering it to the consumer one has to carry dead weight of 425 gm each way i.e. from milk supplier to the consumer and back from consumer during returning of the empty bottle. Since plastic bag weighs about 10- 15 gm for packing 1000 mL of milk, the dead weight is reduced considerably and it is carried only in one direction— from the milk supplier to the consumer. This increases the milk carrying capacity of the milk van. The plastic crates are also lighter than the metallic ones. All this increases the milk carrying capacity of the milk van by about 250%. This saves the petrol and reduces the air pollution to some extent. The washing and cleaning of bottles using surfactants and large amounts of water is also avoided. All this is possible due to innovative packing system through thin film of plastic. The packing of edible packing in small pouches afforded by a poor person is feasible again due to plastic film.

**Environment and Plastic carry bags**

The good properties of plastic thin film have become its own enemy. THE CONVENIENCE OF THIN CARRY BAGS IS TOTALLY LOST DUE TO LITTERING. Disposal of plastic bags in conventional way is not possible. Use of additives to make polyethylene bags photo oxidizable and then degraded polymer suitable for composting is one solution being introduced and examined. Using good quality polyethylene/ polypropylene thin bags and other waste as a source of carbon and hydrogen for cement and steel industry is being examined for commercial uses.

Waste management of polymeric municipal waste is a challenge. Challenge is the right opportunity for innovation. The designing of recycling system for the buy-back operations of plastic goods needs lot of innovation in management for collection and usable form of waste plastic requires man power management. May be some Clean City Sena can be operated. Compacting the plastic waste can reduce the volume considerably and if this is carried out at different wards, it can save the precious fuel as the garbage van can take much more waste plastic when compacted.

**Few Other Points**

Polyethylene was always in short supply till 1990s. The thermoplastic nature of this material brought innovation — recycling. India is the first country to practice industrial recycling of plastic. The buy back system and 'declaration' about the use of recycled plastic was introduced in Western countries based upon this success. Many sought converting waste into usable recycled plastic as a business opportunity. Unfortunately many unethical practices closed this business. Today, China receives technically prepared good quality recycled polypropylene from countries other than India. This business is estimated to be to the tune of more than 1 million US $ annually. The roadside vendor who repairs the plastic bucket or container or bags etc by 'soldering' is certainly an innovation which has gone unnoticed. Perhaps this business could grow only in India.

**Conclusion**

Plastics are safe and can protect the environment. The waste disposal of mixed plastic wastes as well as e-waste requires innovative ways and means. The field is wide open to all of us. For innovation one needs alertness and open mind. Age, position or educational qualifications can become the barrier.

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**About Author**

**Dr. D.D. Kale**

**Former Professor UICT / Consultant.**

- B.Tech (Chemical Engineering), University of Nagpur
- M.Tech (Chemical Engineering), UDCT Mumbai
- PhD (Chemical Engineering), University of Salford, U.K

✓ Guided 28 PhDs and about 60 Masters students.

✓ Consultant to industries like Excel Industries, Balmer and Lawrie, Rainbow Inks, Tipco Industries, Rama Petrochemicals, Gharda Industries, Hindustan Lever Research Centre, Supreme Industries, Reliance etc.

✓ Published more than 80 papers in International Journals.

✓ Fellow of Maharashtra Academy of Sciences.

✓ Visiting Faculty in South Korea.

✓ Received Prof. K. S. Armugam National Award for Innovative Research in the Field of Engineering and Technology by the Indian Society for Technical Education (ISTE) New Delhi.

✓ Honorary Editor of Ind Chem Engg (1991 - 1994).

# Mastering Art of Innovations in Safety, Health and Environment

**Adarsh Kumar Sehgal**
*Vice President (Safety, Health and Environment)*
*ITD Cementation, Mumbai*

**Abstract**

It is a noticeable change that we observe about increased adoption of safety measures at construction projects. Apparently, this initiative is limited to a few socially responsible construction companies. Petty contractors, however, continue to work in the same old manner without any concern for human life and limbs. There is evidence of lack of disciplined working at such sites and it results in significant losses in terms of human life, time, money and reputation. Importance for inculcating and ensuring safety among construction workers has brought to fore dire need of innovations in safety, health and environment and the specific roles that the contractors and the clients can play. Strategies for improving safety conditions at construction sites range from incorporation of safety requirements in contract documents to setting example through responsible behavior at construction sites by the teams consisting of Clients, Consultants and the contractors. What the team needs to do is to set standards, innovate and sit back to appreciate neat looking and profitable sites.

## Introduction

It was interesting to read in the newspaper that a village in Thailand has employed monkeys in place of men to carry out a high-risk job. The villagers have trained the apes, to pluck coconuts from surrounding palms, who in turn train the little apes to do the job before they grow old. The cost is low – just a steady supply of bananas and nuts – and complaints are few, to say nothing of the worries over workers' safety. Apes now pluck coconuts from the surrounding palms and the village economy thrives.

Observe to innovate is the mantra emerging through out-of-the-box systematic thinking. Can we master this art at our construction sites where there is a dire and urgent need to prevent injuries?

## Status of Safety at Construction Sites

It is a well-known fact that at least 50 percent of the people the world over who die at construction sites have been working there for less than two weeks and 70 percent of fatal accidents could have been prevented by effective management action. Are we really concerned and doing all that it takes to prevent incidents? May be no, but probably yes; we are now talking about the safe / unsafe practices at sites to a certain extent because of two main reasons; one that we are being bugged by the multinational who are bound by their law and second that wisdom seems to be dawning on some of us and attitude seems to be changing for good. We have started to recognize importance of integrating safety as part of production. Awareness levels have gone up; there is coordination of efforts all around to provide safe, healthy and environment friendly working. Government agencies are on the move trying to put the legislative measures in place; contractors are making efforts to improve safety in their day to day activities thus adding to the bottom line and the workers have started realizing how important it is to follow site safety rules to prevent pain and suffering resulting from injuries.

Accidents, however, continue to occur. There is loss of life, limbs and property and costs are unbearable and sometimes unimaginable. Though many organizations have established systems conforming to OHSAS 18001;1999, the basic goal of continual improvement is simply forgotten. Our efforts, therefore, have to be much more serious and sincere in adopting and implementing systems. We can no longer give a lip service to the cause of safety and not indulge in excuses like non availability of trained manpower, absence of regulatory authorities and indifferent attitude of managers and construction workers. We need to innovate in making things happen and systems implemented.

## What Innovations Can We Introduce?

Innovations would mean introducing novel ideas to seek indulgence of each person at site in making operations safe and environment friendly. These may

vary from involving workers in carrying out critical study of each cycle of operations to nominating workers as safety captains within their own group to development through esprit de corps, training, team building, discipline and morale, empowerment and motivation of the managers, engineers and workers. Sub contractors are to be motivated as partners / comrades in all activities. Let us discuss these one by one.

**Changing Roles and Responsibilities**

We need leadership and personal example being set by the management of clients, consultants and contractors to impress upon the contractors, petty subcontractors, other agencies and workers that safety is a way of life and the sooner we adopt it, the more we would cut down on the wastages thus adding to bottom line. Leadership is a necessary management skill / quality for "Safe Working" and needs to be well understood, digested and assimilated.

So, whose responsibility is it? Who are to become leaders in this role of Safety? Is it only the principal contractor who is to lead and to be held responsible for all actions? There is no doubt that the contractor is the person to organize work and implement safe procedures but why can't this role be taken over also by the consultants / clients who are technically sound and have the where with all to perform this role effectively.

Today, many a consultants like General Consultants and clients like IOCL, DMRC, TATAS, NTPC and Reliance enforce safety by initiating a host of measures making it mandatory for the contractors to observe basic minimum safety standards. This has definitely improved working conditions at construction sites. There are also contractors who maintain minimum requisite safety standards of their own thus adding value to the way they work. As long as this continues, our safety standards shall continue to rise making our work place safer and healthier each day.

Wherever client / consultant is concerned only about quality and completion and not about safety, accidents keep occurring. Main problem lies in one's perception of whether safety is a part of quality. To me Quality would mean delivering a product that is sound, meets specified requirements and is produced in a safe manner.

How can the client and his consultant help? The client and his consultants can play a critical role in providing safer work environment by standardizing activities ensuring safety and protection of health. This can be achieved by: -

- Laying down safety standards that need to be followed during construction stage. These are generally included as a part of document under Special Conditions of Contract but what is required is ensuring implementation of the standards by: -
- Having pre contract discussions on implementation of safety and health
- Making the safety requirements as a BOQ item
- Ensuring co-ordination between various agencies/contractors working at the site through joint meeting chaired by senior Client / Consultant representative. This is presently being followed by the DMRC, TATAS at their site.
- Establishing and maintaining systems to ensure that tools and equipment being used by the contractors meet requisite standards.
- Last but not the least ensuring that a personal example is set by the engineers of the clients and consultants.

Clients, their consultants and the contractors are partners in construction. What we produce are the temples of modern India and in today's civilized society no one would like to build these temples at the expense of human life and limbs.

Specific Study of Each Cycle of Operational Activity

Safety cannot be ensured by merely appointing safety officers and making them face regulatory authorities. Also safety can not be talked about in general mentioning working at heights, around plant and equipment and in excavations or electrification housekeeping and so on. It would be of value to study each cycle of operational activity and correlate it with each worker's behaviour. Mistakes made by the workers, their unsafe acts and unsafe conditions, if created are to be noted and later discussed with the team of managers, engineers, supervisors and workers. All of them have to participate in the discussion and suggest remedial measures

Innovative Actions at Construction Sites

Safety of its own is intangible and shall come from within only if we build up discipline, esprit de corps and motivate the team. Training to a great extent shall help us achieve this but what shall make the team take initiative are their feelings of belonging, morale, empowerment and self-motivation. Let us see as to what actions we can take in developing above characteristics: -

- **Workers in the Lead Role.** Selected workers who have the enthusiasm to correct unsafe practices can be nominated as "Safety Captains" with the sole aim of ticking off fellow workers in their group as and when unsafe acts are performed or unsafe conditions created. Safety captains shall be very effective in taking preventive and corrective actions. Safety captains can be nominated in rotation and suitably rewarded. Enthusiasm is contagious and others shall easily catch it.
- **Morning Prayer.** A morning prayer by the group stating " May God give me strength to perform my duties in a safe manner so that neither my co-workers nor myself is subjected to any injury" shall enable the workers to attain spiritual strength and follow what is right. A mandir parade can also be organized once in a week at the workers colony.
- **Morning Exercise.** An exercise by the workers lead by a leader (Engineer / Supervisor) shall not only make the workers active and remove lethargy but also strengthen esprit de corps. This also provides an opportunity to each of the leaders to impress his own personality on the workers and motivate them.
- **Morning Briefing.** Workers should be briefed about their work for the day and a job safety analysis should be carried out involving workers.
- **Communications.** Communication of the targets, goals, achievements and injuries should be made to the workers as early as possible. This is a great motivating factor that makes him think that he is a part of the organization. His suggestions can be sought on preventive and corrective measures. Functions be held where experienced workers deliver lectures on safety and environment stating their achievements in that field.
- **Appreciating and Making Them Partners.** For all good actions like quality work, good house keeping and cutting down on wastages, there should be immediate appreciation to make them feel wanted.
- **Pain and Gain Policy.** Each site should formulate a policy of pain and gain – caution / penalty for violations and reward for being the best. Frequent violations should be recorded and person removed from site.

- **Impact of Incidents and Injuries.** Workers should be shown pictures of the incidents held at construction sites describing pain and suffering of the affected person and his family

- **Subcontractors' Training.** Principals of subcontractors (Petty contractors) should be called and explained as to what standards are expected of his workers. A pre bid meeting should be organized. A yearly training session should also be organized for subcontractors and his supervisors.

- **Protection of Environment.** Construction is a resource intensive activity and hence planning, designing and execution should lead to saving of resources and minimizing waste. Various activities that can help in saving resources are: -

  - In addition to storage, stacking and transfer of diesel, cement and steel, sites shall carry out housekeeping at least three times a day for 5-10 minutes each.
  - Wastages like concrete blocks be used for paving office and storage areas.
  - Use of wash water for dust suppression.
  - Recycling of water for curing purposes.
  - Use of stone dust from crusher for bitumen concrete.

- **Preventive Health.** Medical inspection, awareness campaigns, immunization programs, supply of drinking water, sanitation and supervised cooking facilities are a great morale booster for any one at a construction site in far flung remote area.

**Last Word**

It is no use complaining that we have poor safety standards because there are no authorities to enforce law. In fact it is our willingness to adopt and doggedly follow systems in vogue that really matters. We should become the law on to ourselves for betterment.

Monkeys have been trained to follow a system and that speaks for the success of village economy. Systems alone can never be enough. They are to be positively backed by an innovative creative edge supported by educated minds that can determine right from the not-quite-right (Chalta Hai). Each man at any construction site has a very important role to play in this aspect.

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**About Author**

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**Vice President (Safety, Health and Environment)**

**ITD Cementation, Mumbai**

- B.E. (Mechanical), College of Military Engineering, Pune
- M.Tech. (Energy), Indian Institute of Technology, Delhi
- MBA (HR), IGNOU, Delhi
- Advanced Diploma in Industrial Safety, MSBTE.

✓ Forty years of work experience.

✓ Contributed for Integrated Management System.

✓ Served as Colonel-Instructor Class 'A' at the College of Military Engineering, Pune. Served the Army for 31 years.

✓ As a Deputy General Manager Safety he has interacted with National Safety Council and Other Safety Organizations for implementation of statutory rules and regulations.

✓ Significant reduction in Accident Incident Rate in ITD Cementation, Mumbai because of the efforts put in by Col. A.K. Sehgal.

# Water Management
# Innovations in Environment Health and Safety

**Shankar Satam**
*General Manager (Sales and Service), GE India Industrial Pvt. Ltd.*

## Introduction

Preservation of future of our planet is an essential part of our values .We have to play our role to minimize impact on environment by conservation and optimization of various resources like water. In India this is more relevant as only 4 % of globally useful water is available for a population share of 17 % In fact, the United Nations Environment Program (UNEP) predicts that two-thirds of the earth's population will live in water-stressed conditions by 2025 if the current level of usage continues. In a world that depends on water for survival and yet wastes more than half of the water it uses - every effort to conserve nature's most valuable resource is crucial.

## The Reality

- 97% of the world's water is saltwater from sea and brackish water sources
- Less than 1% of the world's water sources is considered potable
- Water consumption is doubling every 20 years
- This rate of consumption increase is twice the rate of population growth
- By the year 2025 water demand is expected to exceed supply by 56%
- Political "water conflicts" and the need to be water independent have created regional water shortages
- Sustainable industrial development requires a reliable supply of high quality water
- Constructing new dams, reservoirs and long conveyance pipelines to tap the above 1% of limited potable water is becoming too costly to justify, environmentally prohibitive, and in many cases the source water is not adequate to accommodate the growing population needs.

Water scarcity is affecting a growing proportion of the world, with a third of people suffering from a shortage. These shortages are driven by factors including climate change, rising populations, increasing prosperity - which drives up water use and poor management of resources. Unless they are solved, we can expect a lengthening series of "water crises" .In a world of water crisis, businesses will face higher prices and competition from other users for the water they require, and increasing regulation of its use. Water is already one of the most heavily regulated sectors of the world economy.

