



Safety and Hazards in Petro Chemical Industry

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ABSTRACT:

Environmental friendly and safe operations and processes are always desired from health perspectives. Due to properties of chemicals in petroleum sector, the chances of accidents are high. Chemical hazards are one of the most dangerous hazards occurring in any industries that uses them. Several devastating effects like explosion, environmental pollution, asphyxiation, acid burns, and skin disorders, chronic and acute conditions of several diseases might occur due to the leakage of the poisonous chemicals. This project deals in the control of the chemical hazards in petrochemical industry. Material, substances, processes or circumstances which pose threat to health and well-being of workers in any occupation are termed as occupational hazards. The health and safety of worker is most important. Operations and processes in petroleum industries are hazardous, due to properties of the petroleum products and raw materials. Various investigations and studies are reported on the safety and hazards in petroleum and refining industries. It is necessary to identify occupational health hazard in addition to occupational safety hazard.

Keywords: Hazards, awareness level, industry workers, risk assessment, exposure

1 INTRODUCTION

In today's world, energy requirement defines growth of the nation. It is key to industrial development. Petroleum and petrochemical sectors are back bone of economic growth. The cost of fuel, many times determines cost of commodities. Many unconventional energy resources are being explored with more or less success. Production of ethanol from different feed stocks is being explored. Still there is large dependence on fossil fuel. Oil exploration remains most important activity towards energy demand fulfillment. The research and studies are being carried out to make the activities in these industries environmental friendly. Petroleum and refining sector is experiencing many challenges. The treatment of flue gases for removal of harmful gases is one such aspect of these investigations. Also wastewater treatment for these plants is being dealt with best possible technology and many investigations are reported on the same. Sludge and solid waste treatment is also important area of research. The removal of impurities from crude and product constitutes upstream and downstream processing in petroleum sector. Environmental friendly and safe operations and processes are always desired from health perspectives. Due to properties of chemicals in petroleum sector, the chances of accidents are high. Material substances, processes or circumstances which pose threat to health and well-being of workers in any occupation are termed as occupational hazards. The health and safety of worker is most important. Various investigations and studies are reported on the safety and hazards in petroleum and refining industries. Current review summarizes research and studies on safety and hazards in petroleum industries.

The chemicals industry produces a wide variety of substances and preparations which are essential for use in a very broad range of applications in virtually all sectors of the economy, including:

base chemicals (petrochemicals and derivatives, basic inorganic and polymers) usually produced in large volumes; specialty chemicals (active ingredients and co-formulates for the pharmaceuticals industry and plant protection, auxiliaries

for industrial processes, paints & inks, biocides, and dyes and pigments) usually produced in lower volumes; and Consumer chemicals (soaps and detergents, perfumes and cosmetics). The chemical industry is one of the industries with the most stringent safety regulations. Regular revision, servicing and maintenance work is required due to the high stress placed on equipment by exposure to very aggressive substances, high temperatures and pressures. Depending on the size and type of plants and operations concerned, maintenance often involves complete shut-downs, however, specific production area maintenance and servicing operations are more common. Whereas small-scale production like that of specialty chemicals is often run as a batch operation, large-scale production is mostly run as continuous operation. In both cases there may be various kinds of technical systems like chemical reactors (which often have to withstand high or low temperatures and pressures), separation devices (distillation, filtration, etc.), and fluid systems for liquids and gases (pumps, valves, tanks), etc. The complex nature of chemical plants increases the risks for maintenance workers. In addition, they may come into close contact with a broad variety of often hazardous chemicals. Some examples of accidents may be found in the EU-OSHA publication 'Maintenance and occupational safety and health: a statistical picture' This e-fact focuses on the specific risks related to various dangerous substances that maintenance workers in chemical plants are exposed to, and gives some basic recommendations on how these risks can be tackled, including some good practice examples. A complementary e-fact discusses maintenance and dangerous substances in general.

2 PROBLEM DESCRIPTIONS

Chemicals which take place in many areas in our industry and our daily lives are used in solid, liquid and gas forms. Since at least 400 million tons of chemical substances are produced each year in the world and used in each type of industries, today many of the employees are exposed to chemical hazard in one way or other. Many of these chemicals can cause extensive damage to people and environment. Chemical substances used in industry are among the main

causes of occupational accidents and health problems which happen as a result of carelessness and misuse. To protect employees from potential diseases and dangers which caused by chemical substances, principally risk assessment should be done to determine the risks. Chemical substances are classified by their degree of risk with the risk assessment, and according to that appropriate measures are taken and health and safety of employees is protected. The risk assessment should include issues which are related to hazardous workplace environment factors in workplaces, the degree of exposure and risks, appropriate control of measurement and analysis, health surveillance, education and information.

