

CHALLENGES FOR PROCESS SAFETY MANAGEMENT IN INDIA

Author:

B.Karthikeyan

Process Safety Consultant

Prism Consultants

1A, 1, Third Main Road, Kasturba Nagar, Adyar, Chennai-600020

www.prismcon.net

bkprism@gmail.com

Abstract:

After the Bhopal disaster, a number of changes in Indian legislation were implemented. With the growth of the Indian chemical industry, the challenges facing the industry are many. One of the challenges is to effectively manage process safety. Process safety management is a specialized techno-management system approach to prevent the recurrence of another Bhopal type disaster. Major disasters like the Indian oil corporation, Jaipur oil terminal fire highlight the challenges facing process safety management in India. This paper looks at the challenges facing process safety management in India in three areas - legislative, industry and academia. Suggestions to meet these challenges are also given.

Keywords: Process Safety Management, Incidents, Indian chemical industry

Introduction:

The Indian chemical Industry plays an important role in the development of the Indian economy. The Indian chemical industry comprises of small, medium and large-scale units. The chemical sector accounts for about 17.6% of the manufacturing sector output, 13% to 14% of total exports and 8-9% of total imports of the country. It contributes to about 3% of the GDP. Its contribution to the national revenue is about 18-20% of total collection by ways of various taxes[1].

The industry is projected to grow at a rate of 10% to 12%. To promote investment in this sector and make the country an important hub for both domestic and international markets, the Indian Government has decided to attract major investment, both domestic and foreign, by providing a transparent and investment friendly policy and facility regime under which integrated Petroleum, Chemicals & Petrochemical Investment Regions (PCPIRs) are being set up across the country.

However, the Indian Chemical Industry also has the stigma of the World's worst Industrial disaster that took place in Bhopal in December 1984. After the Bhopal gas disaster, a number of changes were made in the Indian Factories Act and environmental legislation in India. Specifically, the Factories Act was amended to assign the responsibility of the "occupier", who is legally responsible for the safety of the workplace and workers, to the highest level of management in an organization. The Environmental legislation also underwent changes, with the Environment Protection Act introduced in 1986. Under this act, a number of new

legislations were framed. The Manufacture, Storage and Import of Hazardous Chemical rules, 1989 was introduced with the objective of preventing another Bhopal type of disaster. Specifically, this rule required safety audits to be carried out in hazardous chemical factories, storing more than a threshold limit of hazardous chemicals.

The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 was also introduced. Preparation of on-site Emergency Plan by the Industry and Off-site Plan by the District Collector and the constitution of four-tier Crisis Groups at the Centre, State, District and Local level for management of chemical accidents are mandatory under these rules. Under these rules, the industries have been identified as "Major Accident Hazard" based on exceeding threshold quantities of hazardous chemicals specified in Schedules 2 and 3 of the rules.

India has about 1666 Major Accident Hazard (MAH) units . Of the 602 districts in India, 263 districts have MAH units. Of them, 170 have clusters of more than five MAH units/hazardous/industrial pockets. Between 2002 to 2006, 25 major chemical accidents have been reported in MAH units, involving 52 deaths and 238 injuries. The accidents involved chemicals like chlorine, ammonia, LPG and other hazardous chemicals [2].

Some of the major incidents that have taken place in India after the Bhopal disaster include the explosion in IPCL Gas Cracker Complex at Nagothane in Maharashtra (1990); vapour cloud explosion at HPCL refinery at Vishakhapatnam (1997), ONGC Mumbai High fire (2005) and the Indian Oil Corporation, Jaipur oil terminal fire (2009).

In the USA, after Bhopal and other disasters, the Process Safety Management rule, developed by the Occupational Safety and Health Administration (OSHA) became mandatory since 1992 for industries handling, storing and manufacturing hazardous chemicals above a specified threshold quantity. In India, this system is not mandatory. However a number of large chemical industries in India are proactively adopting the process safety management system.

Challenges for Process Safety Management in India:

The challenges for Process Safety Management in India exist in three areas -Legislative, Industry and Academia.