## Approach

- Combination of conservation (Source Reduction) and Reuse.
- Treatment of waste for safe disposal.
- Environmental consciousness

Treatment of wastes to reduce environmental impacts prior to disposal should be used only when source reduction, and recycling or reuse, are not feasible based on technical and/or economic reasons. While conservation and education are the cornerstones for a water management strategy, technology is also starting to play a larger role in helping communities to get the most from increasingly limited water resources.

It is a good practice to adapt following guiding principles of Environment, Health and Safety (EHS) while deriving solutions.

- We take appropriate measures to the extent reasonably practicable to reduce the use and release of toxic and hazardous material, prevent pollution and conserve, recover and recycle material.
- Every one has obligation to maintain the safe environment for them and others.
- We are responsible members of community and recognize us as good neighbors

## Solutions

- Increase public awareness to promote and enforce water conservation.

- Repair pipeline leaks – water losses greater than 30% is not uncommon for developing countries
- Reduce water pilferage – install water meters.
- Water saving techniques for crop irrigation
- Increase the use of membrane desalination technology to treat seawater, unlimited feed water source
- Increase the use of membranes for the Reuse of Purified Wastewater

Water-saving techniques range from installing spray nozzles on taps in washrooms and sensors on urinals so they flush only when needed, to "grey water" systems that recycle water from sinks for use in flushing toilets, or porous pavements in car parks that collect water underground for similar purposes. Basic maintenance plays a big part: installing a water meter is the first step, while fixing a dripping tap and detecting leaks can do more.

Some people have qualms about recycling sewage into drinking water. But treatment technology today can produce water of high quality. Partially treated sewage can also safely be used for irrigation and in some industrial processes. An alternative is to use wetlands and reed beds, which filter sewage water naturally and create an environment for wildlife.

Farming uses 70 times as much water as cooking and washing, which means encouraging farmers to use only the water they need is a significant part of the solution. Solutions need not be high-tech: some crops requiring heavy watering are grown in unsuitable areas, and water unsuitable for drinking, such as brackish water or partially treated sewage, could be used for irrigation but frequently is not

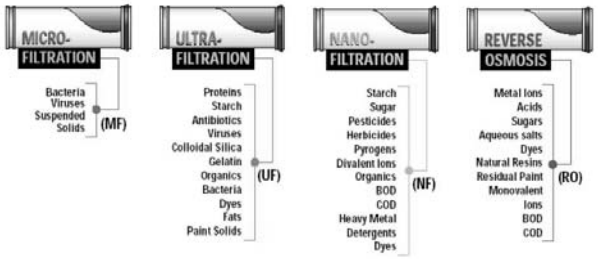
**Role of Membrane Technology**

At present, not enough of the world's water is recycled. Waste - water reclamation has become a viable alternative to supplement water supplies in water –short areas. In particular membrane technology is playing an important role in purifying water cost –effectively. The primary use for reclaimed water has been for irrigation, but increasing need to use reclaimed water for industrial applications has spurred interest in advanced water treatment processes based on membranes.

Membranes are widely used for water treatment in residential, commercial and industrial applications. The use of membranes to selectively remove or separate extremely small substances from water and process streams has become a technological success story. There are four types of membrane filtration technologies in commercial use today, effectively removing substances ranging in size from suspended solids to ionic species**. (Refer Diagram A)**

**Diagram A**

**Membrane Spectrum**




Membrane technology exists for last 50 years and is being used in India since last 25 years. However there are many innovations taking place on continuous basis to widen the scope of membrane use. Few of them are sited below.

- Development of Ultra Low pressure membranes, which reduces the operating pressure and hence energy.
- High Solid rejection membranes, giving better quality.
- Development of Low fouling and chemical resistance membranes.
- Development of new applications for recovery and reuse
- New generation chemicals to enhance the process efficiency and safety.

Advanced wastewater treatment processes incorporating reverse osmosis (RO) are becoming more common partly due to the trend towards using microfiltration (MF) and ultrafiltration (UF) pretreatment. The use of these low pressure membranes as pretreatment to a RO system has resulted in integrated membrane systems that have become more reliable, economical and easier to operate and maintain than earlier systems with conventional pretreatment.

**Benefits of Membrane Separation**

The membrane technology has number of advantages over conventional separation processes like physiochemical and chemical processes. Membrane separation is cleaner as it reduces the use of external reagents. They are more flexible to variation in feed parameters and impact of these variations is minimum. Few technologies, however, achieve the greater objective of economically extracting valuables from the waste stream and improving product quality and/or process efficiencies. These are the challenges that membrane technology undertakes.

We will briefly discuss with few examples of membrane applications, contributing to Environment, Health and Safety.

**Membranes for Drinking Water**

A significant portion of the Indian rural population does not have access to clean drinking water. This is a result of two challenges: water scarcity and water purity**.**

Chemical contamination is primarily due to

- Inherent geological formation
- Over exploitation leading to quality degradation
- Pollution from untreated industrial effluents
- Indiscriminate use of chemical fertilizers in Agriculture sector

The most widespread and significant naturally occurring waterborne toxics are arsenic and fluoride. The rather extensive presence of fluoride in drinking water in India is of great concern. Fluoride problems exist in 150 districts of 17 states in the country, Orissa and Rajasthan the most severely affected. Ill effects of ingestion of fluoride via drinking water range from skeletal Fluorosis (bones) to dental Fluorosis (teeth).

The presence of arsenic – a poison and carcinogen, in several states in India is also an area that needs immediate attention. The WHO estimates that at least 35 million people living in West Bengal, Bihar and Bangladesh are affected by arsenic. Health effects of arsenic include cancers of the skin, lungs, urinary bladder, and kidneys.

Membranes can be use to remove all the contaminants to make the water safe for potable.

**Membranes to Protect Environment**

Textile effluent streams are a complex of unfixed dyestuff, heavy metals, salt, surfactants, stabilizers and others chemicals. There are variations in quality on continuous basis. Conventionally physicochemical and biological processes are used to treat and dispose off the effluent. However, this leads to lot of solid sludge problem

Recycling water, recovering valuables, reducing energy cost and minimizing disposal fees are difficult tasks for conventional technologies. In addition, some textile dyes have been shown to possess carcinogenic properties, creating environmental and public health related disposal issues. Thus membrane separation technology is used to meet these challenges and concentrate/desalt the dyes without the use of chemicals and loss of dyes. Membranes also help in protecting environment, as solid sludge is not created.

**Membranes for safe reuse of waste water**

Over the past several years, membrane bioreactor (MBR) technology has been emerging as an efficient and cost-effective alternative to treating wastewater for water recycling and environmental protection. MBR process consists of a suspended growth biological reactor integrated with an ultra-filtration membrane system in hollow fibre configuration**. (Refer Diagram B)**

**Diagram B**

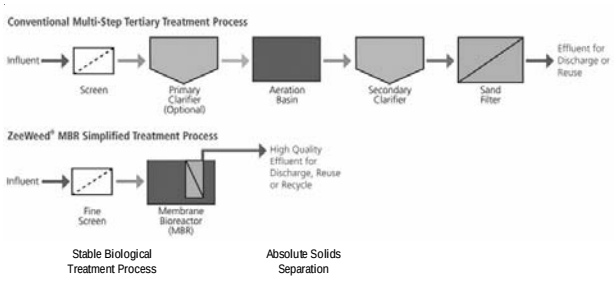
**Membrane Bioreactor (MBR)**

MBR process combines the unit operations of aeration, secondary clarifier and filtration**. (Refer Diagram C)** Simplifying operation, greatly reducing space requirement and gives consistent quality

suitable for recycling. The MBR process effectively overcomes the problems associated with poor settling of sludge in conventional activated sludge process .It permits bioreactor operation with considerable high mixed liquor solids concentration than conventional activated sludge systems, which are limited by sludge settling. MBR is typically operated at MLSS OF 10000-12000 mg/lit. The elevated biomass concentration allow for highly effective removal of both soluble and particulate biodegradable material in the waste stream.

**Diagram C**

**Simplifying Wastewater Treatment**




- Combines the physical barrier characteristics of a membrane with biological treatment
- Replaces conventional clarification, aeration and filtration

**Typical MBR treated quality.**

| Typical Effluent Quality | |
|---|---|
| Parameter | MBR Effluent Quality |
| $BOD_5$ | < 2 mg/L |
| TSS | < 2 mg/L |
| Ammonia | < 1 mg/L |
| Total Nitrogen | < 3 mg/L* |
| Total Phosphorus | < 0.05 mg/L* |
| Turbidity | <0.2 NTU |
| Fecal Coliform | < 10 CFU/100 ml |

Water recycling is another reason that MBR is becoming more widespread in water-short areas. The systems consistently produce high quality water that is near-drinking water quality, and is commonly reused in applications such as irrigation, toilet flush water, car washes, industrial manufacturing processes, and more. This water is also indirectly reused in potable water supplies either through groundwater recharge or by being blended into surface water sources such as rivers, lakes or reservoirs. Groundwater supplies in coastal areas can also be protected from seawater intrusion by injecting recycled water into coastal aquifers.

**Conclusion**

Water reuse is on the rise as global demand for the world's fresh water supplies increases. By recycling and reusing treated wastewater, we can save on the costs of clean water, ensure adequate supplies, and help to preserve a diminishing natural resource.

Management of our global water resources is vital to creating sustainable water supplies for potable, agricultural, recreational and industrial use. Municipalities and industries around the globe have come to rely on innovative products and services designed for operational efficiencies and cost-effectiveness. State-of-the-art membrane filtration technologies can offer water reuse solutions.

**About Author**

**S.B. Satam**

**General Manager (Sales and Service), GE India Industrial Pvt. Ltd.**

- B.E. (Chemical) from IIT, Mumbai

✓ Technology Head at Ion Exchange (India) Limited, Mumbai.

✓ Two-times winner of the prestigious “Eagle Award” for outstanding sales performance.

✓ Received the “Growth and Innovation Award” for his extraordinary contribution to promote membranes for water and wastewater recycle applications.

✓ A Water Technologist for over 25 years.

✓ Presented paper in national and International conferences.

✓ Member of Indian Desalination Association.

✓ Member of task force for drinking water mission.

# Behaviour Based Safety & Safe Attitude Encouragement

**P.M. Joshi**
*Manager Safety, Cabot India Ltd.*

**What Behaviour Safety is not?**

- A tool to blame workers for poor safety performance.
  - Example of Shivaji getting electrocuted
  - Example of laundry & not removing jammed material
- Replacing effective equipment design or safeguarding by "staying out of line of fire".
- Workers getting to work more carefully around hazards.
- Replacing good ergonomic programs by proper body position.
- Substituting noise control, chemical exposure by PPE.

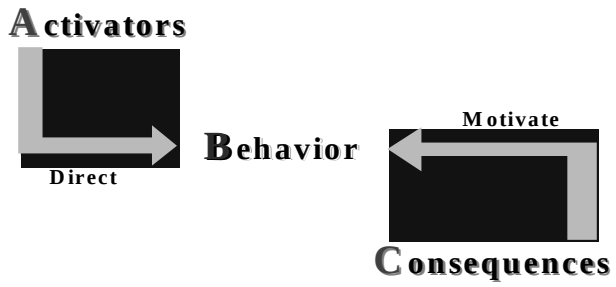
**Questions that made Experts think on Behaviour Based Safety.**

- Why people cross the railway tracks & not use FOB?
- Why people lean out from a running train?
- Why a person jumps over a trench, which has no cover?
- Why people do not always wear safety goggles?
- Why one person is a risk taker while other is risk averse?
- Why one maintenance engineer always goes by procedure and other goes by his gutfeeling?

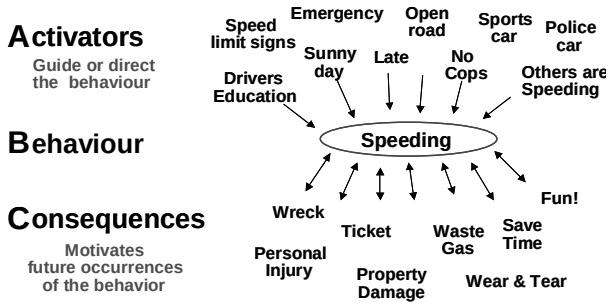
**Behavioural Indicators**

- Clean and tidy
- Smart appearance
- Attractive, up to date notices
- Good facilities
- Everyone treated the same
- People clean up litter, spills
- Manager's talk about safety
- Cheerful, constructive attitude
- Safe behaviour is normal
- Most work is planned and scheduled
- Litter, hoses, waste
- Dirty, worn-out overalls
- Tatty, out of date notices
- Old, damaged, overcrowded
- Second class citizens
- Managers talk about costs
- People walk by problems
- Sullen, resentful, unhelpful attitude
- Special clean-ups for visitors
- Lots of urgent unplanned work

**The ABC Model**

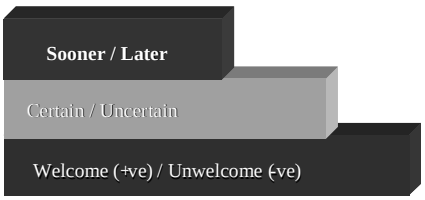



**The ABC Model – Example**



### Which Consequences?

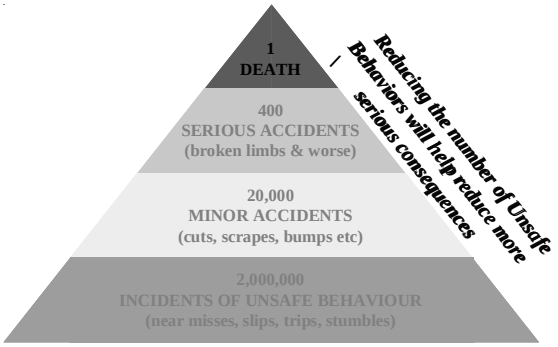
The can be consequences :




### An Example of Unsafe Behaviour

| Cause | Behaviour | Consequence | |
|---|---|---|---|
| Not available | Failure to Wear Eye Protection | Injury | L/U/- |
| In a Hurry | | Discipline | L/U/- |
| No one else does | | Saves Time | S/C/+ |
| Lack of training | | Comfort | S/C/+ |
| Scratched/Dirty | | Convenience | S/C/+ |
| | | Better | S/C/+ |

### Behaviour Vs Consequences




### What BBS Does?

- Modify or eliminate undesirable behaviour
- Replace undesirable behaviour with wanted one

### Change in Behaviour

How easy is it to change people's Beliefs, Thinking, Attitude?

We need to motivate them

### What Motivates People?

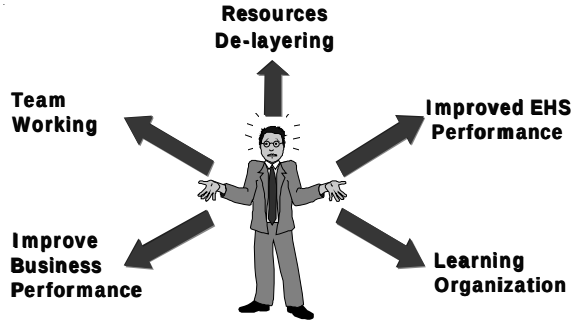
- Skills?
- Knowledge?
- Experiences they have?
- Recognition?
- Reward?
- How competent are they?