3 CAUSES AND EFFECTS OF CHEMICAL HAZARDS

3.1 Chemical hazards:

A chemical hazard is a type of occupational hazard caused by exposure to chemicals in the workplace. Exposure to chemicals in the workplace can cause acute or long-term detrimental health effects. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, and neurotoxins, agents which act on the hematopoietic system and agents which damage the lungs, skin, eyes, or mucous membranes.

3.2 Causes of chemical hazards:

1. Explosive
2. Flammable
3. Oxidizer
4. Corrosive for metals
5. Compressed liquefied gases
6. Toxic
7. Irritant
8. Aquatic toxicity

3.2.1 Explosive chemical hazards:

An explosion involves the production of a pressure discontinuity or blast wave resulting from a rapid release of energy. A pressure disturbance is generated in to the surrounding medium. Air becomes heated due to its compressibility and this leads to an increase in the velocity of sound, causing the front of disturbance to steepen as it travels through the air.



Figure 3.1 Explosive chemical hazards

The loading and hence the damage to the nearby targets are governed by the magnitude of and duration of pressure waves. Missiles may be generated by an explosion and are capable of causing severe damage to adjacent plant structures and people. The explosion mainly occurs due to the rapid combustion of a flammable material but can be brought about the chemical reactions other than combustion, provided they release large amount of energy (heat). Examples of these

chemical reactions are Polymerizations, the decomposition of unstable substances and exothermic interactions of many kinds.

3.2.2 Flammable chemical hazards:

A flammable liquid as having a flash point of not more than 93°C (199.4°F). The flash point is the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. In most cases, the relative hazard of a flammable liquid increases as the flashpoint decreases. Many common solvents (e.g., acetone, ether, toluene, etc.) present in laboratories have flash points well below room temperature, making proper use, storage and disposal even more critical. Flammable liquids and mixtures containing flammable liquids are assigned to one of four hazard categories, as indicated in safety data sheets (SDSs), based on their flash points and boiling points (See table below).



Figure 3.2 Explosive chemical hazards symbol

Category	Criteria	Hazard Statement
1	Flash point < 23°C and initial boiling point ≤ 35°C (95°F)	Extremely flammable liquid and vapor
2	Flash point < 23°C and initial boiling point > 35°C (95°F)	Highly flammable liquid and vapor
3	Flash point ≥ 23°C and ≤ 60°C (140°F)	Flammable liquid and vapor
4	Flash point ≥ 60°C (140°F) and ≤ 93°C (200°F)	Combustible liquid



3.3 Flammable chemical hazards

For a flammable liquid to ignite, three conditions must exist simultaneously: (1) the concentration of the vapor must be between the upper and lower flammable limits of the substance; (2) an oxidizer (usually the oxygen in air) must be present; and (3) a source of ignition must be present. Taking measures to remove any of these conditions will prevent the start of a fire. In addition to flashpoint and boiling point, the hazardous potential of flammable liquids can be intensified by other conditions.



3.4 Flammable chemical hazards symbol

Vapor density, a measure of a vapor's weight when compared to air, also plays a role in the hazards associated with flammable liquids. The vapor density of air is assigned a value of 1. Heavier vapors (i.e. a vapor density greater than 1) from flammable liquids tend to sink in air while lighter vapors (i.e. vapor density less than 1) tend to rise in air. When working with flammable liquids, especially outside of fume hoods, efforts should be made to remove or control ignition sources in areas where vapors would most likely migrate given their vapor densities. The proportion of vapor to air mixture that is ignitable is referred to as the flammable range, and is expressed in terms of percentage of vapor in air by volume. The flammable range is bounded by the Lower Flammable Limit (LFL) and the Upper Flammable Limit (UFL). The range can expand as temperature, pressure and container diameter increase. The graph below shows the flammable range, LFL and UFL of a flammable liquid.

