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Safety Management in the Chemical Process Industries: Implementation of State-of-the-Art Safety Management System to Prevent Chemical Diesters in Chemical Processing Industries

Pankaj Kumar and Prof. Praveen Thatoad

Shiv Kumar Singh Institute of Technology & Science, Indore

Abstract: *It has been observed worldwide that process safety management system is implemented in chemical process industries only. The nature and scale of risk associated with the large-scale and concentrated storage of bulk hazardous substances is ignored in earlier years. But incidents such as Buncefield in the UK in 2005 and the Caribbean Petroleum Refining explosion in 2009 illustrate the catastrophic consequences of a loss of containment and further damage to people, environment, asset and reputation of the organization and country.*

Storage located along estuaries and coastal sites pose a special risk to protected marine environments. The combined pressure of protecting people and the environment comes with the territory of managing any large-scale terminal facility. Fortunately, few operators have ever experienced a catastrophic accident however, the past is not a good predictor of the future when it comes to risk management. Time and human factors often lead to a "Check Box" mentality where requirements are fully complied with "On Paper" with little or no emphases on quality of compliance. Occupational Safety and Health Administration's (OSHA) Process Safety Management (PSM) requirements are often exposed to this "check box" mentality. The big lessons to learn about risks from terminal storage operations over the last 20 to 30 years is that we should implement a process safety management system effectively which manages catastrophic risks and helps to prevent major catastrophic accidents.

Process Safety Management (PSM) comprises the proactive identification, evaluation and prevention of loss of primary containment events in a chemical process due to any failure(s) in the Process, Procedure, Equipment, or Components. Simply put, it deals with the Loss of Primary Containment (LOPC) of Highly Hazardous Chemicals (HHC). The 13 elements of process safety management have been included in this synopsis along with various catastrophic incidents occurred across the world for learning purpose. The implementation of this elements helps to prevent the catastrophic incidents in chemical processing industries

Keywords: Safety Management System

I. INTRODUCTION

The safest and simplest way to avoid chemical Hazards and their ill-effects is to avoid chemical industry itself. But is it possible ? A place of chemical industry can be selected or shifted but it has to run somewhere on the earth and its place in our life has become inevitable because of the following reasons -

1. In homes we need cement, plaster, tiles, paint, plywood, glass, plastic, curtains, TV, tubes etc.
2. In kitchen we want gas, fuel, matches, heating appliances, metal or ceramic dishes etc.
3. For health we need drugs, pharmaceuticals, cosmetics, perfumes, talc etc.
4. Agriculture needs fertilizers and pesticides.
5. Construction requires minerals, metals, lime, cement, explosives etc.
6. Transportation needs petrol, diesel, gas, paints, rubber etc.
7. Clothing requires dyes, colours, soaps, detergents and a variety of chemicals.

Chemical industry is also useful for national production and employment for many people.

It is, therefore, not possible to avoid or prevent chemical industry and the only way remains for us is to run this industry safely by identifying, avoiding and controlling its hazards. This, in turn, suggests the following ten-point safety programmer :-

1. Study and identify chemical hazards using material safety data sheet (MSDS) and a system of classification, packaging and labeling should be developed.
2. Select safer technology.
3. Select safer sitting of chemical industry for minimum loss to men, material, environment etc.
4. Design and construct the factory with all safety precautions from the very beginning.
5. Workplace hazards inside the factory should be controlled by good engineering controls, safe work methods or operating procedure and using personal protective equipment.

II. LITERATURE REVIEW

Essentially the proposed research is expected to cover three distinct subject areas, namely PSMS, BEA and QRA, each of which on its own is a very comprehensive subject. So the literature review will not attempt to discuss each subject in its entirety, but to highlight the links that exist between them, the gaps that still exist and the future direction of research areas as indicated by various researchers. This chapter mainly provides critical reviews of the current situation which deals with PSMS, Bean QRA with the emphasis on the incorporation of management and human error influences to risk assessment. Such review aims to set the scenario of the proposed research and show the direction for its implementation.

Current Situation on Major Hazards Control in India

India as a fairly comprehensive nugatory system o ensure safety and health at work places. Through The Factories and Machinery Act 1967 (FMD, 1967) and the new Occupational safety and Health Act 1994(DOSH, 1994) which is base do n the UX Health and Safety At Work etc Act (HASEWA) (HSE, 1974) the safety and health of workers at work being regulated throughout the country.

However there are other areas which are not regulated in such an explicit manner, yet could significantly contribute to the overall risk from a major hazard installation. Areas like safety managements stem, operator's kill and qualifications the control of human error and the overall system reliability still much left to the operators to implement. This situation to a certain extent resulted in different systems being adopted by each MH operator with different end results. Those who have adopted a good system will benefit from good PSMS performance while those who have not will suffer from low PSMS performance. Similarly from human error point of views operator which implement an effective human error reduction strategy will benefit from low incident rate that contributed to human error while those who do not.

The Application of QRA for Major Hazards Control

The unfortunate events resulting from major hazards incidents that occurred around the world have prompted the need for an effective control system. The major accidents that have took place in Saves, Fill borough, Bhopal and Mexico City, and Piper Alpha has increased the public awareness which in turn have put pressures on various governments to provide legislative measures to prevent such accident from taking place.

In Europe, the EC Directive (CEC, 1982) provided the basis for such legislation. The Directive requires that safety studies of major hazards have to be carried out. In some European countries like the Netherlands the safety studies must include quantified risk estimates (Jensen, 1992). Other countries like Germany do not use probabilistic method, instead rely on consequence analysis to assess safety distance and protective measures (Pasman, 1995). The Health and Safety Executives (HSE) in the U. K uses tolerability criteria of risk for land planning purposes (HSE, 1989).

Current Approaches of QRA

QRA is a methodology for assessing and improving the safety of a technology. The methodology entails the construction of possible chains of events called 'event tree 'which lead to unwanted consequences r working backward, constructing chains of faults called 'fault tree' in search for accident precursors. The risks are quantified by calculating an estimate of probability of these event or fault sequences and combining this with an estimate of consequences(T Weddle, 1992).

This method as introduced s an alternative o deterministic ethos hitch have been the basis of most safety criteria in the past, for example the use of a single criterion and the fail-safe principle. The weakness of a deterministic approach is that it adopts conservative assumptions, and consequently focuses on worst case accident scenarios which provide an unrealistic picture of the safety system and give little evidence on the relative ranking of safety improvements (Bayer, 1991).

The American Institute of Chemical Engineers (AIChE, 1989) described ten components of QRA. They are;

1. QRA Definition: deciding on study goal and objectives
2. System Description: compiling of all technical and human information needed for the analysis
3. Hazard Identification: identifying hazards that could arise from the system using techniques such as HAZOP, FUEA, Fault Trees and Event Trees.
4. Incident Enumeration: identifying and tabulating of all events or incidents without regard to their importance or to the initiating event RISKAT (Neuss eye t al, 1993)w as developed by HSE initially for major toxic hazards and later was refined and extended to flammable hazards. As it is not commercially available its use is restricted within HSE and some other research institutions. SAFETI (DNV, 1994) was developed by Technical Ltd. for the Dutch Government and later was commercialized dosed by quite a number of organization through out the world. There are other software eking eve loped for the same purposes but they are either not as complete as these two or have not matured yet to gain wide acceptance.