LEGISLATIVE CHALLENGES:

The legislative challenges facing India are

a) Lack of a process safety management rule

India does not have a Process Safety Management Rule similar to the US OSHA (Occupational Safety and Health Administration) CFR 1910.119 PSM rule. The OSHA PSM rule has the following elements:

1. Employee Participation
2. Process safety information
3. Process hazard analysis
4. Operating procedures
5. Incident investigation

6. Management of change
7. Pre start up safety review
8. Contractor control
9. Hot work
10. Mechanical integrity
11. Training
12. Emergency planning and response
13. Trade secrets
14. Compliance audits

The oil and gas safety directorate (OISD) has brought out guidelines for process safety management system based on American Petroleum Institute guidelines. With the experience of the USA in implementing the PSM rule since 1992, and taking into account the relevant lessons learnt from incidents after 1992, India can develop and enforce a PSM rule that includes the following additional elements in addition to the 14 elements of OSHA PSM rule:

1. Top management participation and commitment
2. Process safety skills identification and development
3. Process safety knowledge management
4. Proactive and reactive process safety measurement indicators

b) Lack of Specialized Process Safety Training for the law enforcers:

Process safety management is a specialized field that requires technical and management system knowledge to audit and to recommend improvements. One of the actions taken OSHA of USA after the BP Texas city refinery incident in 2005 was to develop a National Refinery Emphasis Plan where all the refineries in the USA are subject to a stringent statutory technical and management audit of their systems. The BP Texas refinery incident has highlighted the need for assessing process safety culture and developing and implementing proactive and reactive measurements for measuring and tracking process safety performance. The present law enforcers in India need to update their knowledge about process safety management including the technical and management aspects. The Government should develop a skill development plan for the law enforcers that should include the following:

1. Difference between occupational and process hazards
2. Various Process hazards in a chemical processing industry
3. Elements of a process safety management program
4. Auditing a process safety management program
5. Assessing top management commitment by tracking proactive performance measures for process safety performance.
6. Understanding of National disaster management authority (NDMA) guidelines for chemical disasters
7. Various process incidents that have taken place across India and their root causes

8. Analysis of few incidents from the Chemical Safety Board of USA

c) Lack of Process Safety Qualification requirements for Safety Officers in Chemical Industries:

In the current legislations, the Central Labour Institute in Mumbai along with regional labour institutes in various cities award a one year diploma in safety which is one of the statutorily approved courses for a safety officer in an industry. The syllabus for this course should be enhanced by having additional requirements for qualifying as a safety officer for a chemical industry. The following topics may be included for this special course:

1. Difference between occupational and process hazards
2. Various Process hazards in a chemical processing industry
3. Process hazard analysis techniques with special focus on “what if” and Hazard and Operability (HAZOP) studies.
4. Layers of defense in process design
5. Management of change
6. Techniques for Root cause analysis of process incidents
7. National disaster management authority (NDMA) guidelines for chemical disasters
8. Human factors and its importance in process safety management
9. Various process incidents that have taken place across India and their root causes
10. Analysis of few incidents from the Chemical Safety Board of USA

d) Lack of sharing of Process incidents:

An initiative called Chemical Accident Information and Reporting System (CAIRS) has been developed to share information about process incidents among the law enforcers. It is a Web Based System where concerned authorities as mentioned in schedule 5 of Manufacture, Storage, and Import of Hazardous Chemical Rule (MSHC) Rules, 1989 can register online (with password security) and post chemical accident information in the pre-set formats. It provides storing, retrieving and analyzing data in visual form for all the information related to the chemical accidents happening in India. The CAIRS project has been developed by Environment & Forest Informatics Division in close consultation with Hazardous Substances Management Division of the Ministry of Environment & Forests [3].

The effectiveness of this system is not known as the website does not reveal many details to the public. It would be a good initiative by the Government to share details and root causes of all chemical incidents that have been reported to the statutory authorities across India.

e) Lack of implementation of facility siting rules:

One of the reasons for the high casualty figures in the Bhopal gas disaster was the development of illegal settlements around the factory. The lack of enforcement of rules led to the development of these illegal settlements, causing many deaths when the deadly methyl isocyanate gas leaked. The Indian Oil Corporations oil terminal fire in Jaipur in 2009 again highlights the need for enforcement of regulations related to facility siting.