3.2.3 Oxidizer chemical hazards:

A heat is applied to a combustible material, the molecules that compose the material start to vibrate rapidly. If the vibrations become strong enough, the molecules break into fragments known as free radicals. The process of breaking into free radicals is known as pyrolysis and is endothermic (requiring heat from an outside source). The free radicals encounter oxygen in the air. Oxygen has a great attraction for electrons (electronegativity) and reacts with the free radicals. The reaction that occurs is known as oxidation and is simply the forming of a chemical bond between a free radical and oxygen. The bond-forming process is exothermic (heat producing) and is, in essence, combustion. Some of the heat produced radiates back to the fuel and now supplies the energy necessary for pyrolysis to continue. This entire series of events is known as fire. The rate at which a reaction occurs is, to a great extent, controlled by the concentration of the materials involved. Air is composed of approximately 21% oxygen. This means that during the combustion process for every 100 molecules that a free radical encounters, about 21 of those will be oxygen. Thus only about 21 out of 100, or 1/5 of the encounters will be with oxygen and can result in a reaction. If the concentration of oxygen is increased, as an oxidizer would do, the rate of reaction will also increase. If the concentration of oxygen is 50%, the rate of encounter between a radical and oxygen is 50 out of 100 or 1/2 of all encounters. Thus the rate of reaction is greatly increased, which increases the amount of heat produced. The fire will be much more intense.

3.2.4 Corrosive chemical hazards:

Corrosives can also damage or even destroy metal. They begin to cause damage as soon as they touch the skin, eyes, respiratory tract, digestive tract, or the metal. They might be hazardous in other ways too, depending on the particular corrosive material. Most corrosives are either acids or

bases. This guideline identifies general safety precautions that should be reviewed and followed when dealing with corrosive chemicals at Brandeis. They represent a significant hazard because skin or eye contact can readily occur from splashes, and their effect on human tissue generally takes place very rapidly.



Figure 3.5 corrosive chemical hazards

3.2.5 Toxic chemical hazards:

Toxic materials are substances that may cause harm to an individual if it enters the body. Toxic materials may enter the body in different ways. These ways are called the route of exposure. The most common route of exposure is through inhalation (breathing it into the lungs). Another common route of entry is through skin contact. Some materials can easily pass through unprotected skin and enter the body. Ingestion is another, less common, route of exposure in the workplace. Ingestion often occurs accidentally through poor hygiene practices (e.g. eating food or smoking a cigarette using contaminated hands).



Figure 3.6 Toxic chemical hazards

3.2.6 Irritant chemical hazards:

Chemical irritants are materials that cause reversible inflammation or irritation to a body surface, including eyes, respiratory tract, skin or mucous membranes, upon contact. Many chemical irritants also cause have other hazardous properties. Primary irritants exert no systemic toxic action. The degree of irritation depends on the chemical concentration, duration of contact, and personal factors (health status, sensitization). Be aware that some irritants are sensitizers or have delayed symptoms. Breathing chemical irritant gases can also cause the buildup of fluid in the lungs or can interfere with the exchange of oxygen.



Figure 3.7 Irritant chemical hazards

3.2.7 Aquatic toxicity chemical hazards:

Chronic aquatic toxicity. Chronic aquatic toxicity means potential or actual properties of a substance to cause adverse effects to aquatic organisms during exposures which are determined in relation to the life cycle of the organism.

1. The basic elements for use within the harmonised system are: - acute aquatic toxicity; - potential for or actual bioaccumulation; - degradation (biotic or abiotic) for organic chemicals; and - chronic aquatic toxicity.

2. While data from internationally harmonised test methods are preferred, in practice, data from national methods may also be used where they are considered as equivalent. In general, it has been agreed that freshwater and marine species toxicity data can be considered as equivalent data and are preferably to be derived using OECD Test Guidelines or equivalent according to the principles of GLP. Where such data are not available classification should be based on the best available data.

3.2.7.1 Acute toxicity:

Acute aquatic toxicity would normally be determined using a fish 96 hour LC50 (OECD Test Guideline 203 or equivalent), a crustacea species 48 hour EC50 (OECD Test Guideline 202 or equivalent) and/or an algal species 72 or 96 hour EC50 (OECD Test Guideline 201 or equivalent). These species are considered as surrogate for all aquatic organisms and data on other species such as Lemna may also be considered if the test methodology is suitable.