However the application of such data may not be representative to developing countries as they are mostly obtained from developed countries which have different operating conditions, level of inspection and maintenance, and operator skill and experience. So ideally a comprehensive country specific data base would be the best sources of data. While the accuracy of the QRA may not be significantly affected for certain data bases like the failure rate, the effect of not using local weather data could be severe, for example for toxic releases (Marshall et al, 1995).

The strength of QRA lies in its ability to decompose complexes systems and extrapolate failure rates derived from historical operating data on the component parts such as vessels and pipe work. Experience as shown hat QRA methodology s well suited for identifying safety improvements in plant design and operations or regulatory compliance, as well as for general safety purposes such as land sitting and environ mental pact statements. The technique as been used extensively an the aerospace, electronics, nuclear and chemical process industries to quantify the likelihood of either a specific incident of event of a sequence of event (Cox et al,1992)

There are a number of weaknesses the current approach of QRA. They can be divided into technical imitations and management citations (AIChE, 1989). The technical imitations s mainly due to the many ounces f uncertainty t all stages the risk assessment recess. They include incomplete numeration f incidents, improper selection of incidents, unavailability of required data, and uncertainty inconsequence's and frequency modeling. Management imitations include lack of resources(personnel me and tool) and inadequate ill to perform he analysis

The influence of PSMS on QRA

According to Hurst (1989), Quantitative risk Assessment(QRA) has traditionally end enveloped on a hardware or engineering base approach but increasingly man factors consideration re seen s at least equally important determinants f risk. It is an important suet o consider he extent o which humane error are included and how organizational structure and managements style affects he risk from specific plant. Kuo (1994) is of the opinion that the identification of hazard for risk analysis and reduction ends o be seen s an engineering sky, but for the effective treatment safety there is a need for the incorporation of the PSMS. More often than not the roles of management and humane error in safety are often not fully understood(Twiddle, 1992). Hence there is a need to address the effects of PSMS in risk analysis as well as to measured e humane error contribution n the overall risk arising from hazardous lent operations. If an effective method could be established to relate human error to PSMS, and PSMS to risk analysis, it would allow more accurate assessment risk from a hazardous lent o be carried out.

The quantification of PSMS influences

As QRA gained considerable acceptance the regulators and the operators he need to look at the possibility of quantifying he management fluencies rose when the industry started to query the application of generic failure rate to all plant and companies spite management inferences hen carrying out the QRA. It is comment hat for a consideration f the QRA, plant hardware net he performance fits PSMS be kept quite separate because while the interlocking between hem is wallop appreciated it is not well understood(Hurst, 1993).

The implicit approach

Modification of Risk

Qualitative Analysis of Human Error

Early human reliability methodologies were dominated by behavioral psychology, and measurements were taken of simple stimulus or response tasks to the exclusion of higher level decision making and problem solving tasks and out of context of the overall system. The behaviorist view of human as a mechanism (or a machine) fitted in with the way in which the human component was modeled in most system reliability assessments s being described by Hagen and May (1981). Here human error is treated as a factor in system reliability and needs to be seen as a process itself Probability data on required task performance were feed into conventional fault reanalysis in the same way as hardware component failure probabilities. Then whether his error could be recovered, and if it cannot be recovered what would be the a sequences at will affect the overall system reliability are considered.

In this context humane error is viewed as a socio technical recess anther than as an individual psychological recess. his requires he study on the interrelation of task, individual, organizational net technology which contributes to human error.

The various approaches attempting to deal with human error analysis that have been described above could be adequately summarized by AIChE (1994) to be made up of,

1. Traditional Safety Engineering
2. Human Factors Engineering/Ergonomics
3. Cognitive System Engineering
4. Socio technical Systems

In between the two classes of techniques hat has been described above lies the System for Predictive Error Analysis nor education(SPEAR)technique. The SPEAR framework was developed s one of the methodologies for analyzing and reducing risks arising from human error in chemical recessing dustiest (Embreye t al, 1994). It is based on an earlier computerized am work called SHERPA which has been developed for the same purposes (Embrey et al, 1986). The framework was developed in order to provide a logical and consistent structure to allow users to easily apply specific technique for human error analysis such as task analysis and predictive error analysis. SPEAR represents an integrated et of techniques or identifying tasks here human error could occur with severe consequences. It goes on with the processor of identifying pacific errors and their consequences within the task. The framework also facilitates he development f cost-effective ethos or reducing the probability of these error. In the area of risk assessment the frame work could be used to identify a critical task with high risk potential which subsequently could be used as input for QRA.

Quantification of Human Error

Safety and Reliability Directorate (SRD) in its publication on Human Reliability Assessor Guide (Humphreys, 1988) described eight techniques for determining human reliability;

1. Absolute Probability Judgment (APJ)
2. Paired Comparison (PC)
3. Technique Empirical Stoma Operation (TESEO)
4. Technique for Human Error Rate Prediction (TIHERP)
5. Human Error Assessment and Reduction Technique (BEART)
6. Influence Diagram Approach (IDA)
7. Success Likelihood Index Method (SLIM)

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8. Human Cognitive Reliability Method (HCR)

The Time-Reliability Curve approaches are based on the assumption that the probability that the operator will not perform a required function is primarily dependent on the time available after the onset of the signal for action. HCR is one of the technique which use this approach where its correlation is a set of time-reliability curves whose shape is determined by the type of information processing associated with the task being performed. It encompasses the ret yes of information recessing; skill-based rule based and knowledge-base processing.

Need of Safety In Chemical Industry

Though safety in each field is of equal importance, safety in chemical field needs more attention because of its specific nature. Chemical safety seems more complicated than civil, mechanical or electrical safety because each chemical has many properties, many processes, many hazards and many controls. The state, pressure, temperature, process parameters etc., are also changeable. Many hazard data and complete reaction documents are still not available. Many hazards are known after the accident only as in case of Bhopal and so many incidents. Engineering controls may not be possible or available at many places. Control devices and personal protections are inadequate many times. Warning devices may either not be available or not be functioning well. All these diversified working conditions and operational situations pose many dangers which need their proper knowledge and attention followed by proper safety measures and proper preventive as well as corrective maintenance.

Bhopal accident is remarkable. It caused more than 2500 deaths, many more injuries and became world famous attracting everybody's attention toward chemical safety. It has opened the eyes and shaken the governments and all safety people to wake up. Many expert committees have been formed and safety reports are published. The Factories Act is rapidly amended to include many matters on chemical safety. Many seminars have been held and the chemical wave is still continued. This shows the significance of chemical safety.

III. TYPES OF CHEMICAL INDUSTRY

Before proceeding toward general safety aspects it is essential to have a look on variety of chemical industries and to realize a very wide scope of the subject. Thousands of volumes are available on chemicals, their processes, effects and control measures. But it is a fact that out of lacks of chemicals, published data of their dangerous properties is available for a few thousand only. Therefore most of then known chemicals must be handled very carefully. This requires basic knowledge of chemical safety. General knowledge is always useful for any type of chemical industry. The 27 dangerous operations, 29hazardous industries and 29 modifiable occupational diseases due to such chemical industries are given inParts6.5 to 6.7 of Chapter-4.