Communicate with them

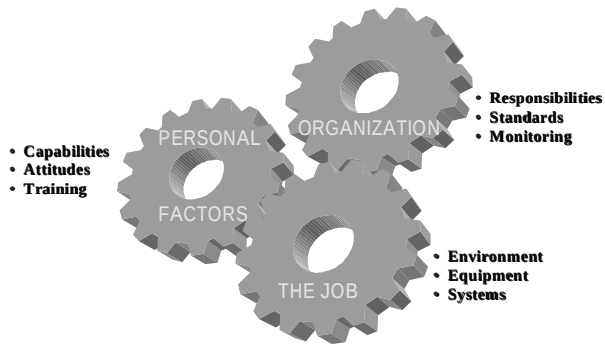
### How do we achieve this?

- Set a high standard
- Fix the small problems
- Ask WHY
- Spot checks and audits:
  - permit systems
  - operating procedures
  - training
  - tests and inspections
- Expect employees to use hearts and minds as well as muscles

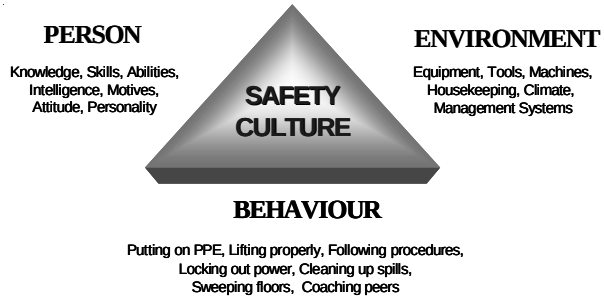
### Benefits of BBS




### Factors leading to safe performance



**Total Safety Culture**




**Safe Attitude Encouragement**

- People are the ones who get injured so focus attention on what people do
- List critical behaviour factors & conduct audits of employees by employees once you train them on the audit technique
- Two-way communication is essential in achieving safe behaviours
- Try to influence attitudes by:
  - Observing what they are doing
  - Discussing the possible consequences
  - Then encouraging them to change their behavior

**Most Important To Know**

- Only working on Behaviour Safety will not yield results or improved safety performance
- Hazard Recognition & Risk Assessment is of prime importance
- Walk The Talk by Leadership Team is must
- Removing unsafe conditions on a regular basis is a must
- Audits/inspections & corrective/preventive actions do help in safety performance improvement.
- Employees involvement in safety activities goes a long way to achieve safe performance
- A strong systemic approach combined with BBS is the solution to safe work environment.

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**About Author**

**P.M. Joshi**

**Manager Safety, Cabot India Ltd.**

- B.E. (Mechanical)
- MBA (Finance)
- Advanced Diploma in Industrial Safety
- Lead Auditor ISO 9000 and ISO 14000

✓ Achieved British Safety Council Five Star Award for Navin Fluorine Industries.

✓ Chairman, SHE Committee, Thane Belapur Industries Association

✓ Co-ordinator, Mutual Aid and Response Group, Navi Mumbai

# Innovations in Environment

**Suresh Kumar**
*HOD Technical Services, Gharda Chemicals Ltd., Chiplun*

Effluent treatment processes have undergone a sea change from earlier times. Effluent treatment plants need to be a increased in chemical industry for safe disposal of waste. ‘‘Prevention is better than cure’’. Following this principle, the aim of chemical processes industries should be to reduce effluents at source that is, recycle, reuse and recovery. Before letting out the effluent stream into the environment it is important to characterise and segregate it.

The innovative of effluent treatment, now in practice, are

- Salt solution concentration by mechanical vapor compression.
- Evaporators for salt solution concentration.
- Wet air oxidation of effluents
- Scrubber for fugivitve emission.

The emphasis of all the above technologies should be

- Water conservation
- Heat recovery and energy conservations

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**Suresh Kumar**

**HOD (Technical Services), Gharda Chemicals Ltd.**

- B.E. (Chemical) from KREC, Surathkal
- M.Tech (Chemical) from KREC, Surathkal. Stood first in the University.

✓ Expertise in new product design and commissioning.

✓ Looking after process improvements and de bottlenecking of the existing products.

✓ Taken various projects in energy conservation and improvement in environment.

# Role of National Safety Council in Overcoming the Emerging Challenges in Health and Safety of Construction Sector

**Girish Yadav**
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## Introduction

Construction sector is very essential and an integral part of infrastructure development which gives tremendous boost to our country's economy. Improvement in infrastructure without development in this sector is impossible. Construction becomes the basic input for socio-economic development. Besides, the construction industry generates substantial employment and provides a growth impetus to other sectors through backward and forward linkages. It is, essential therefore, that, this vital activity is nurtured for the healthy growth of the economy.

Across the world it is felt that safety in construction is a matter of concern. In India this is one of the most vulnerable segments of the unorganized labour in the country. The industry being highly labour intensive, safety should be comprehensively addressed at the national level. A large number of workers are exposed to the risks of workplace accidents and occupational health problems. The rate of fatal accidents in this sector is four to five times that of the manufacturing sector on the global scale as reported by ILO (International Labour Organisation). Hence, this sector needs greater attention in order to improve a lot to enhance its Safety and Health performance.

Construction sector in our country employs around 33 million people; hence, the issue of safety and health assumes importance. As per one survey conducted by ILO 165 per 1,000 workers get injured during construction activities. The workers are exposed to a host of hazardous substances, which have a potential to cause serious health & occupational diseases such as asbestosis, silicosis, lead poisoning etc.

## Back ground of the Construction Industry in India

The construction industry is characterized by the predominance of migratory and unskilled labour. A sample statistics of the industry is given as below:

| | |
|---|---|
| Annual turnover | Rs. 3921 billion |
| Contribution to GDP | 6.2% |
| Employment | 33 million workers |
| Engineers | 4.7% |
| Technicians & Foreman | 2.5% |
| Skilled Workers | 15.3% |
| Un-skilled Workers | 73.1% |
| Annual growth (Targeted) | 8% |

*Source*: CIDC Country Report 2005-06

## Observations and Inference

· Across the world it is felt that safety in construction is a matter of concern. In India this is one of the most vulnerable segments of the unorganized labour.

- The nature of work performed by the construction workers is highly hazardous in nature. Further, working conditions at sites are increasingly getting adversely affected by the use of new technology, hazardous chemicals and a wide variety of material handling and construction equipment.
- Employment relations are contractual and they exist for the project duration only. That is why permanent or semi-permanent systems or arrangements are not thought of.
- Many small contractors do not want to invest in training the workers employed by them particularly with regard to safety measures because of short-term relationship with them.
- The workers themselves do not ask for any safety measures lest this may affect their employment opportunity.
- To regulate Safety and Health measures at the construction sites the government of India has enacted a comprehensive Safety Legislation i.e. the Building and Other Construction Workers

(Regulation of Employment and Conditions of Service) Act, 1996 - (BOCWA, 1996) - which came in to effect from 1.3.1996 and the Central Rules, 1998 effective from 11.11.1998, and identified the Office of the Chief Labour Commissioner (CLC) to enforce the Act. Till today, a few states like Kerala, Tamil Nadu, Delhi, Gujarat and West Bengal have framed their state Rules and identified enforcement agencies. Other states are in the process of doing so.

- Because of these measures, status of safety and health in construction sector is showing some improvement in the recent past.
- In order to provide good safety standard at the sites, there is a need to take up training and awareness programmes vigorously. The training and skill development / certification programmes, should be upgraded both in terms of content as well as reach. To encourage such training, incentives both financial and non-financial may be offered to the contractors.
- There is no institutional framework to impart training at the worker's level, barring a few initiatives taken by Construction Industry Development Council (CIDC), National Safety Council (NSC) and some major construction companies. There is a need to build infrastructure so that the employers and workers have convenient access to these institutions.
- NSC has provided training to the enforcement officials to help them to upgrade their technical capabilities and understand various issues. This programme and refresher programmes should be conducted on a regular basis.
- There should be enough experts in the specific area of management of safety and health in construction industry.
- Till today, many construction companies do not have safety departments at their project site. The responsibility is just given to individuals who even do not posses adequate knowledge and experience in this field.
- Moreover, there is a shortage of professionals for the sector as many of the professionals are getting absorbed in factories and some are getting attracted by good salary and joining firms abroad.
- Good standards of safety and health in a construction project start with the decisions made by the client; this determines the whole safety and health climate of a project. Contracts need to be awarded on the basis of value for money and not on the basis of lowest tender. And value for money means a completed construction project that fits its purpose, fulfils user needs, and achieves a balance between quality and costs throughout its life. A poor safety and health performance not only adds to the client's costs but also undermines his reputation. It is important that clients treat safety, health and environment management at construction sites as any other business investment and integrate it with all other functions.

**Safety and Health Issues**

Being labour intensive industry, a large number of workers are exposed to the risks of workplace accidents and occupational health problems. Hence, Occupational safety and health problems are common in the construction industry. Also, the nature of works performed is highly hazardous in nature. The major types of accidents occur in the industry is:

- Fall from height
- Fall of materials
- Hit by vehicles/construction equipment
- Electrocution
- Collapse of earth

Further, working conditions at sites are increasingly affected by the use of new technology, hazardous chemicals and a wide variety of materials and equipment. Employment relations are contractual and they exist for the project duration only. Piece rate system of payment induces the workers to put in long hours of work. They live near the work sites without adequate housing, civic and other facilities. Difficult terrain makes it impossible for government inspectors or trade unionists to reach the construction site. In general, the work environment at construction sites is far from satisfactory, but no one seems to be bothered. Knowing that the labours are only daily wage earners, the contractors do not want to invest in training them with regard to safety measures. Besides, the workers themselves do not take their own safety seriously. In spite of its rapid growth, the sector maintains the traditional employment structure, a high labour turnover and a large proportion of small

firms operating with minimum outlay and capital. As a result, insufficient attention is paid to welfare, sanitation, first-aid, and health-care facilities. The speed at which the industry is developing, the safety and health implications are complex and need urgent attention due to the rapidly changing site operations.

**Legislation**

Despite of various safety related issues the coverage of laws and regulations is far below than the satisfactory. Though the government has enacted a comprehensive Safety Legislation; the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (BOCWA, 1996) which came in effect from 1.3.1996 and Central Rules, 1998 from 11.11.1998, but the enforcement has not taken its right shape. The government has identified the Office of the Chief Labour Commissioner (CLC) to enforce the Act. Till today, only few states like Kerala, Tamil Nadu, Delhi and Gujarat have framed their state Rules and identified enforcement agencies which indicates in many part of the country framing of state Rules and identify enforcement agencies are yet to be done.

**BOCWA, 1996**

**Applicability**

It extends to the whole of India and has come into force w.e.f. 1st March 1996. It applies to every establishment, which employs or had employed on any day of the preceding twelve months, **10 or more** building workers in any building or other construction work.

**Important Provisions of the BOCWA, 1996**

**Registration of Establishments : Sections 6 to 10**

Employer of every establishment should apply for registration within a period of 60 days from the commencement of the construction work for registration. Every employer shall make an application to the registering officer for the regulation of the establishment to which the Act is applicable along with the prescribed fees. The Registration officer will issue a certificate of registration to the employer to enable him to employ building workers.

**Hours of Work, Welfare Measures and Other Conditions of Service of Building Workers : Sections 28 to 37**

These Sections deal with fixing hours for normal working day, wages for overtime work, maintenance of registers and records prohibition of employment of certain persons in certain building or other construction work with welfare measures such as supply of wholesome drinking water and temporary living accommodation, crèches (where more than 50 female workers are employed), first aid, canteens (250 or more building workers are employed) and other conditions of service to all building workers. The registers and records relate to particulars of building workers employed, the work performed by them, the number of hours of work, the wages paid to them, etc. and the notices in the prescribed form containing the prescribed particulars. Employment of deaf persons, persons with defective vision, or persons with a tendency to giddiness are prohibited to work in any such operation of building or other construction work which is likely to involve a risk of any accident either to the building worker himself or to any other person.

**Safety and Health Measures : Sections 38 to 41**

These Sections deal with Safety and Health measures in the construction establishments. The provisions include – constitution of safety committee and appointment of safety officers, notice of certain accidents, empowering appropriate Government to make Rules for the safety and health of building workers and framing of Model Rules for safety measures.

In every establishment wherein 500 or more building workers are employed, a Safety Committee has to be constituted and Safety Officer(s) should be appointed. In case of certain accidents, which cause death or bodily injury by reason of which the person injured is prevented from working for a period of 48 hours or more immediately following the accident, or which is of such a nature as may be prescribed, the employer should give a notice to the prescribed authority in a prescribed form within a prescribed time.

Sec. 40 empowers the appropriate Government to make Rules concerning safety and health of building workers and the equipment and appliances necessary to be provided to them. Such Rules may provide for all or any of the following matters:

- safe means of access to workplace
- precautions in demolition under supervision of competent person

- Safe handling or use of explosives under the control of competent person.
- Erection, installation, use and maintenance of transport equipment and appointment of competent persons.
- Erection, installation, use and maintenance of hoists, lifting appliances and lifting gear; testing and examination; appointment of competent persons.
- providing adequate and suitable lighting of every workplace and approach thereto, of every place where raising or lowering operations with the use of hoists, lifting appliance or lifting gears are in progress and of all openings dangerous to building workers.
- Precautions to prevent inhalation of dust, fumes, gases or vapours, secure and maintain adequate ventilation.
- Measures to be taken during handling, stacking or Unstacking of materials.
- safeguarding of machinery
- Safe handling and use of plant and tools and equipment operated by compressed air.
- Precautions to be taken in case of fire.
- Limits of weights to be lifted or moved by workers.
- Safe transport of workers.
- Steps to be taken to prevent danger to workers from live electric wires or apparatus.
- Keeping of safety nets, safety sheets and safety belts.
- standards to be complied with regard to scaffolding, ladders and stairs, lifting appliances, ropes, chains and accessories, earth moving equipment, etc.
- Precautions with respect to pile driving, concrete work, hot asphalt and demolition operations.
- Preparation of a policy relating to steps to be taken to ensure the safety and health of the building workers, the administrative arrangements there for and the matters connected therewith.
- To furnish information to the Bureau of Indian Standards regarding the use of any article or process covered under the BIS Act, 1986 in a building or other construction work.
- Provision and maintenance of medical facilities for building workers.
- Any other matter concerning the safety and health of workers working in any of the operations being carried on in a building or other construction work.

Sec. 41 empowers the Central Government to make model rules after considering the recommendations of the expert committee constituted under Sec.5. It also prescribes that the rules made by the State Governments under Sec. 40 shall so far as practicable to conform to such model rules.

**Inspecting Staff : Sections 42 to 43**

These Sections empower the Central/State Government to appoint Director General of Inspection, Chief Inspector of Inspection, respectively through a notification, which shall be responsible for laying down the standards and monitoring the activities of construction establishments. Further, the appropriate Government may also appoint by notification such number of its officers, as it thinks fit to be inspectors for the purpose of this Act under Director General/ Chief Inspector. Inspectors have the powers: enter any premises / place where building work is carried out for the purpose of examining the register or record or notices, examine any person at the place where he inspects, require any person to give any information with respect of the names and addresses of the person to whom the building or other construction work is given out or received and with respect to payment to be made for the building and other construction work, seize or take copies of any register, record of wages or notices or portion thereof as he considers relevant in respect of an offence under this Act, and exercise such other powers as may be prescribed.