4 SYMPTOMS AND RISK FACTORS FOR CHEMICAL HAZARDS

	SYMPTOMS	COMMON CAUSES
Head	Dizziness, headache	Solvents, paint, ozone, smoke (including tobacco)
Eyes	Red, watery, irritated, grainy feeling	Smoke, gases, various dusts, vapors from paint and cleaners
Nose and Throat	Sneezing, coughing, sore throat	Smoke, ozone, solvents, various dusts, vapors and fumes from paint and cleaners
Chest and Lungs	Wheezing, coughing, shortness of breath, lung cancer	Metal fumes, various dusts, smoke, solvents, vapors from paint and cleaners
Stomach	Nausea, vomiting, stomach ache, diarrhea	Some metal fumes, solvents, paint vapors, long-term lead exposure
Skin	Redness, dryness, rash, itching, skin cancer	Solvents, chromium, nickel, detergents and cleaners, paint on skin
Nervous System	Nervousness, irritability, sleeplessness, tremors, loss of balance or incoordination	Long-term solvent exposure, long-term lead exposure
Reproductive System	For men: low sperm count, damage to sperm For women: irregularities in menstruation, scarring, damage to egg or fetus	Lead, toluene, some other solvents, ethylene oxide gas

Table 4.1 Symptoms and Causes Of Chemical Hazards

How toxic the chemical is (toxicity)	The more toxic the chemical, the more likely it will cause health problems, even in small amounts. Asbestos and cyanide are considered highly toxic Because a very small quantity can cause health effects.
How the chemical gets into the person's body (route of exposure)	The way a chemical enters your body affects your risk. Some chemicals, like the pesticide parathion, are very toxic whether they get into the body through the skin, by breathing, or by swallowing. On the other hand, Asbestos is only harmful when inhaled or swallowed. A house may have asbestos insulation, but unless the asbestos is disturbed and becomes a dust in the air, it can't be breathed in, so it won't cause harm.
The amount of the chemical you are exposed to (dose)	For some chemicals, the higher the amount, the greater the damage. For example, acetone is an industrial solvent that is also found in nail polish remover. It is more dangerous to the worker who uses large amounts than to the person who uses a little nail polish remover.

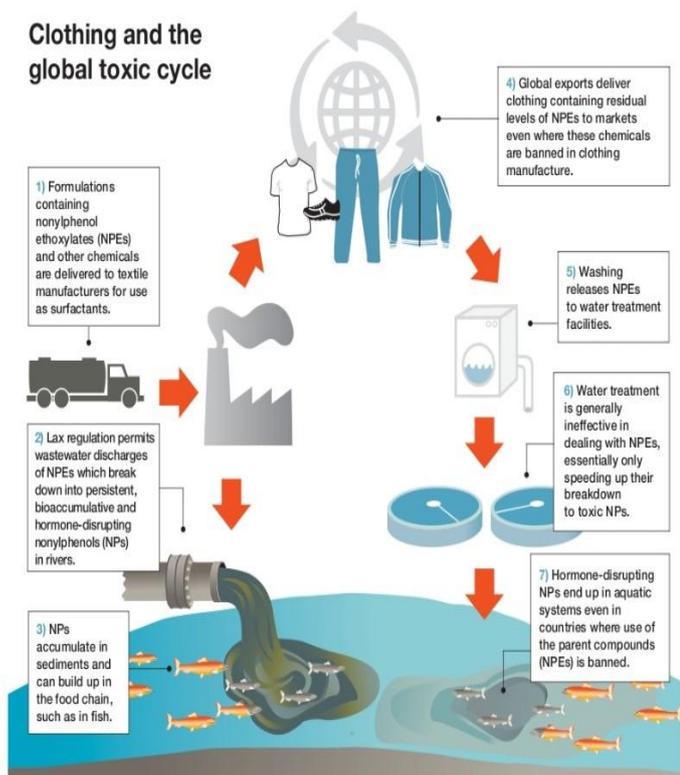


Figure 3.8 Aquatic toxicity chemical hazards

How long you are exposed to the chemical (duration)	The longer the exposure, the greater the danger. For example, someone may work with a chemical for half an hour per day, while another person is exposed for eight hours a day. Also, someone may be exposed for one month, while another person may have 20 years of exposure.
Reaction and Interaction with Other chemicals	Some chemicals in combination can create a different chemical that is more hazardous than the original ones (reaction). For example, ammonia and bleach used together can produce a highly toxic chemical. Some chemicals, in combination, can increase the likelihood of harm. For example, workers who have been exposed to asbestos increase their likelihood of getting lung cancer if they smoke cigarettes.
Individual differences (like heredity, body size, age, smoking, drinking, allergies, sensitivities, or previous exposures to other toxic chemicals)	Chemicals can be more harmful to some people than to others. Lead is much more harmful to small children than adults because it affects their developing brain and nervous system. If two people work with asbestos and one of them smokes, the smoker is more likely to develop asbestos related lung cancer.