National Industrial Classification (NIC-1987) Major Group No. 30 lists 50 types of chemicals and chemical products industries and Major Group No. 31 lists 35 types of rubber, plastic, petroleum and coal product industries. But this is still a broad classification and types of chemical factories are day by day increasing.

IV. STATUTORY PROVISIONS

The Factories Act contains specific provisions on chemical safety. Section 2(cb) defines 'hazardous process'. Section7A and 7B specify general duties of occupiers and manufacturers for health and safety. Sections II to 20 regarding cleanliness, disposal of wastes and effluents, ventilation and temperature/dust and fume, overcrowding, lighting, drinking water, latrines, urinals and spittoons are all useful for chemical factories also. The whole chapter-IV (Sections 21 to 41) on safety is also relevant. Provisions of hoists and lifts, lifting machines, revolving machinery, pressure plant, floors, stairs and means of access, pits, sumps, openings in floors, excessive weights, protection of eyes, precautions against dangerous fumes, use of portable electric light, explosive or inflammable dust, gas etc., fire and building safety are also useful in chemical factories.

Amendment of 1995 (w.e.f. 15-2-95) in the Gujarat Factories Rules 1963, has added many details for chemical factories and for safety, health and welfare of the workers. Newly added following schedules ,u/ r 102, must always be referred for strict compliance

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Sch.19 - Chemical Works
Sch.21 - Solvent Extraction PlantSch.22 - CS2Plant
Sch.25 - Pottery,and
Sch.26 - Foundry.

Other Laws on chemical safety include the Boilers Act 1923, Gujarat Boilers Rules 1966, Indian Boiler Regulations 1950, The Petroleum Act & Rules, The Explosive Act & Rules, The Insecticide Act &Rules, The Poisons Act & Rules, The Electricity Act & Rules, Gas Cylinder Rules 1981, Static and Mobile Pressure Vessels Rules 1981, Water and Air Pollution Control Acts and Rules, Environment (Protection) Act 1986 and Rules, Hazardous Waste Management Rules1989,MSIHC Rules1989,Chemical Accidents (EPPR) Rules 1996, Bio-Medical Waste Rules 1998, Building and Construction Workers Act 1996 and Central Rules 1998, Atomic Energy Act, Radiation Protection Rules etc. See Chapter-28 for all such Acts and Rules.

As the details of all above provision serer daily available in statute books, they are not reproduced here. It is recommended to refer them for details as they are directly applicable and create legal responsibility also.

V. INDIAN STANDARDS

Sectional lists of Indian Standards on chemical, Indian Standards on safety and BIS Handbook are readily available at Bureau of Indian Standards Offices. Each industry should select applicable INDIAN STANDARDS booklets from the selection al lists. They are most useful. As ample list is given below Code of Safety for Acetic acid 5208, acetic anhydride 5302, acetone 7445, air purifying canisters 8318, ammonia 4544, aniline 7415, benzene, toluene & xylem 4644, bromine 6953, calcium carbide 6819, carbon disulphide 5685, caustic soda 4264, laboratory safety 4209, 4906, glossary of terms, chemical and radiation hazards 4155, glossary of terms, respiratory protective devices 8347,glossaryofterms,explosives10081,chlorine4263,classificationofdangerousgoods1446,classificationofhazardouschemicalsandchemicalproducts4607,ethyleneoxide6269,cryogenic.liquids5931,hydrochloric acid 6164, lead and its compounds 4312, LPG installation 6044 (Part I & II), mercury 7812, methanol 7444, nitric acid 4560, phenol 6270, phosgene 8185, sulphuricacid 4262,vinylchloridemonomer 9786.

Fire safety of buildings 3594, ventilation in petro chemical plants and refineries 12332, classification of flammable gases/vapors with air according to their maximum expert mental safe gaps and minimum igniting currents 9570, maintenance and operation of petroleum storage tanks 9964 (Part I&2),safety in electro-heat installations 9080 (PartIto4), flash back arrest or(flame arrester)11006, purchaser's data sheet for gas scrubber, cooler or absorber 9240,safety belt and harnesses 3521, breathingapparatus10245(PartIto 4).

Methods of sampling chemicals and chemical products 8883 (Part I & 2), methods of sampling and test for industrial effluents 2488 (PartI to 5), tolerance limits for industrial effluents CHD 12, or2490 (PartI to 10), treatment and disposal of effluent? of cotton and synthetic textile industry 9508,liquid sedimentation methods for determination of particle size of powders 5282, solid. waste analysis10158

OISD Standards:

Oil Industry Safety Directorate (OISD) has published the safety standards for oil refineries, LPG bottling plants, gas terminals, ONGC and GAIL installations etc. Some such standards are mentioned below:

OISD Standards:

OISD-106 Process design and operating philosophic on pressure relief and disposal system.
OISD-110 Recommended practices on static electricity
OISD-112 Safe handling of air-hydrocarbon mixture; and pyrophoric substances.
OISD-117 Fire protection facilities for petroleum depots and terminals.
OISD-118 Layouts for oil and gas installations.
OISD-119 Inspection of pumps. Inspection of compressors.
OISD-120 Inspection of turbines & diesel engines. Inspection of rotating equipment components.
OISD-121 Predictive maintenance practices. Inspection and maintenance of mechanical seals.
OISD-126 Specific maintenance practices for rotating equipment .

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OISD-127	History recording of rotating equipment.
OISD-128	Inspection of unfired pressure vessels.
OISD-130	Inspection of pipes, -valves and fittings.
OISD-132	Inspection of pressure relieving devices.
OISD-137	Inspection of electrical equipment.
OISD-140	Inspection of jetty pipelines.
OISD-144	LPG bottling plant operations –
Vol. I	Design philosophies.
Vol. II	Operating practices
Vol. III	Inspection and maintenance practices
Vol. IV	Safety and fire protection
OISD-146	Preservation of idle electrical equipment.
OISD-147	Inspection and safe practices during electrical installations.
OISD-148	Inspection and safe practices during overhauling electrical equipment.
OISD-153	Maintenance & inspection of safety instrumentation in hydrocarbon industry.
OISD-154	Safety aspects in functional training.
OISD-156	Fire protection facilities for port oil terminals.
OISD-160	Protection of fittings mounted on existing LPG tank trucks.
OISD-161	Rescue and relief operation involving tank truck accident carrying LPG.
OISD-162	Safety in installation and maintenance of LPG cylinder manifold.
OISD-169	Small LPG bottling plants (Design and fire protection facilities).

TYPES OF CHEMICAL HAZARDS AND CONTROLS

People working in chemical factories and dwelling nearby are exposed to various types of chemical hazards. Inflammable, explosive, toxic, corrosive, reactive, radio active, oxidizing, reducing, decomposing, compatible and hidden hazardous nature of chemicals pose material or property hazards. In process, chemical and physical change, chemical reaction, pressure, temperature, level, flow, quantity and other parameters create process hazards. The vessels and equipment in which the chemicals are stored, handled or processed, pose vessel hazards.

1 Health (Toxic) Hazards:

(a) Types of effects are-

Allergy, Irritation, Oxygen deficiency (asphyxiation). Systemic poisoning (eg damage to liver, kidney, CNS, reproductive system etc.). Cancer, Damage to unborn fetus (teratogenesis). Genetic effects on future generations (mutagenesis). Dust effect (pneumoniosis).