The Act specifies the appointment of Director General, Chief Inspector and Inspector by Central Government and State Governments. Director General of Inspection is responsible for laying down the standards of Inspections for all establishments for which Central Government is the appropriate Government and for states the Chief Inspector of Inspection of Building and Construction is responsible for effectively carrying out the provisions of the Act. Both the Governments appoint Inspectors for the

purpose within local limits as they are subject to general control and supervision of the Director General or the Chief Inspector, as the case may be. The Inspectors have the powers to enter at all reasonable hours any premises or place for the purpose of examining any records required to be kept under the Act.

**Special Provisions : Sections 44 to 46**

Special Provisions deal with responsibility of the employer- for providing constant and adequate supervision and taking all practical steps necessary to prevent accidents, for payment of wages and wherever applicable for payment of compensation as per the Act. Also this Chapter places a duty on employers in filing notice of commencement of building and other construction work within 30 days before the commencement of the said work to the Inspector having jurisdiction of that construction area and whenever any changes occur in the particulars furnished in the notice, the same shall be intimated to the concerned Inspector within two days. The notice should contain: name and location of the place where the building or other construction work is proposed to be carried on, name and address of the person who is undertaking the building or other construction work, nature of work involved and the facilities, arrangements for storage of explosives, if any to be used, number of workers likely to be employed, name and designation of the person who will be in overall charge, approximate duration of work, etc.

An employer shall be responsible for payment of wages to each building worker employed by him or his contractor and such wages shall be paid on or before the prescribed date. He is also liable to pay compensation in case of death or disablement in accordance with the provisions of Workmen's Compensation Act, 1923. In case a contractor is involved, such payment can be recovered from any amount payable to the contractor.

An employer shall, at least 30 days before the commencement of any building or other construction work send or cause to be sent to the Inspector having jurisdiction in the area where the proposed building or other construction work is to be executed, a written notice containing:

- the name and location of the place where the building or other construction work is proposed to be carried on;
- the name and address of the person who is undertaking the building or other construction work;
- the address to which communications relating to the building or other construction work may be sent;
- the nature of the work involved and the facilities, including any plant and machinery, provided;
- the arrangements for the storage of explosives, if any, to be used in the building or other construction work;
- the number of workers likely to be employed during the various stages of building or other construction work;
- the name and designation of the person who will be in overall charge of the building or other construction work at the site;
- the approximate duration of the work;
- Such other matters as may be prescribed.

Where any change occurs in any of the submitted particulars the employer shall intimate the change to the Inspector within two days of such change.

**Penalties and Procedure : Sections 47 to 55**

Under this Chapter, contravention of provisions of any Rules made under Section 40 of the Act with regard to safety and health measures shall be punishable with imprisonment for a term which may extend to three months or with fine which may extend to Rs. 2,000/-, or with both. In case of continuing of such contravention, an additional fine which may extend to Rs. 100/- for every day of contravention after conviction for the first such contravention. For subsequent conviction of the same offence within a period of two years the employer shall be punishable with six months imprisonment or with a fine of not less than Rs. 500/-, which may extend to Rs.2,000/- or with both. Similarly penalties are prescribed for other contravention of provisions under some other provisions. The Director General may impose the penalty / Chief Inspector after following the procedure laid down in the Act

Where an employer fails to give notice of the commencement of the building or other construction

work, he can be punished with an imprisonment up to three months or with fine up to Rs. 2,000/- or with both. For obstructing an Inspector in the discharge of his duties the punishment can be up to three months imprisonment or fine up to Rs.1,000/- or both. No person can be punished twice for the same first offence; more punishment is for repeat offence. Appeal against imposing of a penalty can be made within three months from the date of the Order of the penalty to the Central or the State Government as the case may be.

**Miscellaneous : Sections 56-64**

The Central Government is empowered to give directions to a State Government or a Board as to the carrying into execution in that State of any of the provisions of this Act. Under Sec. 62 the appropriate government is empowered to make Rules, after consulting the expert committee for carrying out the provisions of the Act, especially on 33 matters mentioned in the Section. These matters include: first-aid facilities, canteen facilities, welfare measures, qualifications and duties of safety officers, the form of notice of accident, the rules to be made for the safety and health of building workers, the qualifications and experience which the experts or agencies employed under sub-section (2) of Sec.43 and the terms and conditions on which such experts or agencies may be employed, etc. Sec. 64 provides for repealing of the BOCW, etc. Third Ordinance, 1996 and to save the action taken or thins done under that Ordinance.

**Accident Scenario**

As the sector is unorganized and enforcement has not yet started to its fullest extent, there is no accident reporting system followed by the construction companies and hence, there is no reliable and accurate statistics for the sector. Many accidents are settled by the contractors at the local level so not reach to the enforcement agencies. However, 8 fatal and 1 major accidents were reported during the period of 2003-05 (as reported by CLC). Whatever, reported by the office of the CLC is far below than the realities of the industry.

**Challenges**

It is a bit satisfaction that safety and health have improved significantly in construction. The hard part is that we still have a long way to go. Only major construction companies in our country has gone beyond statutory requirements and formed safety cell at their corporate offices which coordinates with the site operations in order to improve the safety management. But still it needs to be extended to all part of the country through various agencies. In order to provide good safety standard at the sites, there is a need to expand the training and skill development / certification programmes, both in terms of content as well as geographical reach. To encourage such training, incentives may be provided to contractors for funding the skill up gradation of construction workers. However, there is no institutional framework to impart training at the worker's level, barring a few initiatives taken by Construction Industry Development Council (CIDC), National Safety Council (NSC) and some major construction companies. There is need to impart training for the construction workers to bridge the demand-supply gap for skilled labour force. Also, the living conditions and sanitation, quality of drinking water, education for the children of the building workers and access to the good medical facility are to be improved a lot in order to improve the social status of the workmen.

Government has taken some measures to address various Safety issues in the BOCWA, 1996 and Central Rules, 1998. There is a provision in Section-39 (b) (v) of the Act to provide training of the workmen engaged in construction work, which are to be ensured by the construction companies.

**Inferences**

Role of NSC in improving Safety and Health in the Construction sector

**Launching of New Initiative for the sector**

Based on the above facts and figures, NSC has decided to focus its effort to improve Safety and Health for the sector. Considering its infrastructure and core competency it is in better position to give thrust in this direction. Accordingly, the Board of directors in its 121$^{st}$ Meeting held on 8$^{th}$ August, 2003 decided to constitute a Task Force. The Task Force has decided various packages of services.

**Focus**

- To facilitate and accelerate the implementation of the new Legislation.
- To develop and offer services to industry to accelerate and facilitate implementation of the statutory provisions.

- To enhance of technical competence of the enforcement agencies, industry and safety professionals.
- To provide services such as training, information, safety audits and OHSMS guidance this will enable the industry to comply with the statutory provisions.
- To create willingness in the industry to avail of the NSC services.

**Strategy**

A multi-pronged strategy is necessary to involve the three main key players - the enforcement agencies, the construction companies and the safety professionals. For a meaningful impact, it is necessary to at least address the important basic needs of the three main key players and develop prototype services for them. Accordingly, a holistic strategy has been developed.

- Targeting key groups - enforcement agencies, construction companies and safety professionals for need identification.
- Providing training to enforcement agencies for effective enforcement of the statutory provisions.
- Creating awareness in the sector for statutory compliance.
- Supporting industry for its long-term commitment to enhance safety culture through training, information and consultancy services.
- Introducing appropriate motivational measures like launching of a separate Safety Awards Scheme for the sector.
- Collaborating with major construction companies for implementing the Initiative.
- Enroll construction companies as corporate members of the Council.

**Packages of Services**

Developing Manuals for Enforcement Agencies and Construction Companies.

- Designing Training programmes for Enforcement Agencies.
- Designing and conducting specialized and in-plant training programmes.
- Conducting safety audit for companies executing projects.
- Developing publication materials like safety posters, stickers, instruction cards etc.
- Instituting separate Safety Awards for the sector.

**Major achievements**

- Prepared a Training Manual on **"Effective Enforcement of the Building and Other Construction Workers (Regulation of Employment and Conditions of Services) Act, 1996 and Central Rules, 1998"** for Enforcement Agencies.
- Developed a Training Manual on **"Occupational Safety and Health Management System"** for trainers as per the new Safety legislation.
- Drafted a Training Manual on **"Occupational Safety and Health Management System based on statutory provisions under the Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and Central Rules, 1998"**.
- Prepared a Training Manual on "**Safety in Scaffolding and Working at Heights"**.
- Designed an 8-day Specialised Training Programme on **"Effective Enforcement of the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Central Rules, 1998"** conducted in NSC Hqs. for 24 Labour Enforcement Officers (Central) from 22nd to 31st December, 2003.
- Conducted public training courses for construction employees

- Conducted 32 in-plant training programmes for around 1500 employees comprising Civil Engineers, Supervisors and Workers at various construction sites.
- Extended support to AFCONS in their long-term commitment to enhance safety culture across the Company
- Extended support to ABB Ltd. with six locations across the country in stimulating safety awareness and setting up of an effective safety management programme in their locations and project sites.
- Conducted 12 safety audits on construction safety for various organisations on their project sites.
- Launched a separate Awards Scheme for the sector from the Awards Year 2005.

**Conclusion**

Good standards of safety and health on a construction project start with the decisions made by the client; this determines the whole safety and health climate of a project. Too many contracts are awarded on the basis of lowest price tenders, only to see the final price increase significantly through contract variations, failure to meet quality standards or time deadlines. Contracts need to be awarded on value for money grounds, not lowest price tenders. And value for money means a completed construction project that fits its purpose, fulfils user needs, and achieves a balance between quality and costs throughout its life. A poor safety and health performance not only adds to the client's costs but also undermines its reputation. It is important that clients treat construction like any other business investment.

While selecting contractors, clients should take the following occupational safety and health issues into account:

- the contractors' experience;
- their safety and health procedures, for example policies and procedures;
- knowledge and qualifications of both managers and staff, including knowledge of applicable legislation;
- past safety and health performance, including accidents;
- provision of safety and health supervision, management and training for both managers and employees;
- safety and health management systems used;
- arrangements for consulting with their workers;
- selection procedures for sub contractors;
- Membership of relevant trade or professional organisations like NSC, CIDC etc.

To ensure there is enough time to plan, specify and schedule the project as safely as possible, key players – such as the designer, safety and health coordinator and the contractor – should be appointed as early as possible.

**About Author**

**Girish Yadav**

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- B.E. (Mechanical) from VJTI, Mumbai
- PGDISEM (Industrial Safety & Environment Management) from NITIE, Mumbai.
- EMS Lead Auditor IS / ISO 14001:2004
- OHSMS Internal Auditor IS 18001:2000 and OHSAS 18001:1999 Lead Auditor ISO 9000 and ISO 14000

✓ Worked as Executive Engineer – Production in Thermax Ltd., Pune

✓ Worked as Assistant Manager – Safety & Environment in ACC, Himachal Pradesh and Uttar Pradesh Divisons.

✓ Played a major role in obtaining MoEF Environmental Clearance for Expansion project for ACC.

✓ NSCI Awards Mgt, Safety Training, OHSMS IS 18001:2000 Consultancy, Safety Audit, Other NSCI Consultancy.

# Fire Protection System in the High Rise Building

**V.M. Vaidya**
*CFO, Thane Fire Station*

Now a days In Mumbai & an around the city people are leaving in a High rise building. In thane city also because of land scare city people are going vertically and vertically. Because of strict norms there is no options left for developers to go vertically. That is why all developers are constructing tall buildings in and around the city. Staying in High Rise building definitely you will get good comforts but at the same time you must know the physical aspects of the High Rise building and important factors of the building are design & construction as well as inbuilt system of Fire Fighting.

**1) Definition of the High Rise Building: -**

Accordingly Thane city's development control Rules 25 mtrs. and above all the buildings it comes in the category of High Rise building. In Mumbai definition of high rise building is 24 mtrs. and above where as other part of the country is 15 mtrs. above. 15 mtrs. & above it is as per National Building code.

**2) Open Space: -**

25 mtrs. and above all the Residential building must have 6 mtrs. open space for easy manure verbility of Fire applicances. As the height of High Rise building increases the open space will also increases. But, minimum 6 mtrs. around the building is absolutely necessary. This open space is only reserve for Fire appliances. No private vehicles are supposed to park within the open space.

**3) Means of Escape: -**

A single enclosed staircase having width of 1.2 mtrs. must be provided. Trades are 10 inches in width and rises are of 6 inches in high for proposed staircase of proposed building allows movement of fresh lighting for the staircase of High Rise building must be connected to standby electric supply.

**4) Means of Entry: -**

Two lifts which are attached with each other are proposed in the High Rise building out of two passenger Lift one lift is High Speed lift. (Fire Lift)

Planning & Design of the Lifts shall be in accordance with latest National Building code (i.e. section 5, Installations of Lifts and Escalators.)

Lift of the building are to provide with automatic speed doors for Lift cars and Landings.

One lift in building shall be designed and designated as Fire Lift. This lift shall be equipped with Fireman's switch for grounding it in the event of emergency. Lift car doors shall have fire resistance of 2 hrs.

Lift must be connected to standby source of power supply.

Power supply to Fire Lift must be automatically trip over type to the alternate source at power supply in the event failure of normal power supply.

**5) Refuse Area: -**

25 mtrs. and above every after 5 floors refuse Area must be provided for assembly point. This refuse area is kept open for ever For Fire Brigade personnals. This refuse area is free of F. S. I. in refuse Area there must be a provision of sufficient Light and Drinking water.

**6) Electric Cable, Shaft & Electric Meter Rooms: -**

Electric Cable shaft shall be exclusively used for electric cables and shall not open in the staircase enclosure. Electric meter Rooms shall be provided at stilt floor level. They shall be adequately ventilated Electric shaft shall be sealed at each floor level with non combustible material such as vermiculite concrete.

Inspection door for the shaft if provided shall have two hrs. Fire resistance.

**7) Escape Route Lighting: -**

Escape route lighting (Staircase & corridor Lights) shall be an Independent circuit as per rules.

**Fire Fighting Equipment: -**

**Underground water Storage Tank:**

An underground water storage tank of not less than 1, 25, 000 Ltrs. capacity for the proposed each building exclusively for fire fighting shall be provided at ground level as location marked on the plan. As per the design specified in the rules with battle walls & fire brigade collecting breaching. Underground tank shall be connected to wet risers & courtyard hydrant system.

**Overhead (Terrace) Water Storage Tank:**

Another tank of 20000 Ltrs. capacity shall be provided at terrace level for each building. The design & layout of this tank shall be got approved from concerned department prior to its erection. The tank shall be connected to wet riser through a booster pump through N.R. Valve & gate valve.

**Wet – Riser:**

One wet-riser of internal diameter of 15 cms of G.I. 'C' class pipe shall be provided for each building in the duct adjoining the staircase with twin hydrant outlet & hose- reel on each floor in nitches in such a way as not to reduce the width of corridor. Pressure reducing discs or orifices shall be provided at lower level so as not to exceed pressure of 5.5 kgs. /cm2. A fire service inlet on the external face of the each building bear the static directly fronting the courtyard shall be provided to connect the mobile pump of fire service to the wet riser.