Table 4.2 Risk Factors For Chemical Hazards

4.3 NUMBER OF ACCIDENTS, DEATHS AND INJURIES IN THE PERIOD 1998-2016

S. No	Year	Number of Accidents	Number of Deaths	Number of Injury
1	1998	5	1003	8
2	1999	6	8	78
3	2000	5	274	1065
4	2001	12	41	3440
5	2002	0	0	0
6	2003	5	5	12
7	2004	5	56	430
8	2005	3	23	273
9	2006	4	260	62
10	2007	2	5	87
11	2008	6	91	125
12	2009	1	12	150
13	2010	3	34	154
14	2011	2	3	0
15	2012	4	29	8
16	2013	4	81	411
17	2014	2	146	114
18	2015	1	6	0
19	2016	2	168	817
Total		72	2245	7234

5 CONTROL MEASURES IN CHEMICAL INDUSTRY

Once chemical hazards are identified, various methods can be used to protect workers from them. These are called hazard controls. Not all controls are equally effective. There is a

“hierarchy” of possible solutions. The most effective solutions, at the top of the pyramid, are those that actually remove the hazard. Further down are solutions that only reduce or limit the worker’s exposure. To control the hazards there are four principles in general. Elimination of the hazard is the best option; if elimination is not possible then substitution should be considered. Engineering control is applied to control hazards by engineering modifications in the process. The last principles advocate the administrative control by making some administrative mechanism in the workplace to keep away hazards from human and workplace. The application of all four control measures with the use of personal protective equipment’s (PPEs) reduces the hazards significantly in workplace and outside of the unit. Selecting an appropriate control is not always easy. It often involves doing a risk assessment to evaluate and prioritize the hazards and risks. In addition, both "normal" and any potential or unusual situations must be studied. Each program should be specially designed to suit the needs of the individual workplace. Hence, no two programs will be exactly alike.

- Choosing a control method may involve.
- Evaluating and selecting temporary and permanent controls.
- Implementing temporary measures until permanent (engineering) controls can be put in place.
- Implementing permanent controls when reasonably practicable.

For example, in the case of a noise hazard, temporary measures might require workers to use hearing protection. Long term, permanent controls might use engineering methods to remove or isolate the noise source.

Often a combination of methods is needed to get the best protection

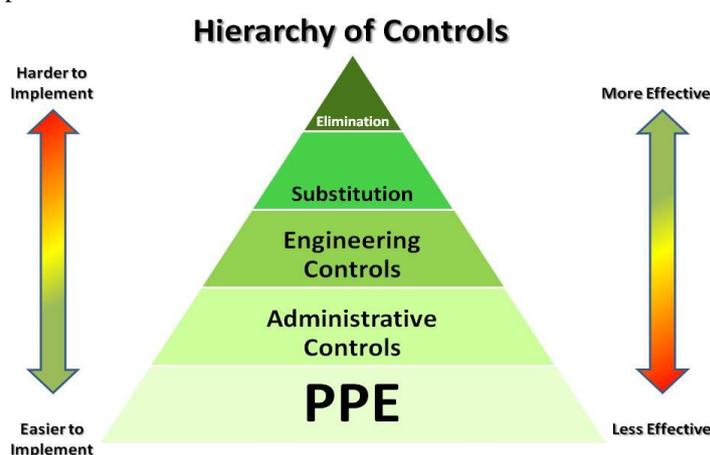


Figure 5.1 control measures for chemical workplaces

5.1 ELIMINATION

The most effective control measure is to control hazards at the source by eliminating the hazard. Eliminate hazards at the “development stage” it is important to consider health and safety aspects when work processes are still in the planning stages. For example, when purchasing machines, safety should be the first concern, not cost. Machines should conform to national safety standards. They should be designed with the correct guard on them to eliminate the danger of a worker getting caught in the machine while using it. Machines that are not produced with the proper guards on them may cost less to purchase, but cost more in terms of accidents, loss of

production, compensation, etc. Unfortunately, many used machines that do not meet safety standards are exported to developing countries, causing workers to pay the price with accidents; hearing loss from noise, etc. Is the best example for accident when machine guard is eliminated or in other words hazard of accident could be eliminated by providing the machine guards