There are numerous examples of developments allowed to take place near an approved chemical industry without the enforcement of rules by authorities. One example is the

development around the major refineries in Vishakapatnam and Mumbai. Unless local authorities enforce the rules, the chemical industry is helpless in preventing the development around it. The lack of enforcement of keeping a safe buffer zone around chemical plants by the authorities is a ticking time bomb.

f) Independent investigation and reporting of chemical incidents:

For the first time in the history of the Indian chemical industry, the oil industry safety directorate has put up the investigation report of the Indian Oil Corporation's Jaipur oil terminal fire on its website. This is a good beginning by the Government for increasing public awareness and also increasing the accountability of organizations.

As India's chemical sector grows rapidly, it will become necessary to constitute and commission a chemical safety board to independently investigate chemical incidents across India. This board may be developed on the lines of the Chemical Safety Board in the USA. The U.S. Chemical Safety Board is authorized by the Clean Air Act Amendments of 1990 and became operational in January 1998. The Senate legislative history states: "The principal role of the new chemical safety board is to investigate accidents to determine the conditions and circumstances which led up to the event and to identify the cause or causes so that similar events might be prevented." The US Congress gave the CSB a unique statutory mission and provided in law that no other agency or executive branch official may direct the activities of the Board. Following the successful model of the National Transportation Safety Board and the Department of Transportation, Congress directed that the CSB's investigative function be completely independent of the rulemaking, inspection, and enforcement authorities of EPA and OSHA. Congress recognized that Board investigations would identify chemical hazards that were not addressed by those agencies.

Although the Board was created to function independently, it also collaborates in important ways with EPA, OSHA, and other agencies. The Board has entered into a number of memorandums of understanding (MOUs) that define the terms of collaboration. For example, in cases where several agencies are conducting investigations of a particular accident, the MOUs outline mechanisms for coordination in the field. The goal of the MOUs is to allow each agency to carry out its statutory mission efficiently and without unnecessary duplication of effort [4].

The CSB is doing a great service to the chemical industry worldwide by investigating and reporting of chemical process incidents in its website. The Indian government may implement a similar model in the Indian context to investigate and report to the public on chemical accidents in India. This will help in improving accountability of the industry as a whole and also educate the public. Today, the greatest difficulty in India is the lack of information about chemical process incidents. While the industry may not want their skeletons to be disclosed in public, the transparency by adopting an independent investigation agency will reap many benefits for the Indian chemical industry as whole, in the long term.

g) Lack of a coordinated Security management system for chemical Industries:

The U.S. Department of Homeland Security was formed in the USA after the 9/11 attacks. It has established rules for risk-based performance standards for the security of chemical facilities. It requires covered chemical facilities to prepare Security Vulnerability Assessments, which identify facility security vulnerabilities, and to develop and implement Site Security Plans, which include measures that satisfy the identified risk-based performance standards. It also allows certain covered chemical facilities, in specified circumstances, to submit Alternate Security Programs in lieu of a Security Vulnerability Assessment, Site Security Plan, or both [5].

With India also experiencing terror attacks, it becomes necessary for security vulnerability analysis to be conducted for the Major Accident Hazard industries. A coordinated approach towards establishing an industry- government initiative is required to prevent chemical industries becoming a victim of a terror attack.

h) Lack of readiness for offsite chemical disasters:

Though the Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 requires preparation of Off-site disaster management Plan by the District Collector and the constitution of four-tier Crisis Groups at the Centre, State, District and Local level for management of chemical accidents. As per the National Chemical Disaster Management Guidelines for Chemical disasters, 2007, [2], off Site emergency plans for 166 districts have been prepared. Twenty-six of them are based on hazard analysis studies undertaken at the initiative of the Ministry of Environment and Forests. Presently, a mock drill of the On-Site plan by occupiers of MAH units every six months is a statutory requirement. However, only a few mock drills of prepared Off-Site plans have been conducted.

Many of the risk assessments that are conducted using consequence modeling use population data that was available during the assessment. With constant change in habitation patterns, it becomes important to update population statistics every year and redo the risk assessments to determine if additional measures are required to mitigate the risks posed by increased population.

The current legislation in India has a predominant focus on emergency planning and disaster response. While this is good, it also requires an equal focus on prevention measures to avoid a chemical accident in the first place.