**Fire Pump & Booster Pump:**

a. Wet riser of each building shall be connected to a fire pump at ground level of capacity of not less than 2400 LPM capable of giving pressure of not less than 3.2 KG./Cm2 at top most hydrant.

b. Booster pump of capacity 900 LPM giving a pressure of not less than 5.2 kg./cm at top most hydrant outlet at the wet-riser shall be provided at the terrace level of each building.

c. Electric supply (normal) to these pumps shall be on independent circuits.

d. Stand by pump of equal capacity shall be provided.

e. Separate pumps shall be proposed for separate U.G. Tanks.

**External Hydrant:**

Four external hydrants shall be provided for the each building within the confines of the site on the wet Riser at location marked on the plan.

**Hose Reel:**

Near each internal hydrant of each building hose reel shall be installed. Each hose reel tubing terminating in to shut off nozzle of 5 mm outlet. Hose reel shall be connected directly to the risers & it shall confirm to the latest codes 8090.

**Hose Boxes:**

Near each internal and external hydrant of each building hose boxes to be provided. Each box shall be equipped with 2 x 15 meter length of 63 mm rubber line hose along with standard branch pipe. It shall confirm to latest IS code 636 & 903 respectively.

**Portable Fire Extinguishers:**

The following portable extinguishers shall be provided at the electric meter room (Service) at ground floor level /stilt & at lift machine room at terrace level of all the buildings.

i. D.C.P. type fire extinguishers of 5 kg. capacity with ISI marks. -1 No.

ii. Buckets filled with dry clean sand – 2 Nos.

**Fire Alarm System:**

All the buildings shall be provided with manual fire alarm system with main control panel at ground floor level & pillboxes & hooters at the each upper floors level. The layout of the fire alarm system shall be in accordance to the Indian Standard Specifications.

**Fire Control Room:**

Fire control room shall be proposed on the ground stilt floor level of the each building. The size of the fire control room must be adequate for housing all indicating / control equipment for the fire alarm system, public address system, intercom system and also for the displaying the plans of all the floors of the each building.

**Sprinklers: -**

**Automatic Sprinklers: -**

As proposed basement area is more than 700 sq.ft.mt.whole basement shall be sprinkler with latest IS specification design and lay out of the sprinkler system shall be dot approved by Chief Fire Officer.

| DON'T'S | DO'S |
|---|---|
| Don't run in panic. | Raise alarm or shout 'FIRE' at the peak of your tone, if you notice fire within your vicinity. |
| Don't take undue risk. | Approach the scene within the quickest possible time. |
| Don't tamper with any machinery during fire fighting. Leave them for authorized handling. | Try to attract others attention as far as possible on your way to the scene of fire. |
| Don't argue or discuss on the scene of fire. | If you are first to reach make sure that no life is trapped. |
| Don't linger with the equipment. If you don't know its operation, keep away or ask some one nearby. | Try to put off the fire with the nearest appropriate type of extinguishers. |
| Don't throw sand on machinery parts. Use C02 or dry powder instead. | As other rush to the scene tell them what the type is and which extinguisher to be use. |
| Don't flood the affected area with water unless required. | Do arrange to put off the supply in case of electrical fires. |
| Don't crowed the scene of fire. | Do not take any chance. Dial '101' and give exact location. |
| Don't close the valve of a flammable gas cylinder of fire. | Open all doors and windows after the fire is completely extinguished to avoid inhalation of any fumes. |
| Don't resort to breaking cutting unless required. | Keep yourself posted with information from time to time. |
| Don't use all the types of extinguishers on one fire. | |
| Don't use water on oil, Electrical and metal fires. | |

**About Author**

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- B.A.
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✓ Member of Local Crisis Group, District Crisis Group

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✓ Frequent interaction with the Mutual Aid Response Group meeting with different hazardous companies.

# BLEVE and Modern Trends of Control

**D. B. Kamble**
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**Abstract:**

This paper outlines the basic principles and mechanism of boiling liquid expanding vapour explosion (BLEVE) for liquefied petroleum gas. The bleve is considered as the most dramatic and potentially dangerous event, which can occur in, liquefied petroleum gas facility. Mexico disaster is well known in the history for the effects of the bleve.

The consequence of the bleve has been discussed to understand its various effects like generation of fireball, explosion overpressures and missiles/fragmentation .The various cases of heat radiations for 1% fatality are also discussed. Various modern trends to eliminate bleve have been given in this paper for increasing safety and reduction of societal risk.

## Introduction

A bleve is an explosion resulting from the failure of the vessel containing a liquid at a temperature significantly above the boiling point of the liquid at normal atmospheric temperature. The bleve can be flammable or nonflammable. The nonflammable bleve can produce two effects viz blast due to the expansion of the vapour in the container and flashing of the liquid and fragmentation of the container.

Generally BLEVE's are more commonly associated with the release of flammable liquid from the vessels such as a consequence of the external fires. Such bleve can produce buoyant fireballs whose radiant energy can burn the exposed skin and ignite the nearby combustible materials. As per NFPA, bleve is defined as failure of a major container in to two or more pieces, occurring at a moment when the contained liquid is at a temperature above its boiling point at the normal atmospheric pressure.

### Causes of BLEVEs

Three different causes of vessel failures have been responsible for Bleve.

- Excessive internal Pressure
- Mechanical Damage due to impact
- Overheating due to external fire

Excessive internal pressure will occur, if the vessel is full of liquid, or the temperature of liquid increases and there is no relief device on the vessel. Vessel rupture due to the latter cause is very rare since numerous design codes specify the provision of relief valves.

In the history few bleves are occurred due to mechanical damage to pressure vessels, particularly damage caused to tank trucks and rail wagons involved in the accidents and derailment. In some cases, the forces imposed by the accident on the pressure vessel were sufficient enough to cause immediate rupture of tank. The most common cause of vessel failure that results in the bleve is over heating of the vessel. At ambient temperature, a pressure vessel is easily capable of with standing the pressure exerted by its contents. However, if the temperature of the shell of the vessel increases due to contact or impingment of the external flames, the shell begins to loose its strength. The relief valves provided on the vessel are capable of limiting the pressure rise with in the vessel to approximately 121% of the vessel design pressure even if the flames engulf the vessel (As per API-521). During this process if the temperature of some localized area of the shell becomes too hot, then the vessel can rupture violently, even though the pressure with in the bullet is marginally higher than the design pressure of the vessel.

## Mechanism of Bleve

Imagine a case wherein a Horton sphere containing liquefied petroleum gas up to 80% level is engulfed in the fire due to formation of liquid pool near the bottom of the sphere. During bleve phenomenon, three mechanisms are responsible for increasing the internal pressure.

1. LPG has a high coefficient of cubical expansion. The increase in the volume of LPG is directly proportional to the temperature of the liquid. As

temperature goes up during heating from flame engulfment, the volume of the liquid inside the sphere will increase and the level inside sphere will rise further. This will compress the LPG vapour inside the vapour space of the sphere.

2. The vapour pressure of the liquid is directly proportional to the temperature of liquid as given by Antoine equation. As temperature of liquid goes up, the vapour pressure of LPG will also go up resulting in further compression of the vapours in the vapour space of the sphere.

3. The LPG vapour in the vapour space follows the ideal gas law. As the temperature goes up and volume get compressed, the pressure will go up many folds.

During the heating of the vessel, the wetted surface of the vessel absorbs heat whereas unwetted vapour space will not able to absorb heat. The temperature will rise at a steeper rate in the unwetted area of sphere resulting in the failure of the vessel. Before Horton sphere rupture, the liquid inside the Horton sphere is in equilibrium with the saturated vapour. If the Horton sphere ruptures, vapour is vented and pressure on the liquid drops sharply. Upon loss of equilibrium, the LPG liquid will flash at vapour liquid interface as well as liquid- container wall interface and depending on temperature throughout the liquid. Depending on the liquid temperature, instantaneous boiling will occur through out the bulk of the liquid. This will result in large vaporizations of liquid in milliseconds. Instantaneous boiling will occur and due to source of ignition, the vapour cloud will get ignited .The liberated energy in such cases is very high resulting in the generation of high blast overpressures and generation of vessel fragments at high velocities and resulting in the propulsion of the fragments over very long range. The fireball generated will lift off and give intense thermal radiation causing bur injuries and secondary fires.

Consequences of Bleve

There are three basic consequences of the Bleve of liquefied petroleum gas:

1. Very intense thermal radiation from the fire ball

2. Generation of high blast over pressure.

3. Propulsion of the vessel fragments at very high velocity and traveling longer distances/range.

**Computer Simulations**

The bleve scenario has been studied for three cases with the help of software for assessing fire, explosion and toxic impacts, supplied by DNV Software, UK. The bleve scenario is studied for the formation of the fireball and generation of blast waves for pasquill stability of 1.5 D, 3D and 1.5 F. The cases and quantity of butane taken are given below:

| SN | Case | Quantity of Butane, Kgs | Operating Pressure,kg/cm2g |
|---|---|---|---|
| 1 | Lpg lorry | 18,000 | 8 |
| 2 | Horton Sphere | 1,050,000 | 8 |

**Case1: LPG Lorry**

The damage distance of the blast wave generated for 18000 kg of butane contained in the lorry is estimated for various pasquill stabilities as mentioned above.

| Overpressure Level | Unit | Effect | Damaged distance at over pressure levels | | |
|---|---|---|---|---|---|
| | | | 1.5 F | 1.5D | 3D |
| 0.01 | bar | window smashed | 355.7 | 355.7 | 355.7 |
| 0.1 | bar | 10% houses damaged | 57 | 57 | 57 |
| 0.3 | bar | 90% houses damaged | 29.3 | 29.3 | 29.3 |

| Radiation Level | Unit | Effect | Damaged distance at radiation levels | | |
|---|---|---|---|---|---|
| | | | 1.5 F | 1.5D | 3D |
| 12.5 | KW/m2 | 1% fatality | 211 | 211 | 211 |

***Case2: Horton Sphere*:**

The damage distance of the blast wave generated for 1050000 kg of butane contained in the Horton sphere is estimated for various pasquill stabilities as mentioned above.

| Overpressure Level | Unit | Effect | Damaged distance at | | |
|---|---|---|---|---|---|
| | | | 1.5 F | 1.5D | 3D |
| 0.01 | bar | window smashed | 1422.3 | 1422.3 | 1422.3 |
| 0.1 | bar | 10% houses damaged | 227.9 | 227.9 | 227.9 |
| 0.3 | bar | 90% houses damaged | 117.2 | 117.2 | 117.2 |

| Radiation | Unit | Effect | Damaged distance at radiation levels | | |
|---|---|---|---|---|---|
| Level | | | 1.5 F | 1.5D | 3D |
| 12.5 | KW/m2 | 1% fatality | 984.4 | 984.4 | 984.4 |

As per above simulation the windows can smash up to 1.5 kms and 1% fatality can result to a distance of 0.98 kilometer for the worst-case scenario.

**Generation of shrapnels/missiles:**

Bleve can generate the sharpnels/misiles from the storage vessel and these can travel to a distance of 400-650 meters depending upon the intensity of Bleve. It has been estimated by CCPS that a15 m dia horton sphere containing

1112 m3 of propane if bleved can generate 14 missiles, which can move at a speed of 256m/s and travel to a distance of 642 m.

**Case studies:**

**1. Mexico disaster:**

On 19th November 1984 at 0535 hrs. a series of explosion and fires started, which lasted until 2300 hours in San Juan Ixhuatepec, Mexico city. The disaster occurred in the premises of the organization PEMEX (Petroleous Mexicanos) a fairly modern plant built to API standards. It functioned as a LPG bulk storage and distribution depot. Total 11,000 m3 of LPG was stored in 160 m3 sphere and 48 horizontal cylindrical bullets. All the spheres were in close proximity. The legs of the Horton sphere were not fire proofed. It is believed that no firewater fixed sprays or deluge system was fitted to the tanks. The initiating event appeared to have been a leak on one of the pipeline bringing the LPG from the refineries. The over ground pipeline was 200 mm in dia and appeared to have ruptured inside the site near to the storage. In consequence, a vapour cloud formed which was driven down a slight slope by a breeze estimated at about 0.4 m/s blowing in a southwest direction. The cloud measured about 200 meters by 150 meters by 2 meters and after 5 to 10 sec. the cloud ignited at a ground flares about 100 meters from the point of release. The storage area was bunded in to 13 separate areas by walls about 1 meter high. The consequence of the disaster is given below:

- A fierce fire developed, engulfing spheres one after another in the series of bleves.
- Nine explosions were recorded, resulting in 542 fatalities and injuring 7000 people.
- 20,000 people were evacuated.
- The fireball went up to 300 meter in dia and lasted for 20 seconds.
- 2000 houses were destroyed located at 300 meters distance and 1800 were badly damaged.
- Windows were broken up to 600-meter distance and missiles were thrown at considerable distance.

The emergency plan functioned well in the circumstances.

**2. Incidence of Bleve in India:**

***The Incident*:**

On 7.1.2001, a LPG lorry containing 17.93 MT of lpg was heading towards varanasi, had an head-on collision with the truck carrying plywood coming from opposite direction at Bara village approximately 25 kms from kanpur. The truck carrying plywood was trying to overtake other truck at the place of accident. There was poor visibility at the accident site due to fog. The collision had resulted in the rear wheels of the LPG bulk lorry skidding down the slope. This has caused the shearing of liquid/vapour line of bullet. Soon after the incidence, the LPG lorry caught fire. The LPG leaking from the lorry formed a pool fire of LPG below the bullet. This has resulted in heating of the bullet and resulted in the bleve.The height of the flames were as high as 50 meters.

The rupture of bullet has taken at the longitudinal surface at the top of the bullet. The bullet has burst

in to 5 major pieces consisting of centre sheet almost flattened, two dished ends and two baffle plates.The dish ends were thrown on the side of road about 100 and 150 meters. Two baffle plates were thrown radially towards the village side and had traveled a distance of 80 and 100 meters from the site of accident. These flying pieces were seen by the villagers, who got panicky and started running away from their houses. The flying bullet pieces fell inside the village as well as other side of the village inside the fields.

**Fatalities**

Total 12 number of people including driver and cleaner of the LPG truck lost their life in the accident.Further driver, cleaner of the truck carrying the plywood and the four villagers got the burn injuries.

**Control measures to eliminate bleve:**

**Short-term measures:**

The bleve scenario can be eliminated by taking some short term and long term measures:

1. Provide deluge system activated by quartzoid bulbs to activate the deluge system in case of high temperature of sphere.
2. Avoid leakage of LPG below sphere and provision of sloped floor (1:100) below the sphere so that LPG do not accumulate below sphere.