Figure 5.2 control measures for chemical Elimination

5.2 SUBSTITUTION

If a particular dangerous chemical or work process cannot be completely eliminated, then try to replace it with a safer substitute. It is not easy to find “safer” chemical substitutes (in fact, no chemical should be considered completely safe). It is important to review every year or so current reports on the chemicals used in the workplace because chemicals considered to be “safer” substitutes today may not be considered safe in the future. When one has to look for safer substitutes, try to choose a less volatile (volatile liquids vaporise, or evaporate easily) instead of a highly volatile one, choose a solid instead of a liquid, etc. For example, many dry, dusty powders are also available in brick, pellet, paste, flakes, oil damped powders, and other forms that create less dust when handled, and reduce the chance of inhaling the dust. Many plastics and rubber industry chemicals can also be supplied in dust-suppressed forms. These materials can be more expensive to purchase but they are safer for workers to handle and can be cheaper when other costs are considered, such as the cost of ventilation to control dust, personal protective equipment, etc. demonstrates the dust/fume of a hazardous chemical, this chemical has been substituted by a chemical which do not have dust/fumes as shown in figure.



Figure 5.3 control measures for chemical substitution

5.3 ENGINEERING CONTROLS

The best way to protect workers from hazards is to remove the hazards from the work place altogether or at least keep them away from workers. These methods are often called engineering controls. They directly address the hazard and do not depend on workers’ actions to be effective. Workers don’t have to wear special protective gear or take special precautions, because the hazard is gone.

Engineering controls include these methods:

1. Redesign the process. For example:
 - Replace gasoline motors with electric motors to eliminate exhaust fumes.
 - Use wet methods when grinding, sanding, or using other tools to reduce dust levels.
2. Substitute safer products for hazardous ones. For example, use chemicals that are less toxic or dangerous, such as some water based cleaners.
3. Isolate the process, or isolate the worker from the process. For example, use glove boxes when working with dangerous substances like radioactive material.
4. Install ventilation systems. These remove chemicals from the air that workers breathe. The best systems remove vapors and fumes close to the source (local exhaust ventilation).

There are a number of common control measures which are called “**Engineering controls**”. These include enclosure, isolation and ventilation.

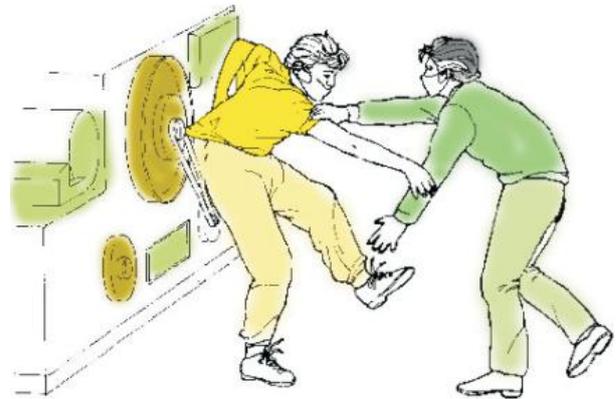


Figure 5.4 Unguarded machines are hazardous

5.3.1 Ventilation

Ventilation in the workplace can be used for two reasons:

- (1) To prevent the work environment from being too hot, cold, dry or humid;
- (2) To prevent contaminants in the air from getting into the area where workers breathe. Generally there are two categories of ventilation: local exhaust ventilation and general ventilation. Whatever the type, ventilation should be used together with other methods of control.

a. Local exhaust ventilation usually uses suction, based on the principle of a vacuum cleaner, to remove pollutants from the air. There are two common types of local exhaust ventilation used in industry today: (i) fumes are sucked into an open tank with side slots and into a closed system, through which they are then transferred to a disposal point away from the workers (a degreasing tank is an example of this); (ii) fumes are sucked into a canopy hood which hangs over a contaminant and forced out through a ventilation duct. This type is very effective where the air pollutants have a high

temperature, or if they rise in the air for another reason (for example, the heat from furnaces or ovens causes pollutants to rise). Demonstrate the suction at local level Partial enclosure (such as laboratory fume cupboards or screens placed around welders) combined with a local exhaust ventilation system is one of the best solutions for controlling toxic material. This type of system must operate as close as possible to the source of the hazardous agent to reduce it from spreading, yet at the same time allow access to the work process. Demonstrate the partial enclosure.