INDUSTRY CHALLENGES:

The Process Safety Management challenges facing the Indian Chemical Industry are many. They are listed below:

a) Improving credibility of the Chemical Industry with the Public:

In today's media savvy World, news of an accident in the Chemical Industry mars the image of the Chemical Industry as a whole. While major players in the Industry are proactively adopting process safety management best practice and thereby avoiding catastrophic accidents, many of the of medium and small scale sector chemical industries in India are averse to deploying resources to implement a process safety management system. This sector also handles highly hazardous chemicals. A release of a small quantity of these chemicals has the potential to cause

an offsite incident with catastrophic consequences. This sector also handles a number of highly hazardous reactions with potential for runaway reactions and subsequent consequences. Process hazard analysis is almost nonexistent in this sector. Many modifications are carried out without properly assessing them for potential hazards. Technical capability to understand and follow process safety management practices is lacking. The sector has experienced a number of accidents in the recent past, with fatal consequences. Every accident that is reported in the media reinforces public perception that the chemical industry is dangerous and should not be encouraged. The recent public opposition to the Kudankulam nuclear power project highlights that need for improving public perception of potentially hazardous projects, including those in the chemical sector.

India has a large number of chemical industry associations. Some of them include the Indian Chemical Council, Pesticide Manufacturers Association of India, Alkali Manufacturers Association of India, Fertiliser Association of India, Indian Drug Manufacturing Association, Bulk Drug Manufacturing Association, Dyestuffs Manufacturers Association of India, Pharmaceutical and Allied Manufacturers Association etc.

The numerous Chemical Industry associations in India must get together and develop a process safety resource pool for the use of those small and medium scale organisations that cannot afford these resources. The bigger players in the industry must take a lead role in the association's effort. The process safety resource pool should be funded by the various chemical industry associations and services of this pool can be subsidized to the medium and small scale sector based on criteria set by the associations.

b) Lack of risk based approach to process safety:

In organisations that have implemented a process safety management system, the pressure to cut costs and improve productivity is continuously increasing. Organisations that do not have a robust risk based process safety management system tend to override the system in times of profit and productivity pressures. Decisions that are made during cost cutting and profit pressures may have an adverse effect on process safety. Management of change procedures have a tendency to get bypassed during these circumstances. The institutionalization of a risk based decision making process that is applied throughout the organization right from board level decisions to the decisions made by a plant manager is necessary to ensure that process safety is considered in a systematic way and does not get the chance to be overridden even during times of pressure.

c) Lack of sharing of incidents:

One of the biggest teachers in Process Safety is the lessons learnt from past incidents. Though there are numerous chemical associations in India, the lack of sharing of incidents even by their members needs to be improved. It is recommended that every chemical association in India collect and share incidents that have occurred in their member companies and share it with other associations without mentioning the name of the company in which the incident occurred. Dr. Trevor Kletz has said "organizations do not have memory". Time and again what is observed is that an accident that occurred many years ago is repeating today. Sharing of incidents and ensuring that the incident learnings are cross fertilized across various sectors of the industry like oil and gas, petrochemicals, pesticides, dyes, fertilizers etc will definitely

prevent incidents. The author has started a small initiative to share knowledge about process safety and incidents in his blog [6].

d) Lack of credibility of System Certification:

Though many of the Indian Chemical Industries are certified to ISO 14001 (Environmental Management System) and OHSAS 18001 (Occupational Health and Safety management System), the quality of third party certification has deteriorated over the years. Many Industry associations do conduct their own assessments of the member company's process safety performance and institute annual awards. The criteria and selection process for these awards should be made public. This will help to build public confidence in the selection and award process.

e) Lack of technical competency to run a process safety management system:

The management of Process safety requires technical competency. The management of change element in PSM requires understanding and application of relevant engineering standards and codes, relief system selection, sizing and design basis, equipment sizing and specifications, emergency shutdown system design, electrical hazardous area classification, Safe Operating and instrumentation philosophies, design basis of trips and interlocks etc. Training on relevant process hazard analysis techniques is also important to maintain the integrity of the PSM system. Unless the technical competency to operate the PSM system is clearly specified and an ongoing training program is implemented, the lack of technical competency may lead to a false sense of complacency. Top management may be under the false impression that all changes are being processed through the management of change element of the PSM system and all process hazards are hence being effectively handled. On the contrary, the change may be being processed without all process hazards identified.