Long-term measures**:**

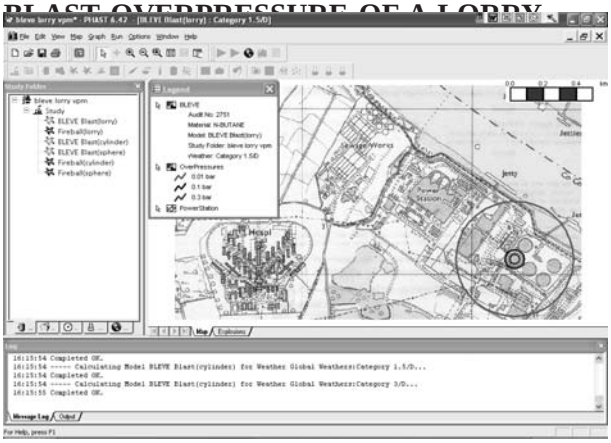
1. Conversion of Horton spheres in to mounded bullet:

   This design will cover the shell of the mounded bullet with cement mound and in between space is filled up by using quartz sand so that flame impingement is never possible

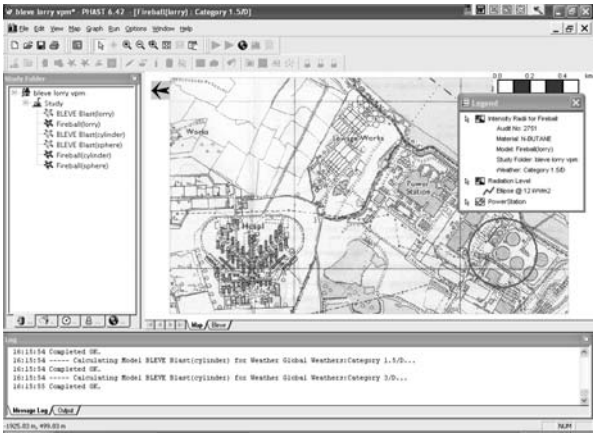
2. Conversion of Horton sphere in to stoned mined caverns:

The LPG is stored in the rock cavities below the ground water table so that the hydrostatic pressure is far more than the vapour pressure of the liquid at the temperature of the surrounding rock. The hydrostatic pressure ensures containment of the product in the cavities created. These caverns are safe from warfare, sabotage and natural calamities. The other advantages are no risk of leakage, occupying much less land as compared to other storage facilities, requires lesser investment and maintenance and offering longer life as compared to the surface tanks

**BLAST OVERPRESSURE OF A LORRY**



**FIREBALL FROM A BLEVE OF LORRY**



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# Case Study: Innovation in Packaging for Safety and Health

**Abhijeet M. Kulkarni**
*Food Safety Coordinator, Cadbury India Ltd., Thane*

**Introduction:**

Product range includes chocolates & Drinks:

Dairy Milk, 5 Star, Bourn Vita, Celebrations, Wowie, Perk, Crackle, 5 Star, etc.

**History:**

CADBURY existed in India for more than 50years. Market leader comprising more than 70% market share. In UK it is there for more than 100years.

In October 2003, just a month before DIWALI festival – customers in Mumbai complained about finding worms in Cadbury's premium brand **Dairy Milk chocolate**.

A major set back to Cadbury. Chocolates not stored as per the storage instructions in market.

The heat of negative publicity melted Cadbury's sales by 30% as against festival rise of 15%.

Not only loss of business but also loss of credibility.

**Solution**

Launch of project **VISHWAS** – An educational initiative for huge business partners covered entire supply chain (190000 retailers).

Corporate head quarter jumped in to save consumer interest.

Recover customer satisfaction.

**PROJECT VISHWAS - Confidence Building**

Following are the focus elements of PROJECT VISHWAS:

- Incoming Material Quality Assurance
- Prerequisite Programme
- HACCP implementation
- Control of Non Conformance Product
- Microbiological Safety
- Meeting Legal requirements
- Distribution Management

Company invested Rs.150 million (Rs. 15 crore) on imported machinery for new packing style of chocolates. Revamped the packaging of Dairy Milk:

PACKAGING. Earlier chocolates were band wrapped while now chocolates are packed in pillow pack. This eliminates prospective problems of infestation.

| Band Wrap | Pillow Pack |
|---|---|
|  |  |

**Comeback**

What consumer wants?

Answer: Consumer insists assurance of QUALITY.

Best piece of suggestion came from a Sales Executive – To get bollywood star

Amitabh Bacchan as brand Ambassador.

Bib B – A personality of conviction, honest.

Idea worked wonders for the Cadbury brands.

By June 2004, Innovation in packing coupled with advertisement restored consumer confidence.

Leader in Indian chocolates market with over 70% market share.

**About Author**

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**Food Safety Coordinator, Cadbury India Ltd., Thane**

- M.Sc. (Microbiology)

# ARTICLES

# Safety in Excavation

**A.K. Kulkarni**
*AGM – Safety*
*Afcons Infrastructure Limited.*

The possible type of accidents during excavation is

- Collapse of the sides
- Material falling onto the people working in excavation
- People and vehicle falling into the excavation
- People being struck be the plant and machinery
- Undermining the nearby structure
- Contact with the underground services
- Access to the excavation
- Fumes and
- Accidents to the member of the public

To avoid the above type of accidents, we must start with the basics from the soil ty[pe, its mechanics etc. Let us start with –

DETERMINATION OF SOIL TYPE: Categories of soil and rock deposits in 4 groups

STABLE ROCK is natural solid mineral matter that can be excavated with vertical sides and remain intact when exposed. It is usually identified by a rock name such as granite or sandstone. Determining whether a deposits of this type may be difficult unless it is known whether cracks exists and the crack run into or away from the excavation.

**TYPE A SOILS** are cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) (144 kPa) or greater. Examples of Type A cohesive soils are often: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. (No soil is Type A if it is fissured, is subject to vibration of any type, has previously been disturbed, is part of a sloped, layered system where the layers dip into the excavation on a slope of 4 horizontal to 1 vertical (4H:1V) or greater, or has seeping water.

**TYPE B SOILS** are cohesive soils with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa). Examples of other Type B soils are: angular gravel; silt; silt loam; previously disturbed soils unless otherwise classified as Type C; soils that meet the unconfined compressive strength or cementation requirements of Type A soils but are fissured or subject to vibration; dry unstable rock; and layered systems sloping into the trench at a slope less than 4H:1V (only if the material would be classified as a Type B soil)

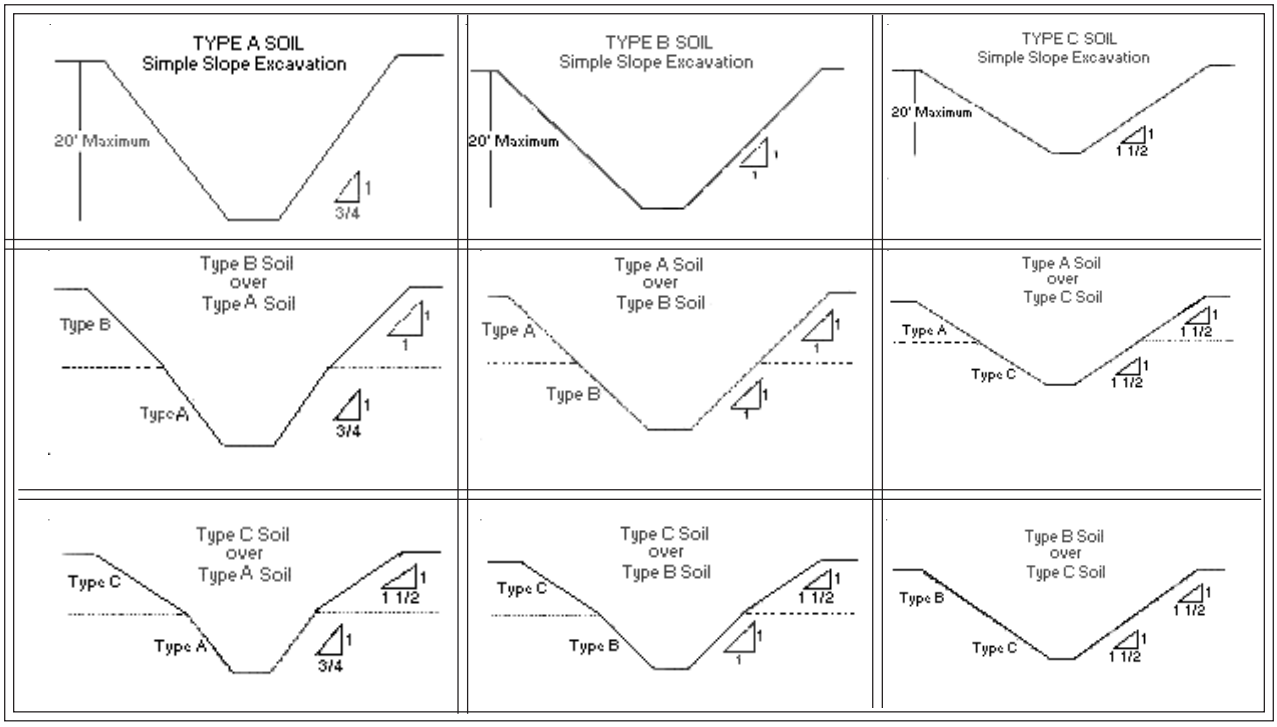
**TYPE C SOILS** are cohesive soils with an unconfined compressive strength of 0.5 tsf (48 kPa) or less. Other Type C soils include granular soils such as gravel, sand and loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable. Also included in this classification is material in a sloped, layered system where the layers dip into the excavation or have a slope of four horizontal to one vertical (4H:1V) or greater.

**LAYERED GEOLOGICAL STRATA.** Where soils are confined in layersi.e. Where a layered geological structure exists, soil must be classified of the weakest soil layer. Each layer may be classified individually if a more stable layer lies below a less stable layer i.e. Where a type C soil rests on top stable rock

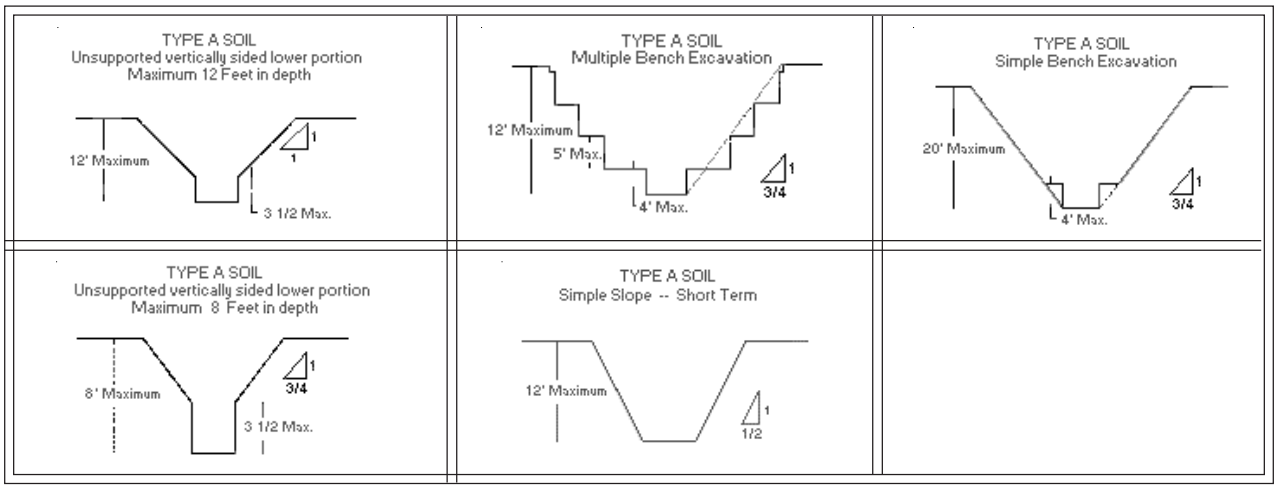
**BENCHING.** There are two basic types of benching, simple and multiple. The type of soil determines the horizontal to vertical ratio of the benched side.

As a general rule, the bottom vertical height of the trench must not exceed 4 ft (1.2 m) for the first bench. Subsequent benches may be up to a maximum of 5 ft (1.5 m) vertical in Type A soil and 4 ft (1.2 m) in Type B soil to a total trench depth of 20 ft (6.0 m). All subsequent benches must be below the maximum allowable slope for that soil type. For Type B soil the trench excavation is permitted in cohesive soil only.

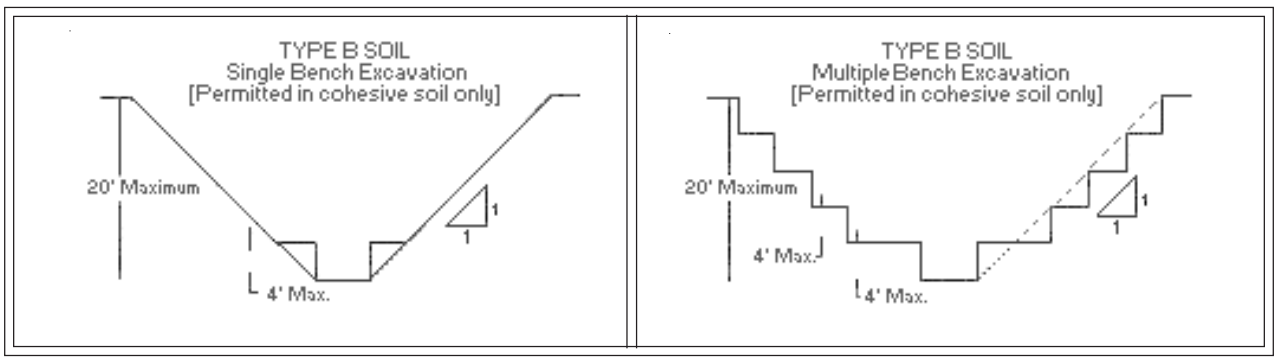
**SLOPE CONFIGURATIONS: EXCAVATIONS IN LAYERED SOILS.**




**EXCAVATIONS MADE IN TYPE A SOIL.**




EXCAVATIONS MADE IN TYPE B SOIL.



**SLOPING AND BENCHING. 1.**

SLOPING**. Maximum allowable slopes for excavations less than 20 ft (6.09 m) based on soil type and angle to the horizontal are as follows:**

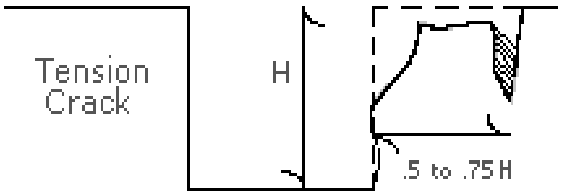
| ALLOWABLE SLOPES. | | |
|---|---|---|
| **Soil type** | **Height/Depth ratio Slope angle** | |
| Stable Rock | Vertical | 90° |
| Type A | ¾:1 | 53° |
| Type B | 1:1 | 45° |
| Type C | 1½:1 | 34° |
| Type A (short-term) | ½:1 | 63° |
| (For a maximum excavation depth of 12 ft) | | |

**SOIL MECHANICS**

A number of stresses and deformations can occur in an open cut or trench. For example, increases or decreases in moisture content can adversely affect the stability of a trench or excavation. The following diagrams show some of the more frequently identified causes of trench failure.

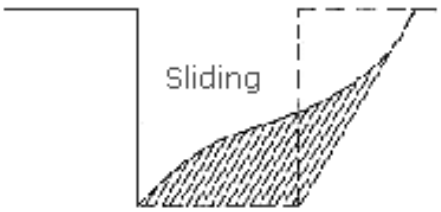
**A. TENSION CRACKS**. Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench, measured from the top of the vertical face of the trench. See the accompanying drawing for additional details.

**FIGURE 5:2-1. TENSION CRACK**



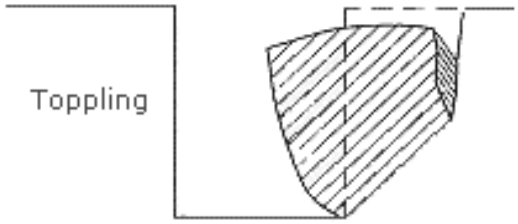

**B. SLIDING** or sluffing may occur as a result of tension cracks, as illustrated below.

**FIGURE 5:2-2. SLIDING.**



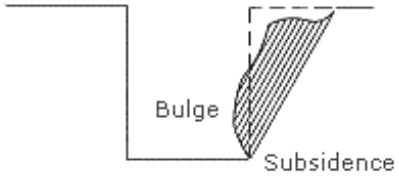

**C. TOPPLING**. In addition to sliding, tension cracks can cause toppling. Toppling occurs when the trench's vertical face shears along the tension crack line and topples into the excavation.