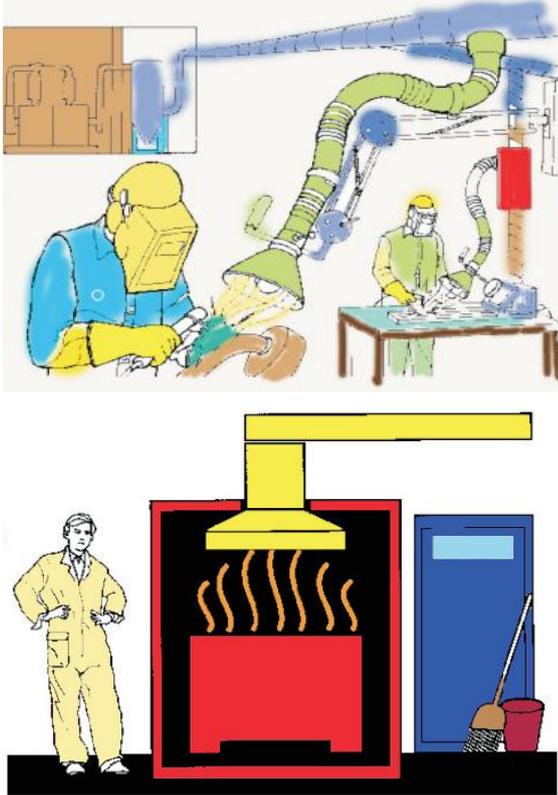


Figure 5.5 Local Exhaust Ventilation

5.4 ADMINISTRATIVE CONTROLS

When the hazard cannot be eliminated altogether, another option is to set rules that will limit workers' exposure to the danger. These measures are often called administrative controls. Administrative controls include:

- Rotate workers between a hazardous task and a non-hazardous task so that the length of exposure is reduced.
- Increase the number of breaks to reduce the time of exposure.
- Restrict access to the work area.
- Improve personal hygiene facilities and practices. Provide a way for workers to wash their hands and faces before eating and drinking. Prohibit eating in work areas. Set up facilities for showering after the shift, and leaving contaminated clothes at the workplace.
- Provide worker training programs. Increase workers' ability to recognize and evaluate chemical hazards, and to take action to protect themselves.

5.5 PERSONAL PROTECTIVE EQUIPMENTS

Personal protective equipment (PPE) is the least effective method of controlling occupational hazards and should be used only when other methods cannot control hazards sufficiently. PPE can be uncomfortable, can decrease work performance and can create new health and safety

hazards. For example, ear protectors can prevent from hearing warning signals, respirators can make it harder to breathe, earplugs may cause infection, and leaky gloves can trap hazardous chemicals against the skin. PPEs should be used in addition to other control hazards methods however, if it is impossible to reduce hazards inspire of the, elimination, substitution, engineering and administrative controls then PPEs should be used to save lives of workers and even community. A fifth method of reducing hazards is to use personal protective equipment (PPE). PPE is worn on the body and protects you from exposure to chemicals. It includes gloves, goggles, respirators, and coveralls. Wear PPE when other methods of hazard control aren't possible or don't give enough protection. For PPE to be effective, workers must be given the correct PPE and trained in its use, care, and storage. PPE is usually considered less protective than the other methods because:



Figure 5.6 Personal Protective Equipments

- It doesn't get rid of the hazard itself. However, it can reduce the amount of exposure by placing a barrier between the hazard and the worker.
- Workers may not want to wear it because it can be uncomfortable and hot, and may make it hard to communicate.
- It has to fit properly to work. In many cases, it must be cleaned and inspected often.
- It has to be the right type for the particular hazard, such as the right respirator cartridge or glove for the chemical being used. Workers must know and remember how to use it properly.
- Some PPE creates its own hazards, such as heat, heavy weight, reduced visibility and reduced hearing, restricted movement, and discomfort. PPE depends entirely on human action to be effective.

