HAZARDS IN OIL REFINERIES AND ITS SAFETY

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ABSTRACT

Most of the new of generation petroleum refineries possess high complexity indices, which indicate their extensive conversion capabilities in terms of refining and improving the quality of petroleum product for global consumption. Because of the high demand for petroleum product yield from the aforementioned processes, there is complexity in technology used in handling the processes. This complexity in technology also increases the complexity of petroleum refinery operations. In oil refineries, the concern for safety could be said to focus on two main areas: process safety and personal safety. These two areas are very different from each other, but both are important. They require two very different approaches to what one might call “the safety problem”. Process safety involves the development and implementation of interventions concentrated on preventing or minimizing the effect of loss of containment of flammable, toxic, or reactive chemicals. Personal safety interventions focus on the prevention or mitigation of hazards that can result in individual injuries, exposures, or less catastrophic problem, but a no less important one. In this project, the data was collected through open-ended questionnaires from the workers in the oil refinery. The questionnaire was administered to the workers randomly and was used to identify the Health Hazards, determine the awareness of the workers of the Health Hazards and evaluate the Occupational Health Practice that exists in the Refinery.

Keywords: Petroleum refinery operations, reactive chemicals, petroleum refineries

INTRODUCTION

The importance of occupational health is often overlooked and people tend to equate occupational illness with industrialization and huge factories in urban areas. This narrow view hampered the development of occupational health in developing countries. While at work, people face a variety of hazards almost as numerous as the different types of work, including chemicals, biological agents and adverse ergonomic conditions etc. Globally, there are 2.9 billion workers who are exposed to hazardous risks at their work places. Annually there are two million deaths that are attributable to occupational diseases and injuries while 4% of Gross Domestic Product (GDP) is lost due to occupational diseases and injuries. WHO’s programme on workers health is concerned with the control of occupational health risks, the protection and promotion of the working populations and the humanization of work. Also work has its positive effect as increased productivity, higher quality work and increased workforce morale among others are indices of workers well being and to some extend job satisfaction. However the importance of occupational health is often overlooked. This is because; the level of occupational safety and health in Africa is low compared with the rest of the world. In Sub-Saharan Africa public health problems of child mortality, malaria, water quality and HIV/AIDS have overshadowed occupational health problems.

In today’s world, Man lives in a “chemical age” as there is hardly any industry that does not make use of it and/or produce chemicals in the work process. Petroleum products are derived from crude oil that occurs as a complex of chemicals, primarily hydrocarbons. This undergoes fractionalization to yield a variety of products for various uses. The petrochemical industry has been cited as a major pollution source, as the industrial processes involved ranged from prospecting for petroleum to refining of the crude and finally the arrival of the finished products. The petrochemical workers are thus exposed to many and varied health hazards, accidents/injuries with heavy tools and equipments, pipeline explosions, fire and transportation accidents and adverse ergonomic conditions etc.