Some effects are acute (local or short term) and some are chronic (long term, delayed or after repeated exposures).

(b) Factors creating effects are-

Type of concentration of chemical. Combined effects of mixtures, Properties of the material including its toxicity. Work methods. Nature of exposure (short term, long term) Routes of entry (through nose, mouth or skin)and Individual susceptibility.

2 Fire and Explosion Hazards:

Heat generation due to chemical reaction, Open flame, Radian theat. Friction, Spent an oust combustion. Electric current. Static electricity and Fuel or Solvents like Low flash point and Low boiling point liquids, Gases and Solids (dusts, powders, lumps, crystals)

Biological Hazards:

Biohazards refer to plants, insects, animal and human pathogens that pose a potential risk to the health of humans, animals and also to the environment. Their ill effect is the illness through infection or disruption of the environment.

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They can be unique to a specific occupation or may affect the general public as epidemic(e.g. cold virus)or spread from person to person like highly publicized AIDS.

Occupational exposure is possible in bio-laboratory work, hospitals, nursing or medical research, farming ,agriculture, slaughterhouses, meat cutting and packing etc.

Safety and Control Measures : These are necessary to prevent health effects of toxic, highly infectious or oncogenicbio-agents. A written control plan including instructions for awareness, emergency action, safe procedure for handling, first-aid and reporting is useful. Employees should be immunized by effective vaccine if available. Vaccination is effective against smallpox, tetanus, yellow fever, diphtheria and hepatitis B. Proper placement and medical surveillance are also important. Pre-placement medical examination can give abase line reference. Work assignment records should be maintained.

Pregnant women working in on cognac virus laboratories should be counseled at the earliest possible time. They should be transferred to anon-vireo logical department if possible.

Good housekeeping, quick decontamination of place and equipment, sterilization, cleaning by germicide, use of PPE, no eating, drinking, smoking etc. in work areas, display of biohazard symbol, animal care and handling, bio-safety cabinets (local exhaust ventilation), effective filtration of room-air, ultra violet air locks and door barriers to separate area so unequal bio-risks, change rooms, safety showers, effluent treatment etc., are important safety measures.

Preventive & Control Measures:

Six Basic Principles

1 Elimination of substance or process.
2 Substitution of safe alternative.
3 Distance, Guard, Enclosure, Isolation, Shielding or Segregation of hazardous process.
4 Ventilation, general & local exhaust.
5 Personal Protective Equipment.
6 Personal hygiene.

Emergency Control Procedures:

1. Speedy Leak & Spill Control procedures.
2. Emergency shut-down procedure.
3. On site emergency plan.
4. Off site emergency plan.
5. Mutual aid arrangement with neighboring industries.
6. Retainer ship for help at the time of emergency.
7. Regular rehearsal of emergency procedures (drill), updating and reviewing of the plan.

Storage Hazards and Controls

Mainly three types of vessels are used in industry. Storage vessels. Reaction vessels and Pressure vessels. Their safety aspect is discussed in brief below :

Material of Construction and Lining:

The first step toward controlling vessel hazards is the proper selection of construction of material for the vessel depending on the type of chemical to be stored or processed, chemistry of that chemical in relation to the material of vessel, type of use, durability required etc.

Storage Vessels and their Safety Aspects:

Storage vessels are used to contain chemicals in bulk. Storage tanks to contain 10 tones to 10000 tones material are constructed. Oil refineries, petrochemical plants or fertilizer plants have even bigger tanks also. If such tank leaks, breaks or caught in fire, a great hazard is possible. Bhopal tragedy was also arose from a storage tank of methyl isocyanine. When a fire, explosion or gas leak takes place from a bulk quantity, tremendous efforts are required to

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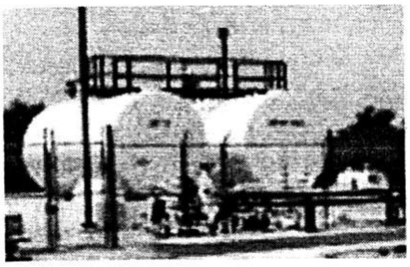
control the situation and save loss to people, property and environment. There fore safety of storage tanks need; highest attention. Some main points are mentioned below-

The main types of storage are:

1. Liquid atmosphericpre sure and temperature (i.e.ambient condition).
2. Liquefied gas under pressure and atmosphere temperature.
3. Gas under pressure and
4. Refrigerated storage of liquids at low temperature(e.g.ammonia).



Safe Design and Maintenance:
After studying the properties of the material to be stored, proper selection of the material of construction, metal thickness, design, nozzles, connections, pipe lines, fittings, valves, pumps, lining, coating, jacketing, insulation, cladding etc. and color coding are necessary.

Notice of Identification:
A notice indicating the name of the chemical stored, tank capacity (tones or liters) and some important properties (e.g. Sp. gravity. Vapour density, Boiling point. Flesh point, LEL-UEL, TLV and Solubility) should be displayed on or near the tank. It should be clearly and easily visible and in the language understood by the workers.

Dyke or Bund :
This is required to restrict the spread of the leaking material, to safely contain with in its periphery and to restrict the surface area of the leaking material in order to reduce its evaporation and foresee of fire fighting or other emergency control activity. The contained material can be safely disposed off or if it is burning, it can be extinguished easily by reaching up to dyke wall. If there is no dyke (or bund) the leaking material can come-on the road or go in the plant and make more damage.
By partition walls in dyke, reactive chemicals or chemicals of different flash points can be kept aggregated.

Separation Distances:
Some recommend actions are available to keep minimum safe distance, known as 'separation distance', between two tanks or between two groups of tanks or between a tank and a building or between a tank and a source of ignition. Based on radiant heat from the burning liquid or fire spread by vapors(VCE or BLEVE) such distances are prescribed. Normally a 15 m and 30 m distances are suggested. But based on the tank capacity this distance is variable. In a congested area, it is difficult to maintain such distance.

Vent Pipe:
While filling a tank air has to come out. A vent pipe at the top is required for this purpose. It is also useful to depressurize the vessel before opening it. Its diameter should be sufficient for easy scope of the air. Vent pipe may have a bend or roof to prevent outside thing (rain, bird etc.) going inside. Vent pipe should have wire mesh, flame arrester or breathervalveifany flammable content is in the tank. They should be kept clean to avoid choking.
Normally flame arrester is suggested when the flash point of the content is below 23 °C. When explosive air mixture with vapors pressure is inside the tank, breather valve and flame arrester both are required. Flame arrester will disallow any spark to enter inside. The breather valve will inhale air when inside pressure will drop (due to vapors cooling) and

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exhale vapors when inside pressure will exceed the set pressure (due to pressure rising).Thus Brea the prevents continuous vapors discharge(evaporation) and loss of the content.