**FIGURE 5:2-3. TOPPLING.**



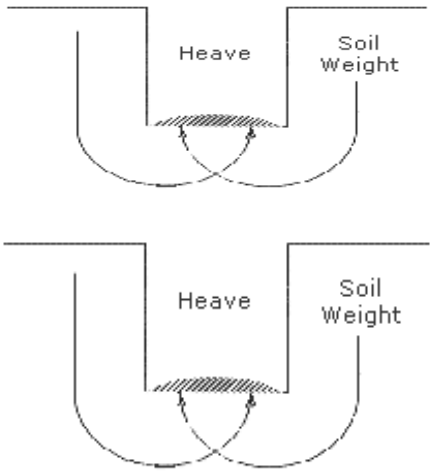

**D. SUBSIDENCE AND BULGING**. An unsupported excavation can create an unbalanced stress in the soil, which, in turn, causes subsidence at the surface and bulging of the vertical face of the trench. If uncorrected, this condition can cause face failure and entrapment of workers in the trench.

**FIGURE 5:2-4. SUBSIDENCE AND BULGING.**



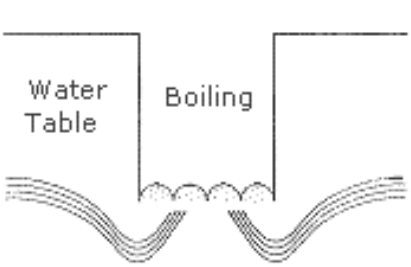

**E. HEAVING OR SQUEEZING**. Bottom heaving or squeezing is caused by the downward pressure created by the weight of adjoining soil. This pressure causes a bulge in the bottom of the cut, as illustrated in the drawing above. Heaving and squeezing can occur even when shoring or shielding has been properly installed.

**FIGURE 5:2-5. HEAVING OR SQUEEZING.**



**F. BOILING** is evidenced by an upward water flow into the bottom of the cut. A high water table is one of the causes of boiling. Boiling produces a "quick" condition in the bottom of the cut, and can occur even when shoring or trench boxes are used.

**FIGURE 5:2-6. BOILING.**




## SELECTION OF PROTECTIVE SYSTEMS IN EXCAVATION

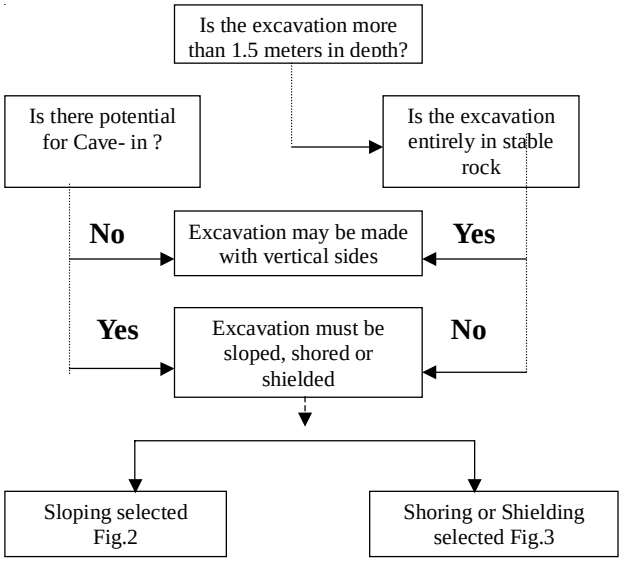



Fig. 1 – Preliminary Decision

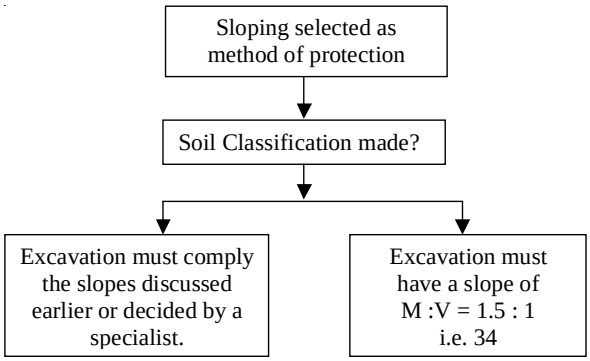



Fig. 2 – Sloping Options

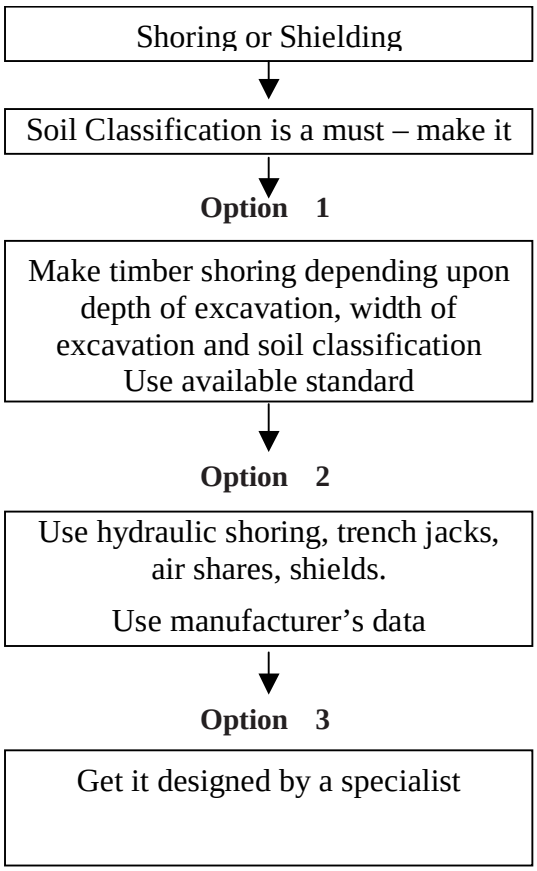
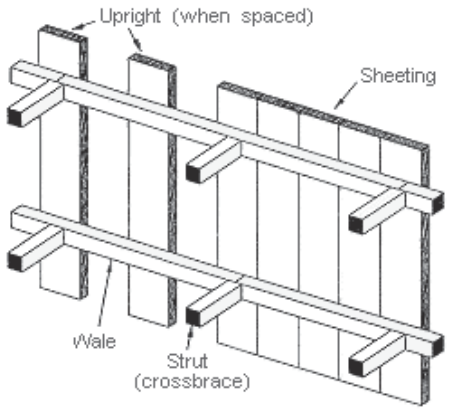



Fig. 3 Shoring Types

## SHORING TYPES.

Shoring is the provision of a support system for trench faces used to prevent movement of soil, underground utilities, roadways, and foundations. Shoring or shielding is used when the location or depth of the cut makes sloping back to the maximum allowable slope impractical. Shoring systems consist of posts, wales, struts, and sheeting. There are two basic types of shoring, timber and aluminum hydraulic.

**FIGURE V:2-7. TIMBER SHORING.**

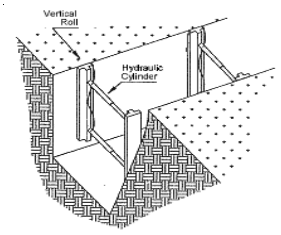


**HYDRAULIC SHORING**. The trend today is toward the use of hydraulic shoring, a prefabricated strut and/or wale system manufactured of aluminum or steel. Hydraulic shoring provides a critical safety advantage over timber shoring because workers do not have to enter the trench to install or remove hydraulic shoring. Other advantages of most hydraulic systems are that they:

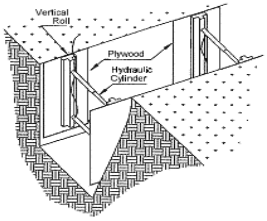
- Are light enough to be installed by one worker;
- Are gauge-regulated to ensure even distribution of pressure along the trench line;
- Can have their trench faces "preloaded" to use the soil's natural cohesion to prevent movement; and
- Can be adapted easily to various trench depths and widths.

All shoring should be installed from the top down and removed from the bottom up. Hydraulic shoring should be checked at least once per shift for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, and any other damaged or defective parts.

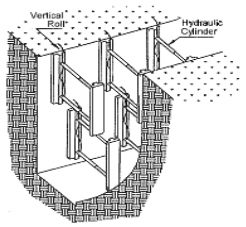
**SHORING VARIATIONS: TYPICAL ALUMINUM HYDRAULIC SHORING INSTALLATIONS.**



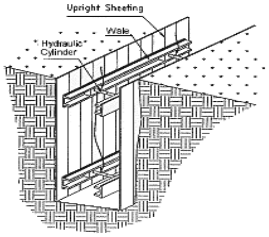
Vertical Aluminum Hydraulic Shoring (Spot Bracing)



Vertical Aluminum Hydraulic Shoring (With Plywood)



Vertical Aluminum Hydraulic Shoring (Stacked)



Aluminum Hydraulic Shoring Waler System (Typical)

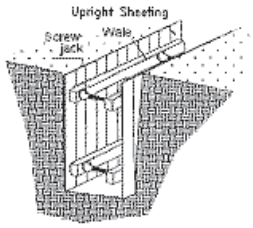
**PNEUMATIC SHORING** works in a manner similar to hydraulic shoring. The primary difference is that pneumatic shoring uses air pressure in place of hydraulic pressure. A disadvantage to the use of pneumatic shoring is that an air compressor must be on site.

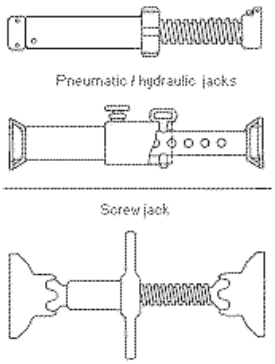
**1. Screw Jacks**. Screw jack systems differ from hydraulic and pneumatic systems in that the struts of a screw jack system must be adjusted manually. This creates a hazard because the worker is required to be in the trench in order to adjust the strut. In addition, uniform "preloading" cannot be achieved with screw jacks, and their weight creates handling difficulties.

**2. Single-Cylinder Hydraulic Shores**. Shores of this type are generally used in a water system, as an assist to timber shoring systems, and in shallow trenches where face stability is required.

**3. Underpinning**. This process involves stabilizing adjacent structures, foundations, and other intrusions that may have an impact on the excavation. As the term indicates, underpinning is a procedure in which the foundation is physically reinforced. Underpinning should be conducted only under the direction and with the approval of a registered professional engineer.

**SHORING VARIATIONS.**

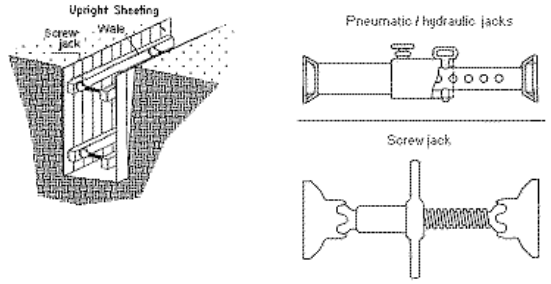


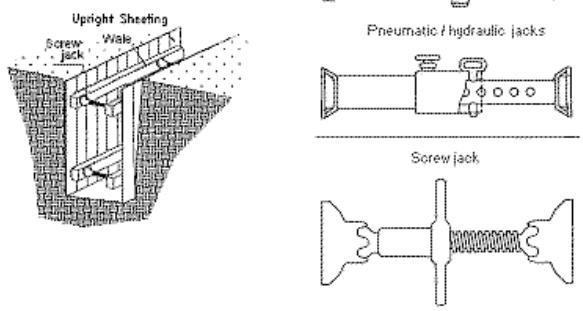

**SHIELDING TYPES.**

**TRENCH BOXES** are different from shoring because, instead of shoring up or otherwise supporting the trench face, they are intended primarily to protect workers from cave-ins and similar incidents. The excavated area between the outside of the trench box and the face of the trench should be as small as possible. The space between the trench boxes and the excavation side are backfilled to prevent lateral movement of the box. Shields may not be subjected to loads exceeding those which the system was designed to withstand.

**TRENCH SHIELD.**




**TRENCH SHIELD, STACKED.**




**COMBINED USE**. Trench boxes are generally used in open areas, but they also may be used in combination with sloping and benching. The box should extend at least 18 in (0.45 m) above the surrounding area if there is sloping toward excavation. This can be accomplished by providing a benched area adjacent to the box.

Earth excavation to a depth of 2 ft (0.61 m) below the shield is permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench and there are no indications while the trench is open of possible loss of soil from behind or below the bottom of the support system. Conditions of this type require observation on the effects of bulging, heaving, and boiling as well as surcharging, vibration, adjacent structures, etc., on excavating below the bottom of a shield. Careful visual inspection of the conditions mentioned above is the primary and most prudent approach to hazard identification and control.

**SPECIAL HEALTH AND SAFETY CONSIDERATIONS.**

**A.SURFACE CROSSING OF TRENCHES**. Surface crossing of trenches should be discouraged; however, if trenches must be crossed, such crossings are permitted only under the following conditions:

- Vehicle crossings must be designed by and installed under the supervision of a registered professional engineer.
- Walkways or bridges must be provided for foot traffic. These structures shall:
  - have a safety factor of 4;
  - have a minimum clear width of 20 in (0.51 m);
  - be fitted with standard rails; and
  - extend a minimum of 24 in (.61 m) past the surface edge of the trench.

**B. INGRESS AND EGRESS**. Access to and exit from the trench require the following conditions:

- Trenches 4 ft or more in depth should be provided with a fixed means of egress.
- Spacing between ladders or other means of egress must be such that a worker will not have to travel more than 25 ft laterally to the nearest means of egress.
- Ladders must be secured and extend a minimum of 36 in (0.9 m) above the landing.
- Metal ladders should be used with caution, particularly when electric utilities are present.

**C.EXPOSURE TO VEHICLES**. Procedures to protect employees from being injured or killed by vehicle traffic include:

- Providing employees with and requiring them to wear warning vests or other suitable garments marked with or made of reflectorized or high-visibility materials.
- Requiring a designated, trained flag person along with signs, signals, and barricades when necessary.

**D. EXPOSURE TO FALLING LOADS**. Employees must be protected from loads or objects falling from lifting or digging

equipment. Procedures designed to ensure their protection include:

- Employees are not permitted to work under raised loads.
- Employees are required to stand away from equipment that is being loaded or unloaded.
- Equipment operators or truck drivers may stay in their equipment during loading and unloading if the equipment is properly equipped with a cab shield or adequate canopy.

**E. WARNING SYSTEMS FOR MOBILE EQUIPMENT**. The following steps should be taken to prevent vehicles from accidentally falling into the trench:

- Barricades must be installed where necessary.
- Hand or mechanical signals must be used as required.
- Stop logs must be installed if there is a danger of vehicles falling into the trench.
- Soil should be graded away from the excavation; this will assist in vehicle control and channeling of run-off water.

**F. HAZARDOUS ATMOSPHERES AND CONFINED SPACES**. Employees shall not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with:

- Less than 19.5% or more than 23.5% oxygen;
- A combustible gas concentration greater than 20% of the lower flammable limit; and
- Concentrations of hazardous substances that exceed those specified in the *Threshold Limit Values for Airborne Contaminants* established by the ACGIH (American Conference of Governmental Industrial Hygienists).