The Baker panel report of the BP Texas refinery disaster, which gave suggestions to the chemical industry as a whole, throughout the world, has recommended that a person with process safety competency be appointed on the board of directors to help the board to fully understand the consequences of certain board level decisions on process safety. In today's scenario, this recommendation is highly relevant as many of the boards of chemical industries do not have a person competent to understand the technical implications of certain decisions that may have a direct impact on process safety.

Another area that needs improvement is the lack of simulator training of operators for the process industry. It is a paradox that while India is acknowledged as a superpower in software development, the cost of developing a chemical process simulator for chemical plant operator training is still high. Process simulator training is a very effective tool to prevent human errors in actual operation. Many of the technologies are common across refineries, ammonia plants and petrochemical plants. The concept of cluster simulator training where a set of industries employing common technology contribute to implementing a common simulator training facility will not only be cost effective but also enhance the skills of the operators.

f) Skill development for the chemical industry:

The average age of the Indian population is reducing and is currently reported to be 26 years. This has serious implications to the Indian industry as a whole due to the massive resources required to develop skills of the young generation. The Government has instituted the National Skill Development Corporation with the intent to identify the skill gaps in various sectors and to implement plans to plug these gaps in a time bound manner. The NSDC has brought out a report on the skill gaps in various industries including the chemical sector [7]. It is imperative for the various chemical industry associations to come together and work with the NSDC to ensure that the industry needs are secured for the future.

ACADEMIC CHALLENGES:

a) Lack of process safety curriculum in chemical engineering undergraduate courses:

A chemical engineer who graduates from a university in India has inadequate knowledge of process safety requirements. Though some of the universities are incorporating some process safety requirements in the courses, a holistic approach needs to be taken. A process safety curriculum needs to incorporate the following topics:

1. Process design basis and its relevance to process safety
2. Engineering codes and standards and their importance to process safety
3. Process hazard analysis techniques like “what if” and hazard and operability (HAZOP) techniques and their importance process safety
4. Technical requirements for managing change in a chemical industry
5. Relief systems and their importance in process safety
6. A complete analysis of the Bhopal gas disaster, its reasons and its relevance in current times also. This is important as many of the recent incidents around the world have many reasons common to the Bhopal incident. The lessons from Bhopal must not be forgotten.

b) Lack of continuing education in process safety topics:

Another area that needs improvement is continuing education in process safety management. Indian universities must offer continuing education courses in process safety topics, including inherent safety, nanotechnology and process safety, process hazard analysis techniques, process design and equipment specifications, risk mitigation techniques, human factors etc.

c) Industry- academia research and utilization for improving process safety:

The industry must increase the use of academia for developing and implementing new approaches to process safety. With nano technology and new technologies being developed every day, it becomes imperative that research in these new fields and their impact on process safety be studied.

Many of the small and medium scale chemical industries do not have access to calorimetry data for the reactions they carry out. This results in not understanding the hazards of these reactions and their catastrophic consequences. Academic institutions could assist the chemical industry by conducting reaction calorimetry tests and relief system sizing studies.

Conclusion

The Indian chemical industry is on the path of vibrant growth. This brings about challenges in process safety in the areas of legislative, industry and academia. By a concentrated effort by all three, the chemical industry can effectively manage process safety along with its growth. The public will also be assured that adequate steps are being taken for their safety and that progress and process safety can go hand in hand.

References:

- [1] National Chemical Management Profile for India prepared by Ministry of Environment and Forests and Central Pollution Control Board, http://cpcb.nic.in/upload/NewItems/NewItem_112_nationalchemicalmgmtprofileforindia.pdf
- [2] National Disaster Management Guidelines(2007) published by the National Disaster Management Authority, <http://ndma.gov.in/ndma/guidelines/Chemical-Disaster.pdf>
- [3] Chemical Accident Information and Reporting System, <http://cairs.nic.in/home.aspx>
- [4] Chemical Safety Board, USA, <http://www.csb.gov/about/history.aspx>
- [5] Department of Homeland Security, USA, http://www.dhs.gov/files/laws/gc_1166796969417.shtm
- [6] Process Safety Management India, <http://indiaprocesssafety.blogspot.com>
- [7] National Skill development Corporation Report on the human resource and skill requirements in the Chemicals & Pharmaceuticals sector in India, www.nsdcindia.org/pdf/chemical-pharma.pdf