Over flow Pipe:
For the overfilling safety a safe overflow pipe is required. Its diameter should be slightly more than the inlet pipe diameter so that the overflow will be maintained if inlet flow is continued. If the diameter of the overflow pipe is smaller than that of the inlet pipe, continuing overflow may reach up to the top (may enter the vent) and damage the tank if the pressure is excessive. Connection of the over flow pipe should be 2 to 3 inch below the roof joint so that the material will come out (overflow) leaving some air space under the roof and the tank will never be subjected to the filling pressure. The overflow pipe should be extended unto bottom to disallow any free fall of the material and to discharge it in the dyke or any container safely.
If the liquid is fuming or contains less toxic or less flammable vapour it should have a valve or a bend with water sealing arrangement (if water is permissible) so that during normal condition vapour will not come out from the overflow pipe. The valve will be open only at the time of filling and closed when the filling is over. HCI vapour should be passed (scrubbed) in water and oleum vapor (SO) in sulphuricacid.

Pressure Relief Devices :
If pressure inside a tank rises due to any reason, it may burst the tank from its weakest part or cause leakage from where it is possible. The content thus coming out is a material loss and in addition, it may create fire, explosion or toxic hazard. Therefore to avoid such situation a pressure relief device is necessary.
A safety valve is a common pressure relief device. It can be set to a predetermined (desired)pressure and when pressure exerted on it exceeds that pre-set value, it automatically opens and allows the pressure to release in the atmosphere or in a catch-pot or drowning tank if the content coming out is hot or hazardous. It automatically closes down also, after release of the excess pressure. Safety valves are of four types - spring loaded, weight lever, solenoid and pilot. Safety valves are used to release gas or vapour but not the liquid.
Relief valves do not full open at set pressure like safety valve, but open slightly and then open further as the pressure increases. They are of two types - spring loaded or power actuated by electric, air, steam or hydraulic power activated by après sure sensorium stream of the valve. Manually operate relieve valves (like vent valve) are also possible but they are to be operated after seeing the pressure in the pressure ague or after hearing an alarm. Relief valves are used for liquid discharge and not for gas or vapour.
Safety-relief valves can be used either as a safety valve or a relief valve, depending on the application. They are used for gas, vapour and liquids.
Fusible plug is a fitting filled with an alloy that melts at a predetermined temperature (not pressure) and gives way to the material to come out. Fusible plugs are used in boilers, domestic pressure cookers and compressed gas cylinders to prevent violent bursting. They are used for gas, vapour and liquid s of high temperature.
Fire or Explosion Relief is provided by making the seam between the shell and the roof of the tank deliberately weak so that it mayrupturefirst and the shell stays intact.
Vacuum breaker is also a type of pressure relief device and works like a spring loaded safety or relief valve but in the reversed direction. The outside atmospheric air pressure being higher than that inside the vessel, opens it to break the vacuum. This is required when the vacuum may increase to collapse the vessel. This device is used for air only.

Handling of Corrosive Chemicals

Corrosive chemical will cause severe damage when in contact with living tissue or, in case of leakage, ill materially damage or even destroy the surrounding they come in contact with. It is likely to cause a fire when in contact with organic matter or certain chemicals. Certain corrosive substances have other more serious hazardous properties (toxicity, flammability etc.) and are commonly classed astoxic or flammable etc .rather then as corrosive.

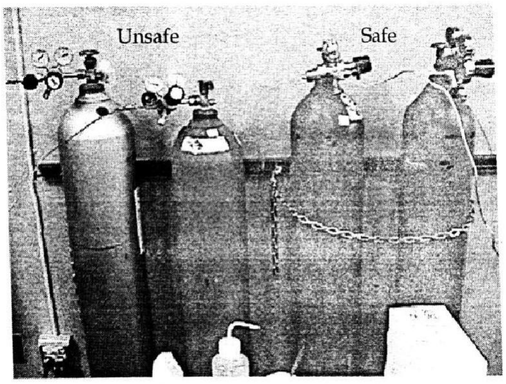
Important corrosive substances are : Acids and anhydrous alkalis, halogens and halogen salts, organic halides, organic acid halides, esters and salts.

When in contact with human tissues, most corrosive substances will produce chemical burns, while certain other substances (as Chromic acid) produce deep ulceration. Many corrosive substances shaved feting action on the skin and may cause dermatitis.

The safe guards against these hazards are:

1 Preventing or minimizing contact between corrosive substances and skin, mucous membranes and eyes.
2 Corrosive sub stances should not be allowed to come in contact with materials that may react.
3 All the containers, pipes, apparatus, installations and structures used for the manufacture, storage, transport or use of these substances may be protected by suitable coatings, impervious to an dun affected by corrosive
4 All containers or receptacles should be clearly labeled to indicate their contents and should bear the danger symbol for corrosives.
5 A highest and arid of maintenance and good house keeping is essential.
6 Adequat ventilation and exhaust arrangement whether general or local, should be provided whenever corrosive toxic gases or dust are present.

Safe Storage & Handling of Gas Cylinders



Cylinders should be tied by chain

In factories we find the use of gas cylinders of oxygen, nitrogen, acetylene, LPG, carbon dioxide, chlorine, sculpture dioxide etc. The gases are filled with pressure. Therefore when they leak, they come out with force and pose hazards of fire, explosion or toxicity. Therefore some rules are to be observed while handling them. They restated below.

1. Following Indian Standards are useful for understanding design, construction, fittings, testing ,safety devices, valves and use of gas cylinders:

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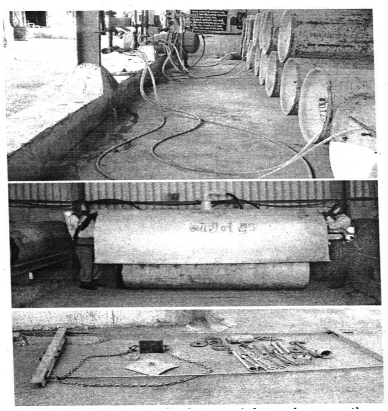
IS	8198 (12parts)	:	Code of practice for steel cylinders for different compressed gases.
IS	7241	:	Glossary of terms.
IS	5903	:	Safety devices.
IS	3224	:	Valve fittings.
IS	7202, 9199 & 9687	:	Threads of valves.
IS	4739	:	Identification of contents (Colour Code).
IS	6901	:	Pressure regulators for welding and cutting.
IS	8868	:	Periodical inspection.
IS	5845	:	Visual in section for low pressure gas cylinders.
IS	8451	:	Visual inspection for high pressure gas cylinders.
IS	8433	:	Visual inspection for dissolved acetylene.
IS	3196 (3parts)	:	For LPG, Steely lenders for low pressure.
IS	8776	:	For LPG ,valve fittings.
IS	8867	:	For LPG, vapour & test pressure.
IS	6044	:	For LPG cylinder installations.
IS	7680	:	For ammonia(anhy.) gas.
IS	7681	:	For chlorine gas.
IS	7312	:	For dissolved acetylene gas.
IS	7142	:	For low pressure liquefiable gas.
IS	7682	:	For methyl bromide gas.
IS	8016	:	Hand trolley for.
IS	5844	:	Hydro static stretch testing.
IS	3933, 3870 & 8382	:	For medical use.

2 Types of safety devices mentioned in IS 5903 are Bursting disc, fusible plug, PRV and their combination. It is prohibited to provide any safety devices on cylinders containing obnoxious or poisonous gases such as CO, HCI, HBr, HF, SO2, CI2, H2S, town gas, Carbonyl chloride, Nitro sylchloride, ,Nitrogen peroxide, Methylamine and Methyl bromide. Shut-off device (except built-in with safety device) is also prohibited.