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Fig 1 Oil Refinery
Therefore, occupational health practice in the oil and gas industry must take cognizance of the known hazards that exist in the particular locale of operation in order to prevent and control their occurrence. To the best of our knowledge, there has not been any recent study to identify and assess the health risk of occupational health hazards of the refinery and petrochemical workers. The joint international labour organization committee on occupational health, 1950, defined occupational health as “the highest degree of physical, mental and social well-being of workers in all occupation.” A hazard is a source of danger that has the ability to cause injury or harm. Occupational hazards are dangers to human health and well-being which are associated with specific occupations. While efforts are made to reduce hazards, these hazards remain present in the workplace by nature of the profession. Occupational or workplace hazard is danger to health, limb, or life that is inherent in, or is associated with, a particular occupation, industry, or work environment. It includes risk of accident and of contracting occupational disease. The dictionary definitions do not correspond entirely with what epidemiologists or professionals in the field of Occupational and Environmental Health would understand these terms to mean. Hazard is not deemed to be synonymous with risk although it can be an important determinant of risk. Although risk may be related to a chance event and expressed as a probability, there is much more to it than that. Probability is not an entirely haphazard one of course but relates to a number of factors. However in Occupational and Environmental Epidemiology, we prefer to define these two words as follows: Hazard is the potential to cause harm; risk on the other hand is the likelihood of harm (in defined circumstances, and usually qualified by some statement of the severity of the harm). The relationship between hazard and risk must be treated very cautiously. If all other factors are equal - especially the exposures and the people subject to them, then the risk is proportional to the hazard. However all other factors are very rarely equal (Health, Environment and Work, October, 2013). Occupational hazards can be divided into two categories: Safety and Health Hazards. Safety Hazards that cause accidents that physically injure workers, and Health Hazards which result in the development of disease. It is important to note that a hazard only represents a potential to cause harm. Whether it actually does cause harm will depend on circumstances, such as the toxicity of the health hazard, exposure amount, and duration. Hazard can also be rated according to the severity of the harm they cause - a significant hazard being one with the potential to cause a critical injury or death (Ontario Ministry of Labour, October, 2013). Occupational hazards may lead to illness, injury or death. They can include physical risk like falls and exposures to heavy machinery, along with Psychosocial ones such as stress. Occupational hazards like exposure to chemical, biological and radiological agents are also concern. In people who work in jobs with recognized occupational safety hazards, special training is often provided so that the people are made aware of the hazards. Jefferson (2013) has opined that, health and safety have been a priority for oil and gas companies for many years. However, occupational hygiene is often not properly assessed to determine the true risk to employees. Author has also highlighted some of the occupational diseases and other hazards that employees of oil and gas companies should be aware of. Hanna and Sell (2012), have suggested that each of the industries, including oil and gas company should pay attention to aspects of industrial hygiene, as well as possible, given the magnitude of the risk level of activity contained in each employee. The study aims to design what should be done to manage occupational health risks in oil and Gas Company based on the framework of industrial hygiene. Mahdi Golara and Setareh Shokat Sadry (2015) suggest that Occupational diseases usually develop over an extended period of time. They are slow and generally develop over an extended period of time. They are slow and generally cumulative in their effects, are irreversible and often complicated by non-occupational factors. Generally, the occupational diseases are the effects of frequent exposure to the influence of toxic substances, of microorganism, or air borne contaminants, and stress producing factors. Faith Eyayo (2015) pointed that Occupational Health Hazard which is different from Occupational Safety Hazard is prevalently on the rise as industrialization increases in the global world. And identifying them in order to prevent and control them is very imperative to the health and well-being of the workers. The health and well-being of the workforce of a Company which is their most valuable asset should not be toyed with by the Management. Reiman and Pietikainen (2012), the safety level in an organization is determined based on the view of top management in terms of their interpretation of safety indicators in line with the goal that the organisation sets. This kind of approach is not sufficient enough to address latent conditions that can contribute to the underlying safety deficiencies in the risk management of petroleum refinery operations. Ademola Isola (2017) has analysed various risk elements and their attributes that can interact to cause the disruption of PRPU operations were identified and analysed, in order to determine their criticality levels and to shows that the convergent effect of the interactions between the risk elements and their attributes can lead to the disruption of petroleum refinery operations. Gary and Handwerk and Kaiser (2007) gives a detailed overview of today’s integrated fuels refinery, refining process and topic such as feedstock preparation, operating costs, catalysts, yields, finished product properties and economics. It also contains ongoing problems and case study.

**REFINERY PROCESSES**

The physical and chemical transformations that crude oil undergoes in a refinery take place in numerous distinct processes, each carried out in a discrete facility, or process unit. Large modern refineries comprise as many as fifty distinct processes, operating in close interaction.

**Crude Distillation**

Crude oil distillation is the front end of every refinery, regardless of size or overall configuration. It has a unique function that affects all the refining processes downstream of it. Crude distillation separates raw crude oil feed (usually a mixture of crude oils) into a number of intermediate refinery streams (known as “crude fractions” or “cuts”), characterized by their boiling ranges (a measure of their volatility, or propensity to evaporate). Each fraction leaving the crude distillation unit

- It is defined by a unique boiling point range (e.g., 180–250 F, 250–350 F, etc.
- It is made up of hundreds or thousands of distinct hydrocarbon compounds, all of which have boiling points within the cut range.
These fractions include (in order of increasing boiling range) light gases, naphthas, distillates, gas oils and residual oil. Each goes to a different refinery process for further processing. The naphthas are gasoline boiling range materials; they usually are sent to upgrading units (for octane improvement, sulfur control, etc.) and then to gasoline blending. The distillates, including kerosene, usually undergo further treatment and then are blended to jet fuel, diesel fuel and home heating oil. The gas oil go to conversion units, where they are broken down into lighter (gasoline, distillate) streams. Finally, the residual oil (or bottoms) is routed to other conversion units or blended to heavy industrial fuel and/or asphalt. The bottoms have relatively little economic value indeed lower value than the crude oil from which they come. Most modern refineries convert, or upgrade, the low-value heavy ends into more valuable light products (gasoline, jet fuel, diesel fuel, etc.). Because all crude oil charged to the refinery goes through crude distillation, refinery capacity is typically expressed in terms of crude oil distillation throughput capacity.