All operations involving such atmospheres must be conducted in accordance with requirements for occupational health and environmental controls for personal protective equipment and for lifesaving equipment. Engineering controls (e.g., ventilation) and respiratory protection may be required.

When testing for atmospheric contaminants, the following should be considered:

- Testing should be conducted before employees enter the trench and should be done regularly to ensure that the trench remains safe.
- The frequency of testing should be increased if equipment is operating in the trench.
- Testing frequency should also be increased if welding, cutting, or burning is done in the trench.

Employees required to wear respiratory protection must be trained, fit-tested, and enrolled in a respiratory protection program. Some trenches qualify as confined spaces. When this occurs, compliance with the Confined Space Standard is also required.

**G. EMERGENCY RESCUE EQUIPMENT**. Emergency rescue equipment is required when a hazardous atmosphere exists or can reasonably be expected to exist. Requirements are as follows:

- Respirators must be of the type suitable for the exposure. Employees must be trained in their use and a respirator program must be instituted.
- Attended (at all times) lifelines must be provided when employees enter bell-bottom pier holes, deep confined spaces, or other similar hazards.
- Employees who enter confined spaces must be trained.

**H. STANDING WATER AND WATER ACCUMULATION**. Methods for controlling standing water and water accumulation must be provided and should consist of the following if employees are permitted to work in the excavation:

- Use of special support or shield systems approved by a registered professional engineer.
- Water removal equipment, i.e. well pointing, used and monitored by a competent person.
- Safety harnesses and lifelines
- Surface water diverted away from the trench.
- Employees removed from the trench during rainstorms.

- Trenches carefully inspected by a competent person after each rain and before employees are permitted to re-enter the trench.

**Prevention : by proper Inspection**

Inspections shall be made by a competent person and should be documented. The following guide specifies the frequency and conditions requiring inspections:

- Daily and before the start of each shift;
- As dictated by the work being done in the trench;
- After every rainstorm;
- After other events that could increase hazards, e.g. snowstorm, windstorm, thaw, earthquake, etc.;
- When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur;
- When there is a change in the size, location, or placement of the spoil pile; and
- When there is any indication of change or movement in adjacent structures.
- Water removal equipment, i.e. well pointing, used and monitored by a competent person.
- Safety harnesses and lifelines
- Surface water diverted away from the trench.
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**About Author**

**A.K. Kulkarni**

**AGM - Safety**

**Afcons Infrastructure Limited**

- Post Diploma in Production Engineering, VJTI, Mumbai
- Diploma in Industrial Safety

✓ Presented about 50 papers at National and International level.

✓ Written two books on Safety – 1) Safety in Arc Welding Process and 2) Various aspects of Safety.

✓ Presented paper at International Conference organized by Japan International Centre for Occupational Safety and Health and won first Prize.

✓ Biography appeared in Marquis Who's Who of USA and directory of International biography from Cambridge.

# Safety Sampling

**G.S. Waikar**
*Asst Manager, Health, Safety & Environment Department,*
*AWCIL, Ambarnath*

Safety Sampling is also known as behaviour sampling. It is a statistical technique, which uses expertise within the Management to inspect, identify and evaluate hazards.

The method relies on personnel, usually management or safety staff members, who are familiar with operations & well trained in recording unsafe practices. While making record of the plant the observer records the types of the defects. He follows the certain route and performs number of tours in which instantaneous impressions are recorded at random on actual work. No attempt is made to correct the worker for his unsafe acts or unsafe conditions.

**Ideal Status To Follow**

Usually the HSE person and the Safety committee member do Safety Sampling twice a month. Observer members are changed after two months in rotation.

1) Workmen are explained the purpose of Safety Sampling.
2) Observer records two types of impressions.
   a. Workers performing safely.
   b. Workers performing unsafely.
3) Defects found are informed to supervisors or departmental head and reported to Safety Committee.
4) They are published on General Notice Board and opportunity is given to improve the defaulters.
5) Results are added to Summary Sheets and plotted on Graph, later on displayed on board. These are compared with the past results for continuous improvement.

**Model Defect List Used:**

Following list is used to serve the guideline to judge the nature of unsafe act committed by the defaulters.

- Using a machine, tool or performing job without legal or official authority.
- Operating motorized machine at unsafe speed.
- Operating machine without guard.
- Operating machine without oiling & greasing.
- Operating valve in wrong direction.
- Bypassing safety devices like high temperature, alarm, flame failure alarm, level indicators, interlocks without written permission from Departmental heads.
- Using defective tools & machine.
- Using hands & body for object instead of tools.
- Using defective ladder.
- Placing ladder in wrong position.
- Using wrong posture of body.
- Repairing / adjusting / oiling equipment in motion under pressure or when electrically charged.
- Improper lifting of load.
- Lifting excessive load than capacity.
- Overloading the equipment than its rated capacity.
- Failure to use or maintain PPEs.
- Creating unhealthy condition.
- Working in unauthorized area.
- Standing or working under suspended loads, scaffolds or hoists.
- Unauthorized persons riding on FLT, JCB.
- Overtaking in congested passages.
- Violation of safety procedure by working without Safety permit or incomplete permit.

- Material Handling – using defective hooks, wheelbarrows, trolley etc.
- Making emergency safety aids inoperative like Eye Wash Fountain, Safety Shower, First Aid Box, and Emergency Sirens etc.
- No labeling on containers.
- Using filled containers without lids.
- Storing material in gangways.
- Improper stacking of material.

Safety sampling is carried out regularly for company as well as temporary and contract employees. Also this helps us in achieving

- ❖ Identifying the hazards.
- ❖ Reducing the unsafe practices
- ❖ Improving HSE awareness
- ❖ Prevention in accidents
- ❖ Improvement in working condition
- ❖ A practice of building good HSE teams.

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**About Author**

**G.S. Waikar**

**Assistant Manager (HSE), Albright & Wilson Chemicals India Ltd.**

- B.Tech(Chemical Engineering), UDCT, Matunga.
- Advanced Diploma in Industrial Safety, MSBTE, Mumbai
  - ✓ Worked in Production, Design, Development Department in various Chemical Industries
  - ✓ Achieved Meritorious award from National Safety council, Maharashtra Chapter in 2003 for recognition of achievement of zero accident period of consecutive 3 years.

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H$m`ÚmÀ`m d{Z`_mÀ`m MmH$QrV amhZ H$m_ H$c Va AnKmV ZŠH$sM Qmi Vm `Vrc _mÌ Ë`mgmRr nË`H$ì`ŠVrÀ`m AmZa{enMr OmS AgU Amdí`H$ Amh. AnKmV KSë`mda H$mcmVamZ AmnU `m KQZm {dgaVm _mÌ X…lr _ZMr ñnXZ QrH$Z amhVmV V Qmi Ê`mgmRr "Prevention is always better than cure".

**About Author**

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- M.Sc. (Oraganic Chemistry), Mumbai University
- Advanced Diploma in Industrial Safety, MSBTE, Mumbai
- M.Sc. (Fire Safety), YCMOU, Mumbai

✓ Organised and Conducted S.H.E. related Awareness and Training Programmes, Fire Fighting Education and Awareness programmes.

✓ Accident analysis and investigation of accidents.

✓ Consultant for Environmental monitoring and other aspects.

# Tool Box Talk

**Mahesh Hivarekar**
*Siemens India Ltd.*

Tool box talks are designed to promote safety awareness among all employees.

Supervisors are advised to conduct on-the-job safety "toolbox talks" with each employee she/he supervises. The talk can be a one-on-one discussion with an employee or it can be a group discussion including the entire department.

Topics addressed in the "toolbox talks" should include the safe operation of equipment and how it is and has been operating, reminders about the safe operation of equipment, tools and handling procedures, personal protective equipment, and safety procedures. The employee shall be given an opportunity to recommend to his/her supervisor solutions to potential problems that she/he has encountered while working.

To minimize social and economic costs of work related injuries informative change on safety is required at workplaces. Instructions on safe use of equipment helps to reduce the risk of injury. Learning how to use and handle tools correctly protects the worker as well as the equipment. The following three steps can diminish work related injuries.

1. Spot the hazard

2. Assess the Risk

3. Make the changes.

How effective are your **"Safety Tool Box Talks"**?

A successful Tool Box Talk is a specific part of your company's Safety, Health & Environment Program, developed to reduce accidents and injuries.

**What is a safety hazard?**

A safety hazard is anything that could cause an injury. Injury caused by a safety hazard. Safety hazards cause harm when workplace controls are not adequate. Some examples of safety hazards include:

_Slipping/tripping hazards (such as electrical cords across floors)

_ Fire and explosion hazards

_ Moving parts of machinery, tools and equipment (such as pinch and nip points)

_ Work at height (such as work done on scaffolds or ladders)

_ Ejection of material (such as from moulding operations)

_ Pressure systems (such as steam boilers and pipes)

_ Vehicles (such as forklifts and trucks)

_ Lifting and other manual handling operations

_ Injuries due to flying particles.

Communication is one of the best ways to prevent accidents. One of the best ways of communicating the importance of safety on a construction job is through toolbox talks. You don't have to be a professional speaker to give a good toolbox talk. But there are ways you can make your talks more effective! Let's take a look at them.

**The Agenda**

- Know your topic and plan your agenda a few days before the meeting so you're well prepared. (Be able to present the talk without reading it and lead a discussion afterward.) Wherever possible use actual equipment to illustrate your points. Coordinate handout literature or other material you intend to use at the meeting.
- Limit the length of your presentation. Given your operation, you would be the best judge of how much time to set aside. Generally speaking. a half-hour is adequate. Allow for questions and answer afterward-about 15 minutes.
- Use visual examples.
- Do a wrap-up. Reinforce the important points brought out during the meeting. Thank your staff for their interest and enthusiasm.

Start the meeting on a positive note. After welcoming your staff, promote teamwork and how toolbox meetings not only provide valuable information but also give everyone the opportunity to get together and exchange ideas. Be sure to compliment a job well done. Moral plays a bigger part than people think in affecting productivity and job satisfaction.

Keep it informal. Even though you may be using this resource as well as others, use your own words in making actual presentation. For effective and rewarding results, do what's comfortable for you. Invite people to participate. The purpose of any toolbox talk is to get people to think about safety problems. Make the talk a hands-on session. Have your people name hazards and what to do about them. Encourage them to offer suggestions to improve safety. When asking questions. Use open-ended questions instead of questions that require only a yes or no answer.

**The topic**

Choose timely topics. Gear your talks to safety problems you are encountering at the moment or that you anticipate in upcoming jobs.

Review recent injuries-What happened?

Why did it happen?

What should have been done?

How To Give A Tool Box Talk

Review recent safety violations ?

Review upcoming work schedule.

What procedure should be followed?

Tips for Holding an Effective Safety Talk!

Say hello

Meet and greet your workers as they file in to the room where the safety meeting is being held. Not only is this a morale-booster, but it is a reminder of who is attending. You can hand out the read-along copies of the safety talk as you say hello.

**An MSDS a day**

Go over one Material Safety Data Sheet at each safety meeting until you have covered all the chemicals your workers are using. After a break, start going through them again, because you will likely have some new workers.

**One idea**

Ask each worker to come up with at least one idea to improve safety in your work area. Have them present their ideas at the next few safety meetings.

**Find the answer**

Encourage solutions. If your workers come to you with safety problems, ask them to think of solutions too. They might come up with unexpected answers, such as setting up equipment differently and eliminating the need for the missing guardrail.

**New hazards**

New safety hazards can develop even if you are working in the same familiar location. Take a walk with your workers at the start of your next safety meeting to see what you can find. Defective condition of equipment or premises, lapsed work habits and changes in equipment, procedures or arrangement of the work area can all create new hazards.

**Company procedures**

Review the written safety procedures for your crew at your safety meetings. Take a section at a time and work through the procedures over several weeks of safety meetings.

**Emergency plan**

Dust off the company's emergency plan and review it section by section at several safety meetings.

**Stay loose**

Remain flexible about topics for your safety meetings. You might want to reinforce fire prevention after a company fire drill, or severe weather safety when a bad storm is forecast.

**Everybody speaks**

Give all participants a chance to speak at your safety meetings. Don't let the same people dominate meeting after meeting.

**Top safety concern**

What is your number-one safety worry today? Open your safety meeting with a review of the most serious safety issue facing your crew.

**Tailgate talk**

A weekly session is just part of the safety meeting schedule. The short meeting at the start of a shift – called a tailgate talk or toolbox talk – is

important for zeroing in on the specific hazards of the job for that day.

**Personalize safety**

And this affects me how? Encourage your workers to ask this question when you are discussing hazards and safe procedures. They need to think about how they can be injured if something goes wrong, and how they should personally take steps to stay safe.

**Open book policy**

The operator's manual should be easily available to any worker who runs equipment. At a safety meeting remind your workers what the manual looks like, where it is kept and what it contains. You can also review the manual, a chapter at a time, at safety meetings coming up. Even office equipment such as copiers and computers came with safety instructions.

**Where are we?**

Could your workers direct an emergency responder to their work area in case of a fire, injury or other crisis? Ask everyone to write down the address of the work area and directions to it. In many plants, various entrances might be on different streets.

**Safety snapshots**

A digital camera with its instant images is a handy tool for a safety meeting. When you want to demonstrate the right way to do something – or perhaps the wrong way – simply snap a series of photos and prepare them for viewing on the screen, projecting on to a wall or printing them. A camera is especially useful for illustrating the steps of a complex procedure such as equipment lockout.

**Save sign-up sheets**

Keep track of your meeting safety attendance sheets. Talk to your company's safety director if you are not sure where they should go so they will be accessible in case of an inspection or an incident investigation.

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**About Author**

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- Advanced Diploma in Industrial Safety, MSBTE, Mumbai
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# V.P.M.s POLYTECHNIC, IT CENTRE

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## Advanced Diploma Programme in Industrial Safety

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**Affiliated to Maharashtra State Board of Technical Education (MSBTE)**

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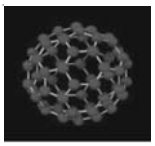
## Latest Trends in Nanotechnology

5th January 2008



**Preamble:**

Nanotechnology, the major frontier area of science and technology to produce materials of nanometer scale from multi-micron to sub micron diameter has reached greater heights of scientific & technological developments. Rapid progress has been made in recent years to bring nano-structured materials in various applications such as devices, components, sensors and coatings. The advent of nanomaterials has introduced a new dimension in applications of energetic and reactive materials.

The process of transfer of nanostructured materials for commercialization is an increasingly popular scientific area. This pools together researchers from many fields including physics, chemistry, chemical Engineering, Electronics, Material science and technologists to meet the challenges. The objective of this conference is to bring together Scientists, Engineers, Technologists and industrialists from different disciplines to a common platform. They can present and discuss the recent advances in the synthesis, processing and device applications.

**SCOPE:**

The conference is meant for scientists, Engineers, Technologists and industrialists who can discuss wide range of topics on Nanotechnology from fundamental problems to technological and industrial applications such as carbon Nanotubes, nanostructures, Quantum dots, nanoscaled biological assemblies, nanofabrication, nanoprocessingand characterization. The conference will include the various aspects of commercialization of nanotechnology by R& D Laboratories.

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