For mulae for flow capacity of safety devices, identification and marking, number of test and test procedure and periodic inspection and maintenance are also specifiedinIS:5903.

Cylinders–Toners/Containers



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1. Store chlorine cylinder up-right and secure them so that they cannot fall.
2. Ton containers should best oared on their sides on rail safe winches above the floor. They should not be stacked or racked more then one high.
3. Keep enough space between containers so that all are accessible incase of emergency.
4. Store the containers in a covered shed only. Keep them away from hot sun or any other source of heat.
5. Do not store chlorine container with explosives, acids, turpentine, ether, anhydrous ammonia, finely divided metals or other flammable material.
6. Cylinders should be stored on a cement floor sloping towards a pit capable of collecting all the liquid in the cylinders. Under no circumstances should water be allowed to run on to the chlorine in the pit.
7. Do not store containers in wet and muddy areas.
8. Use cylinders in order of their receipt.

Process Hazards and Controls

Types of Processes and Operations

Generally in a chemical plant processes are classified as batch processes or continuous processes or their combination. In a batch process relatively more man-power is required, the workers are exposed to hazards more frequently and process automation and instrumentation are possible only to a limit detents. A continuous process is carried out in a close vessel or circuit and good automation and instrumentation are possible. Many processes are operated at high pressure and high temperature(as incase of petroleum and petro chemical industry)for which automatic warning, monitoring and controlling devices are desired. Pressure and temperature should be properly controlled by cooling and ssafety devices. Flammable, explosives and solvent distillation processes should be carried out under inert atmosphere or vacuum and toxic processes should be connected with appropriate scrubbers and neutralizers.

Adsorption : The adherence of a substance on a surface, the substance that adsorbs is adsorbent and that is adsorbed is adsorb ate. It is relatively a slow penetration or consumption of gas or liquid particles through the surface of another substance mostly solid or liquid. It is used to remove colors, odors and water vapors' through activated carbon, activated alumina, silicate etc.

Rumination : A reaction in which -one or more bromine atoms are substituted for hydrogen atoms in an organic molecule.

Calcinations: Strong heating, conversion of metals into their oxides by heating in air.

Carbonation :Treatment with carbon dioxide. Usually for formation of carbonates.

Catalysis and Catalyst : The alteration of the rate of chemical reaction, by the introduction of a substance (catalyst) that remains unchanged at the end of the reaction. Small quantities of the catalyst are usually sufficient to bring the action about or to increase its rate substantially.

Chained action: Any self-sustaining molecular or nuclear action, the products of which contribute to the propagation of the reaction, viz. nuclear fission.

Decomposition: The breaking up of chemical compound sunder various influencese.g.by chemical action, by heat(pyrolysis),by an electric current(electrolysis),by biological agents(biodegradation) etc

Distillation : The process of converting liquid into vapour, condensing the vapour and collecting liquid or distillate. Used for separating mixtures of liquids of different boiling points or for separating apure liquid from a non-volatile constituent.

Electrostatic precipitation: A widely used method of controlling the pollution of air (or other gases). The gas, containing solid or liquid particles suspended in it, so that the particles are attracted to and deposited upon, the positive lec trode.

End other mc process: A process accompanied by the absorption of heat.

Evaporation: The conversion of a liquid into vapor, without necessarily reaching the boiling point ,use din concentrating solutions by evaporating off the solvent.

Exothermic process: A process in which energy in the form of heat is released.

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Extraction: The process of separating a desired constituent from a mixture by means of selective solubility in an appropriate solvent. Also used to describe any process by which a pure metal is obtained fro more.

Fermentation: A chemical change, brought about in organic substances by living organism(yeast ,bacteria, etc.) as a result of their envy me action.

Fractionating column: A long vertical column, containing rings, plates or bubble caps, that is attached to a still. As a result of internal reflux a gradual separation takes place between high and low boiling' fractions 'of liquid mixture.

Freezing: Change of state from liquid to solid, it takes place at a constant temperature (freezing point)for any given substance under a given pressure(normally standard atmospheric-pressure).

Fumigation: The destruction of bacteria, insect by exposure to poisonous gas.

Hydrogenation: Subjecting to the chemical action of or causing to combine with hydrogen.

Leaching: Washing out soluble constituent.

Use of Vessels, Equipments & Control Room

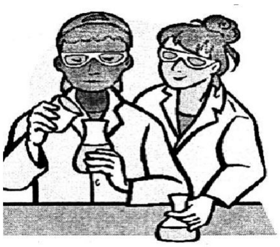
Many vessels and equipments are used in chemical processes. Storage vessels, reactors, distillation vessels, transfer vessels, holding *vessels, measuring vessels, open or closed vessels, pipelines and a variety of equipments are used as per design and need. Their material of construction (MOC) should be studied as stated in Part 8.1 for safety point of view. They should be used in en closed manner as far as possible. Acids, alkali, solvents and dangerous chemicals should not be handled in open bucket or container. Schedule19,Chemical Wo GFR should be strictly followed owed. Necessary PPE should be used.

Operation of valves and other control devices should be done carefully and as per guidelines and training. SOP should be followed.

Safety in Laboratory

Laboratory is used for test in go fray materials, intermediates and finish products. It is also used for research purpose..

Hazard of glass break age should be understood and handle such vessels carefully. Screen and other guard should be provided. Rubber and flexible tubes should be checked frequently and replaced periodically. Their connections should be checked and kept leak proof .Laboratory vessels and reactors should never be subjected to over pressure, temperature, speed etc. Necessary PPE and apron should be used. Safety showers and wash bas in should be provided for washing hands etc.



Batch sheets should be used for recording of the process and necessary instructions should be mentioned for the next shift worker if the process is to continue in the next shift.

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Room exhaust and process exhaust systems should be provided and run efficiently.
Cupboards, shelves and racks are used to put small bottles, equipment etc. Necessary stool or support should be used while working with them. Laboratory should be kept clean, attractive and without any smell, dust or dirtiness

Personal Protective Equipment

1. Chemical splash goggles
2. Faces shields
3. Lab coat
4. Lab apron
5. Gloves (selected based on the material being and led and the particular a hazards involved)

Safety and Emergency Equipment

1. Hand-free eye-wash stations(not eye-wash bottles).
2. Deluge safety showers.
3. Safety shields with heavy base
4. Fire extinguishers(dry chemical and carbon dioxide extinguishers).
5. Sand bucket.
6. Fire blankets.
7. Emergency lights.
8. Emergency signs and placards.
9. Fire detection or alarm system with pull stations.
10. First-aid kits.
11. Spill control kit(absorbent and neutralizing agents).
12. Chemical storage cabinets(preferably with an explosion proof ventilation system).
13. Gallon-size carrying buckets for chemical bottles.
14. Laboratory chemical hood (60-100ft/minute capture velocity, vented outside).
15. Ground-fault in erupted electrical outlets.
16. Container for broken glass and sharps.
17. Material Safety Data Sheets.
18. Emergency Action Plan for the institution.

General Rules for Chemical Storage

First, identify any specific quirement regarding this to rag of chemicals from(1)local. State, and Central regulations and (2) insurance carriers.