Examples of PPE include:

- ✓ safety glasses
- ✓ ear protectors
- ✓ respirators with filters
- ✓ dust masks
- ✓ gloves
- ✓ protective suits
- ✓ safety shoes

6 RESULTS AND DISCUSSION

The chemical causes of process accidents due to hydrocarbons, toxic chemicals and others in developed and developing countries. The most of process accidents are concerned with hydrocarbons (such as organic solvents, oils and natural gases, etc.) in developed and developing countries are 21 and 17 respectively. Furthermore, the process accidents

are concerned with toxic chemical releases such as ammonium gas, radioactive gases, organic, inorganic acids and metallic dust (Arsenic, Iron, Aluminum etc.). Besides, a few number of accidents concerned with others such as steam pipe line blast and equipment related

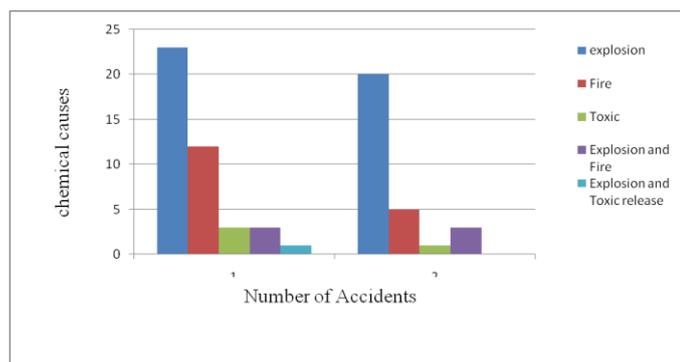


Figure 6.1 primary Chemicals causes of process accidents

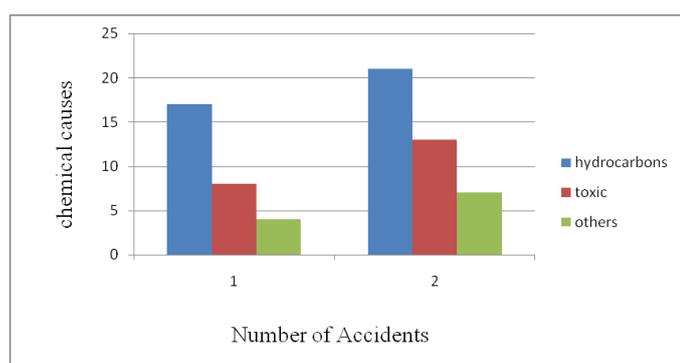


Figure 6.2 Major Chemicals causes of process accidents

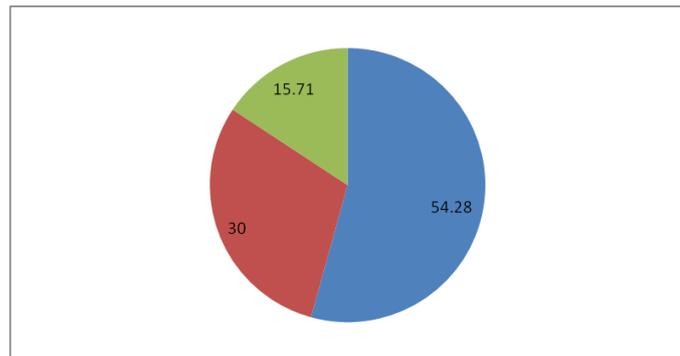


Figure 6.3 Major Chemicals causes of process accidents

It is revealed that, 55% and 30% of the accidents are concerned with hydrocarbons and toxic chemicals. Other accidents are related to the failure in the process equipment, steam lines and some of the chemical cause data is not available in the database.

CONCLUSION

This project carried out identification of Chemical Hazards in a chemical Industry plays a vital role in preventing Explosions, Fire and Toxic Gas release. HAZOP helps in identifying all the possible hazards and their effects, and source of hazard thereby preventing it. Material substances, processes or circumstances which pose threat to health and well-being of workers in any occupation are termed as occupational hazards. The health and safety of workers is most important. Operations and processes in petroleum industries are hazardous, due to properties of the petroleum products and

raw materials. The occupational and hazard is major issue in oil and gas extraction industry. From the observations, it is revealed that the most of the accidents concerned with hydrocarbons and toxic chemicals are 55% and 30% respectively. Furthermore, around 63% and 25% of accidents are concerned with explosions and fire due to flammability and explosive nature of hydrocarbons..Therefore better process safety and robust enforcement of safety regulatory legislation need to be required in developed countries. The present investigation is useful to develop the prevention and mitigation strategies for controlling the process failures particularly dealing with highly flammable chemicals such as hydrocarbons and toxic chemicals in the process industries.

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