Conversion Process

Conversion processes carry out chemical reactions that fracture (“crack”) large, high-boiling hydrocarbon molecules (of low economic value) into smaller, lighter molecules suitable, after further processing, for blending to gasoline, jet fuel, diesel fuel, petrochemical feed stocks, and other high-value light products. Conversion units form the essential core of modern refining operations because they

• enable the refinery to achieve high yields of transportation fuels and other valuable light products.
• provide operating flexibility for maintaining light product output in the face of normal fluctuations in crude oil quality
• permit the economic use of heavy, sour crude oils.

The conversion processes of primary interest are fluid catalytic cracking (FCC), hydro cracking and coking.

Upgrading Process

Upgrading processes carry out chemical reactions that combine or re-structure molecules in low-value streams to produce higher-value streams, primarily high octane, low sulfur gasoline blendstock. The upgrading processes of primary interest all employ catalysts, involve small hydrocarbon molecules, and apply to gasoline production. The most important of the many upgrading processes are catalytic reforming, alkylation, isomerization, polymerization and ethereification.

Treating Process

Treating processes carry out chemical reactions that remove hetero-atoms (e.g., sulfur, nitrogen, heavy metals) and/or certain specific compounds from crude oil fractions and refinery streams, for various purposes. The most important purposes are

• protecting the catalysts in many refining processes from deactivation (“poisoning”) resulting from prolonged contact with hetero-atoms.

By far the most widely-used of the various treating technologies is catalytic hydrogenation, or hydro treating. Hydrotreaters remove hetero-atoms by reacting the refinery streams containing the hetero-atom(s) with hydrogen in the presence of a catalyst. The hydrogen combines with the hetero-atom(s) to form non-hydrocarbon molecules that are easily separated from refinery streams. Hydro treating has many forms and degrees of severity; as a result, it goes by many names in the refining industry and in the literature. Hydro treating focused on sulfur removal is often referred to as hydro-desulfurization; hydro treating focused on nitrogen removal is called hydro-gentrification. Hydro treating conducted at high severity (i.e., high temperature, pressure, and hydrogen concentration) often involves some incidental hydro cracking as well. Deep hydro treating of this kind is called hydro-refining. Hydro treating conducted at low severity is used to modify certain characteristics of specialty refined products (e.g., various lubricating oil properties) to meet specifications. Mild hydro treating is often called hydro-finishing.

Separation Process

Virtually all refinery streams are mixtures of hydrocarbon compounds. Separation processes use differences in the physical and chemical properties of these compounds to separate one refinery stream into two or more new ones. Distillation, or fractionation, the most common separation process, uses differences in boiling point temperatures to effect separations into relatively lighter (lower boiling) and relatively heavier (higher boiling) mixtures. Distillation employs well-established technology and is doubtless the most widely used refining process; distillation units (fractionators) are ubiquitous in refineries. Distillation units require significant inputs of thermal energy, to boil the more volatile components of the mixture being separated. Consequently, a refinery’s distillation units, including crude distillation collectively account for a significant fraction of the refinery’s total energy use. Extraction, another common separation process, uses differences in the relative solubility’s of different compounds in a liquid solvent to remove specific compounds from hydrocarbon mixtures. The most common refining application of extraction is aromatics extraction, which selectively removes certain aromatics compounds from the highly aromatic reformate stream produced in catalytic reforming. The extracted aromatics (benzene, toluene, xylene) are primary petrochemical feed stocks.

Utilities and Supporting Operations

Refineries encompass many additional process units of varying complexity and purpose. Some produce specialty products (waxes, lubricants, asphalt, etc.); others control emissions to air and water; and still others provide support to the mainline processes discussed above.