Criteria for Storage Area

1. Store chemicals inside a close able cab inetorona sturdy shell with a front-edge lip to prevent accidents and chemicals spills; a¾-inch front edge lip is recommended.
2. Secure shelving to the wall or floor.
3. Ensure that all storage areas have doors with locks.
4. Keep chemical storage areas off limits to all persons.
5. Ventilate test orangeade aide quietly.

Organization

1. Organize chemicals first by compatibility-not alphabetic succession.
2. Sorel phonetically with in compatible groups.

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Chemical Segregation

1. Store acids in a dedicated ac incubi net. Nitric acid should be stored alone unless the cabinet. provide saseparate compartment for nitric acid storage.
2. Store highly toxic chemicals in a dedicated ,lockable poison cabinet that has bee labeled with a highly visible sign.
3. Store volatile and odoriferous chemicals in a ventilated cabinet.
4. Store flammables in an approved flammable liquid storage cabinet.
5. Store water sensitive chemicals in a watertight cabinet in a cool and dry location segregated from all other chemicals in the laboratory

Storage Don'ts

1. Do not place heavy materials, liquid chemicals, and large containers on high shelves.
2. Do not store chemical son top of cabinets.
3. Do not store chemical son the floor, event temporarily.
4. Do not store it meson bench tops and in laboratory chemical hoods, except when in use.
5. Do not store chemical son shelves above eyelevel.
6. Do not store chemicals with food and drink.
7. Do not store chemicals in personals a fire frigates, event temporarily.
8. Do not expose stored chemicals to direct heat or sunlight, or highly variable temperatures.

VI. EXPERIMENT

This chapter presents case studies on Chemical safety , risk assessment and management in Radico Khaitan Limited -Rampur, which are used to illustrate the developed risk assessment and management methodology, including an evaluation of important safety risks using the many methods which have been incorporated into the model. The case study materials were collected from the particular in projects site of The Radico Khaitan Limited -Rampur. The results of the safety risk assessment are safety risk scores for overall project, hazard groups, hazardous events, and types of safety risk with a confidence percentage.

HSE Organizational portfolio

Providing personal protective equipment’s tools and tackles to conduct all work in a safe manner and to ensure integrity of the assets.

Periodic internal and external audits of work procedures and practices.

Investigating all incidents relating to health, safety and environment including minor ones and near misses followed by implementation of corrective measures.

Identifying and evaluating health risks related to its operations and carrying out pre- employment and periodic medical check-up of its employees.

Implementing programs and appropriate protective measures to control such risks.

Continuous monitoring of work environment and plant effluents – gas, liquid and solid and taking measures to achieve better environmental performance.

Interaction with local communities regarding its operations, likely hazards and emergency response systems.

Keeping abreast of latest international codes, standards and practices and adopting the same where applicable.

Broad Objectives Of Safety Department:

- Total Loss Control.
- Protection Of Life & Injury Prevention.
- Fire & Loss Control.
- Materials & Machinery Damage Control.
- Prevention Of Property Damage.
- Preservation Of Environment.
- Uninterrupted Production.

FUNCTIONS OF SAFETY DEPARTMENT

- Compliance Of Statutory Regulations.
- New Innovative And Development Work.
- Internal Audit.
- Safety Management System Audit.
- Plant Audit.
- Training.(Induction + Contractor Employee)
- Shutdown Monitoring.
- Risk Assessment.
- Safety Committee.
- Monthly Performance Review.
- Weekly Safety Engineering Meeting.
- Safety Promotional Activities.

Compliance Of Statutory Regulation

- Factory Act/Rule
- Petroleum Act / Rule
- Static & Mobile Pressure Rule
- Gas Cylinders Rule
- Public Liabilities Act
- Insurance And TAC
- Safety Code Standards
- OISD Norms
- Indian Explosive Act
- Environment Protection Act
- Indian Boiler Act
- MSHIC & Chemical Accident Rules
- Water & Air (Prevention & Control) Act

Developing Safety Skills And Knowledge

- Safety Induction For New Recruits
- Safety Orientation Program For Sup/Non-Sup Employees.
- Employees Protection Program
- Specialized Training Program
- Safety Seminars/ Workshop.
- Safety Talks

Special Activities

- Safety Day Celebration
- Campaign Month
- Accident Prevention Program
- Village Safety Awareness Program
- Transports Safety Program

Safety Meetings

- Weekly Interaction With Plant Safety Engineers
- Shop Floor Safety Committee
- Plant Safety Committee
- Apex Safety Committee

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- Departmental Review

VII. WORK PERMIT SYSTEM

WORK PERMIT PROCEDURES & ELECTRICAL LOCKOUT PROCEDURE:

The Procedure Helps To Identify The Precautions To Be
Taken And Proper Work Procedures To Be Adopted During The Course Of The Work With A View To:
Ensure Safety Of Personnel,
Avoid Damage To Equipment And Other Near By Installations,
Avoid Or Minimize Environmental Pollution, And
Comply With Statutory Requirements.
The Procedure Identifies Responsibility Of Individuals For Preparation, Issue, Acceptance And Closure Of The Work Permit. Work Permit Procedure Authorizes Non-Routine Or Maintenance/ Construction Work, To Be Carried Out Within The Complex.

Details Of Work Permit Format

The Work Permit Format Contains Several Sections From A To K And Provide A Checklist For The Issuer And The Acceptor To Identify Different Hazards Associated With The Work And What Precautions And Procedures Need To Be Followed In Carrying Out The Job In A Safe Manner. Details Of Different Items In The Various Sections Of The Permit Are Given Below.

SECTION "A" - Permit Required For

All Work Activities Are Categorized Into The Following Three Types.

- Work At Height.
- Hot Work And
- Confined Space/Vessel Entry.
- Opening Pipe Line
- Excavation
- Electrical

SECTION B – Job Particulars:

The Following Details Relevant To The Work Are Filled In This Section Plant / Unit: The Manufacturing Unit Or A Plant Or A Non-Process Facility.
a)Area / section: part of the facility belonging to a plant or unit.
b)Equipment tag no. And equipment name, easily identifiable by all people involved in the work execution.
c)Job description: the details of work relating to maintenance, construction, inspection etc to be carried out.
d)Name of contractor: if a contractor is engaged for carrying out the job, the name of the contractor is given here.

SECTION "C" – Nature Of Work:

Identifying The Nature Of Work Helps To Decide The Appropriate Precautionary Measures To Be Taken During The Work Progress.
o Welding / Gas Cutting
o Work On Electrical System
o Work On Instrument System
o Work At Height
o Excavation
o Hot Tapping
o Work On Radiation Sources
o Hydro jetting

o Photography
o Isolation Of Firewater Network

SECTION "D" – Tools / Equipment To Be Used
Identifying Hazards Associated With The Tools Or Equipments Used For Carrying Out The Job Helps To Decide The Necessary Precautionary To Be Taken During The Execution Of The Work.

SECTION "E''– Hazard Considerations:
The Hazard Considerations Arise Due To
1.Nature Of Work
2.Type Of Tools Used And
3.The Environment In Which The Work Is Carried Out.
The Hazard Considerations Likely To Be Present In The Work Will Help In Identifying What Preparations Required To Be Taken Prior To Commencement Of The Job And Also The Precautions That Need To Be Taken During The Progress Of Work.
Risk Assessment Of Job / Activity Should Be Carried Out Critically To Identify The Hazards Likely To Be Present During The Execution Of The Work.