The primary support facilities include:

• Hydrogen production and recovery
• Sulfur recovery (from desulfurization processes)
• Light gas handling and separation
• Wastewater treatment
• Oil movement and storage
• Electricity and steam generation

Hydrocrackers and hydrotreaters require substantial inputs of hydrogen. As noted above, some of the refinery hydrogen requirement (about 45% of the total in U.S. refineries) is met by by-product hydrogen produced in the reformer. The rest of the hydrogen requirement is met by on-purpose hydrogen production units in the refinery or (in some locales) by purchases of hydrogen from near-by merchant hydrogen plants. These units produce hydrogen from natural gas. Because on-purpose hydrogen is expensive, regardless of its source, most refineries also have facilities for recovering and recycling the spent hydrogen in hydrocracking and hydrotreating effluent streams. Refinery processes use fuel and steam to heat and/or boil process streams and to provide the energy needed to drive chemical reactions, and they use electricity for running pumps and compressors. Some refineries purchase fuel (natural gas), electricity, and/or steam; others generate some or all of their utilities on-site. On-site generation involves traditional steam boilers and power generation facilities, or cogeneration. Co-generation is the integrated production of electricity and steam, at very high thermal efficiency, using either purchased natural gas or refinery-produced light gas as fuel.

**Product Blending**

Product blending, the operation at the back end of every refinery, regardless of size or overall configuration, blends refinery streams in various proportions to produce finished refined products whose properties meet all applicable industry and government standards, at minimum cost. The various standards pertain to physical properties (e.g., density, volatility, boiling range); chemical properties (e.g., sulfur content, aromatics content, etc.), and performance characteristics (e.g., octane number, smoke point).

Production of each finished product requires multi-component blending because

- refineries produce no single blend component in sufficient volume to meet demand for any of the primary blended products such as gasoline, jet fuel, and diesel fuel
- many blend components have properties that satisfy some but not all of the relevant standards for the refined product into which they must be blended
- cost minimization dictates that refined products be blended to meet, rather than exceed, specifications to the extent possible.

Typically, gasoline is a mixture of ≈ 6–10 blendstocks; diesel fuel is a mixture of ≈ 4–6 blendstocks. Gasoline blending is the most complex and highly automated blending operation. In modern refineries, automated systems meter and mix blendstocks and additives. On-line analyzers (supplemented by laboratory analyses of blend samples) continuously monitor blend properties. Computer control and mathematical models establish blend recipes that produce the required product volumes and meet all blend specifications, at minimum production cost. Blending of other products usually involves less automation and mathematical analysis.

**Refinery Processing Units**

Petroleum refineries processing units are large, continuous-flow production facilities that transform crude oils into refined products. Hence, to comprehend the details of petroleum refining processes it is important to consider a refinery physical configuration and operating features. A refinery configuration defines the set of process units, the capacity of the various units, their significant technical features, and the flow configurations that link these units (John Rudill, 2005). Refinery process units are integrated as necessary to meet product targets based on their capacity and configuration. The entire refinery consists of a number of processing units which include (OSHA, 1999; John Rudill, 2005): Crude Oil Distillation Unit (CDU): To separate crude oil into valuable distillates such as naptha, kerosene, diesel, and other heavy components for further processes.

**Vacuum Distillation unit (VDU):** For distillation to recuperate valuable gas oils from crude oil residue from CDU via vacuum distillation.

**Hydrotreater unit:** Desulphurize sulphur contaminant from unsaturated aromatics and olefins hydrocarbons of crude oil to yield a clean product for advance processing or finished product.

**Catalytic Reforming unit:** This unit produces high-octane reformate from desulfurized hydrocarbon molecules for gasoline blending and also produce other petrochemical raw materials.

**Alkylation unit:** This unit produces alkylate, a high-octane constituent of the end-product gasoline or petrol from butylene and isobutene.

**Isomerization unit:** Transforms normal hydrocarbon molecules of low octane number into higher-octane branched molecules for blending to finished product such as gasoline or petrol. Normal butane is converted to branched isobutene in isomerization unit.

**Fluid Catalytic Cracking unit (FCC):** FCC converts low gas oil from crude oil distillation to upgraded valuable light product such as naptha, diesel and slurry oil.

**Hydrocracker unit:** Provides catalytic cracking and hydrogenation of heavy aromatic hydrocarbon fractions from the crude oil distillation unit and the vacuum distillation units to produce light hydrocarbon products.