SECTION "F" – Job / Equipment Preparation:
Process Equipment Normally Handles Hazardous Substances Under Various Operating Conditions Like High Temperature And High-Pressure. Jobs/Equipment Need To Be Made Safe From Potential Hazards Present Due To Nature Of Work, Working Conditions Or Due To Hazardous Tools Used, Before Work Can Be Started.
In Cases Involving Road Repair Or Excavations Etc, Access By Emergency Services May Be Hindered And It Is Necessary That These Services Are Informed Before Such Work Is Carried Out.

SECTION "G" - PPE / Fire Protection Required:
All Employees Are Required To Wear Appropriate PPE In Their Work Area. Additional PPES And Fire Protection Equipment Are To Be Specified By The Issuer Depending Upon Nature Of Work And Hazards Involved In The Work.

SECTION "H" – Gas Tests
Gas Test For Toxic Hazards.
Examples Of Toxic Gases Are CO, EO,Cl2, NH3, Etc.
(B) Gas Test For Hot Work.
(C) Gas Test For Confined Space / Vessel Entry.
Gas Test Is Required To Be Done For Oxygen, Toxic Gas/Vapor, Flammable Gas/Vapor Inside Confined Space /Vessel And Also Outside Confined Space/Vessel Near Manholes And Openings.

SECTION "I" – Approvals
Issuer:
The Shift In-Charge Or Shift Engineer / Officer Or A G-Shift
Officer Can Issue The Work Permit In Plant Operation Areas As Authorized By The Plant HOD. For Non-Plant Areas The Supervisory Employee Authorized By The Area In-Charge Will Be The Issuer.

Acceptor:
The Work Permit Acceptor Is The Supervisory Employee Or Technician/Non Supervisory Employee From Maintenance, Inspection, Construction Or Any Other Service Department Or An Operator In Some Cases, As Authorized By The Plant HOD / Area In Charge.

SECTION "J" – Revalidation & Renewals:

(a) Validity Of Work Permit:

All The Work Permits Are Issued For Completion Up To The End Of Shift. However, For The Jobs, Which Are Carried Out Without Interruption Beyond 14.00 Hrs

(b) Revalidation And Renewal Of Work Permit:

If Work Is To Be Continued Without Interruption Beyond The Approved Time Limits, Then The Work Permit Requires To Be Revalidated.

SECTION "K": Closure And Cancellation: Closure Of Work Permit:

In Any One Of The Following Condition Work Permit Closure / Cancellation, May Occur,

1)Permit Is Closed, Because, Time Validity / Period Is Expired, But Job Is Incomplete.

2)Permit Is Closed – Job Is Complete.

3)Permit Is Cancelled, As Present Work Conditions Are Not Conducive For Carrying The Job.

In Any One Of The Situation, Acceptor Will Close The Permit By Putting Sign, Date, Time, Then The Acceptor Will Take The Sign Of Area Operator, And Handover Back To Issuer For His Sign, Date And Time.

SAFETY IN CHEMICAL INDUSTRY

A) Safety in Chemical Storage -

•Well intentioned people can easily block vents.

•Never cover or block the atmospheric vent of an operating tank.

•Routinely check for plugging of vents on tanks in fouling service.

•Periodically Thickness Check.

•Periodically Safety Valve Check.

•Displaying Proper MSDS.

•Provide Suitable Fire Extinguisher or Hydrant system.

SAFETY AUDIT

Safety Audit Is Management Tool Comprising Of A Systematic, Periodic And Objective Evaluation Of How Well The Safety Organization, Management, And Equipment Are Performing, With The Aim Of Helps To Safeguard A Company's Assets By Facilitating Management Control Of Safety, Health And Environmental Practices And Assessing Compliance With Established Standards.

Details Of Process Safety Activities and Management of Radico Khaitan Limited -Rampur.

1. Process Safety Information (PSI)
2. Operating Procedures (OP)
3. Hot Work Permit (HWP) – part of Safe Work Practices (SWP)
4. Training (TRG)
5. Contractor Safety Management (CSM)
6. Process Hazard Analysis (PHA)
7. Management of Change (MOC)
8. Pre-Start-up Safety Review (PSSR)
9. Mechanical Integrity (MI)
10. Compliance Audits (CA)
11. Emergency Response and Planning (ERP)
12. Incident Investigations (II)
13. Employee Participation (EP)

VIII. CONCLUSION

After completion of the study, I found that here are many benefits to working with chemicals safely in the workplace.

Reduced injuries and illnesses

When a company has a high-quality chemical safety program established and manages its chemicals correctly, employees are less likely to be injured or killed by chemical exposures. In addition, employees that work with chemicals safely will avoid injuries or illnesses from inhalation, skin contact, ingestion, or injection.

Save money and improve productivity

Minimizing injuries and illnesses will save companies money since there are no direct or indirect costs from chemical exposure. When an employee is injured, they will likely be out of work, and your company will need to hire another person or train a replacement worker. It takes time for a new worker to learn the old worker's tasks which will reduce productivity. Another indirect cost of a chemical exposure injury includes the time and effort required to complete an incident investigation and implement corrective actions. Direct costs would consist of the medical bills from the employee's exposure.

Minimized risk of property damage

If your workplace focuses on chemical storage safety best practices, there will be a negligible risk of property damage. However, storing incompatible chemicals together can cause fires or explosions, resulting in millions or billions of dollars in damage to property. If your organization's building burns down, you won't be able to make the product and will lose a significant amount of money from a lack of manufacturing.

Increased employee morale, knowledge, and communication

When you have a robust chemical safety program, there is increased employee morale. Employees are informed and educated on the types of chemicals they are working with and know how to protect themselves from harm. When your employees are knowledgeable about the chemicals they are using and the controls established to prevent injury or illness, they feel safe at work.

In addition to feeling protected, employees who are well-informed about the chemicals they work with will also be aware of the emergency procedures if something occurs. For example, suppose a chemical alarm were to start ringing. In that case, educated employees will know the process to either take action to shut off machinery or exit the building, depending on the situation and type of chemical alarm. Once outside, they will know exactly where to go to wait for further instructions.

Employers must understand the importance of chemical safety in the workplace. Companies must recognize the benefits of safely working with chemicals and put controls in place to protect employees from all routes of exposure and the health and physical hazards associated with chemical use.

When companies use the Hierarchy of Controls and other best practices to control chemical hazards, the risk of chemical exposure will be minimized, resulting in fewer injuries and illnesses, increased productivity and morale, improved communication and emergency response, and will ultimately save the company money.

IX. FUTURE SCOPE

The intent of this element is to define the requirements to conduct a Chemical Safety Management in each process covered by the PSM Program. This critical element identifies the process hazards, evaluates the consequences and defines appropriate control measures to eliminate or minimize the severity of the hazard.

To help assure that all hazards are identified and evaluated, PHA will be help to the following processes.

- Oil & Gas Processing
- Rubber Processing
- Petrochemical
- Cement Processing
- Pharmaceutical

- Water Treatment Process
- Toxic or Pesticide Chemical Processing
- Hazardous Waste Treatment Process
- Textile Processing
- Other Chemicals and Process Industries

REFERENCE AND RECOMMENDED READING

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