**Visbreaker unit:** Convert heavy residual oils from the vacuum distillation unit into light product with lower viscosity by thermal cracking process.

**Delayed coking and Fluid Coker units:** This unit converts low value residual oils into lighter product such as cooker gas oil, diesel and naptha by severe thermal cracking.

**Refinery Products**

Refined products produced in petroleum and gas refining may be classified into four categories: Light distillates, middle distillates, heavy distillates and others.

**Light distillates include** Liquid petroleum gas (LPG), Gasoline (or petrol) Kerosene and Jet fuel.
**Middle distillates** include Automotive and rail diesel fuels and other residential heating fuel and light fuel oils.

**Heavy distillates include** Heavy fuel oils bunker fuel oil and residual fuel oils.

**Others includes** Petroleum naphtha Petrochemical feedstocks, asphalt, tar petroleum coke, lubricating oils, waxes and greases, Transformer and cable oils, sulphur, special solvent and Carbon black.

**OCCUPATIONAL HEALTH HAZARDS**

Workplace health hazards generally differ from those found in the general environment. Furthermore, because workers are often exposed in confined spaces, exposure levels to workplace hazards are often much higher than exposures to hazards in the general environment. In developing countries, workers may be exposed simultaneously to workplace hazards, to an unsafe housing environment, and a polluted general environment. Occupational Health Hazards are broadly divided into Physical, Chemical, Biological, Behavioral, Psychosocial, and Mechanical/Ergonomics.

**Physical Hazards**

Physical hazards are often said to be less important than chemical hazards but this is not so. They can and do cause several health problems, injuries or even death. The nature of physical agents is wide and should not be underrated but the main ones capable of causing occupational disorders and injuries are:

- Noise
- Illumination
- Vibration
- Radiation (ionizing and non-ionizing)
- Microclimatic conditions in the case of extreme heat and cold.

A noise in oil and gas companies, include hearing loss of employees. This hearing loss may be permanent due to long term exposure to hazardous noise. The severity of hearing loss is affected by the intensity of the noise and the duration of exposure. In a nut shell, employees of oil and gas company exposing to wide range of hazardous substances, noise, vibrations, radiations, extreme heat and cold and ergonomic hazards. All these have the potential to adversely impact or to harm the health of employee immediately or in later life. Noise level in oil and Gas Company can exceed 90 decibels, posing a significant threat to the health of employees. In many oil and gas companies, work place is limited and fully enclosed or partially enclosed. This space is not designed for someone to work in regularly, but employees may need to enter the enclosed space or area for activities like inspection, maintenance and repair or cleaning etc. Area layout with obstructions can make entry and exit difficult and may complicate rescue procedures. Many times employees have deceased because of they did not know that they were entering such a enclosed area with a hazardous atmosphere and therefore, they did not take necessary precautions before
entering in such area. Such enclosed areas are common in oil and gas companies; particularly in processing operations. The examples of such enclosed or confined areas are – storage tanks, boilers, tunnels and pits, pipelines, ventilations and exhaust ducts, process and reaction vessels.

**Mechanical/Ergonomics Hazard**

Unshielded machinery, unsafe structures in the workplace and dangerous tools are some of the most prevalent workplace hazards in developed and developing countries. In Europe, about 10 million occupational accidents happen every year (some of them commuting accidents). Adoption of safer working practices, improvement of safety systems and changes in behavioral and management practices could reduce accident rates, even in high-risk industries, by 50% or more within a short time. Approximately 30% of the workforce in developed countries and between 50% and 70% in developing countries may be exposed to a heavy physical workload or ergonomically poor working conditions, involving much lifting and moving of heavy items, or repetitive manual tasks. Workers most heavily exposed to heavy physical workloads include miners, farmers, lumberjacks, fishermen, construction workers, storage workers and healthcare personnel. Repetitive tasks and static muscular load are also common among many industrial and service occupations and can lead to injuries and musculoskeletal disorders. In many developed countries such disorders are the main cause of both short-term and permanent work disability and lead to economic losses amounting to as much as 5% of GNP.

**Biological Hazards**

Exposure to some 200 biological agents, viruses, bacteria, parasites, fungi, moulds and organic dusts occurs in selected occupational environments. The hepatitis B and hepatitis C viruses and tuberculosis infections (particularly among healthcare workers), asthma (among persons exposed to organic dust) and chronic parasitic diseases are the most common occupational diseases resulting from such exposures. Bloodborne diseases such as HIV/AIDS and hepatitis B are now major occupational hazards for healthcare workers. This can be classified into:

- Human tissue and body fluids
- Microbial pathogens (in laboratory settings)
- Genetically modified organisms
- Animals and animal products
- Organic dusts and mists

**Chemical Hazards**

About 100 000 different chemical products are in use in modern work environments and the number is growing. High exposures to chemical hazards are most prevalent in industries that process chemicals and metals, in the manufacture of certain consumer goods, in the production of textiles and artificial fibres, and in the construction industry. Chemical hazards could be classified into:

- Particles, fibers, fumes and mist: Carbon Black, Welding Fume, Oil Mist
- Metals and metalloids : Arsenic, Cadmium, Chromium, Mercury, Zinc
- Organic, solvents and compounds: Acetone, hydrocarbons, Benzene
- Inorganic gases: Carbon monoxide, Hydrogen sulphide, Sulphur dioxide

Chemicals are also increasingly used in virtually all types of work, including non-industrial activities such as hospital and office work, cleaning, and provision of cosmetic and beauty services. Exposure varies widely. Health effects include metal poisoning, damage to the central nervous system and liver (caused by exposure to solvents), pesticide poisoning, dermal and respiratory allergies, dermatoses, cancers and reproductive disorders. In some developing countries, more than half of the workers exposed to dust-containing silica in certain high-risk industries (such as mining and metallurgy) are reported to show clinical signs of silicosis or other types of pneumoconiosis. About 300–350 substances have been identified as occupational carcinogens. They include chemical substances such as benzene, chromium, nitrosamines and asbestos, physical hazards such as ultraviolet radiation (UVR) and ionizing radiation, and biological hazards such as viruses. In the European Union alone, approximately 16 million people are exposed to carcinogenic agents at work. The most common cancers resulting from these exposures are cancers of the lung, bladder, skin, mesothelium, liver, hematopoietic tissue, bone and soft connective tissue. Among certain occupational groups, such as asbestos sprayers, occupational cancer may be the leading factor in ill-health and mortality. Due to the random character of effect, the only effective control strategy is primary prevention that eliminates exposure completely, or that effectively isolates the worker from carcinogenic exposure.

**Psychosocial Hazards**

Psychosocial hazards comprises of the Psychosocial and social hazards. Psychosocial hazards are caused when time and a work pressure has become more prevalent during the past decade. Monotonous work, work that requires constant concentration, irregular working hours, shift-work, and work carried out at risk of violence, isolated work or excessive responsibility for human or economic concerns, can also have adverse Psychosocial effects. Psychosocial stress and overload have been associated with sleep disturbances, burn-out syndromes and depression. Epidemiological evidence exists of an elevated risk of cardiovascular disorders, particularly coronary heart disease and hypertension in association with work stress. Severe Psychosocial conditions have been observed among workers involved in catastrophes or accidents during which human lives have been threatened or lost. Social conditions of work such as gender distribution and segregation of jobs and equality (or lack of) in the workplace, and relationships between managers and employees, raise concerns about stress in the workplace. Many service and public employees experience social pressure from customers, clients or the public, which can increase the psychosocial workload. Measures for improving the social aspects of work mainly involve promotion of open and positive
contacts in the workplace, support of the individual's role and identity at work, and encouragement of teamwork. Organizational Psychosocial factors include but not limited to the following:

- Violence and aggression
- Lone working
- Shift and night work
- Long working hours
- Time zone changes

Exposure to the estimated 3000 allergenic agents in the environment is mainly occupational. In the work environment, such hazardous agents enter the body via the respiratory tract or the skin. Allergic skin diseases are some of the most prevalent occupational diseases. Occupational respiratory diseases should therefore be the focus of any occupational health programme. Occupational asthma, for instance, is caused by exposure to various organic dusts, microorganisms, bacteria, fungi and moulds, and several chemicals. The increased number of people who develop an allergic response, coupled with high numbers of occupational allergenic exposures and improved diagnostic methods, has led to a steady growth in the registered numbers of occupational asthma cases in several industrialized countries.

The great variety of occupational health hazards makes quantification of their associated health risks and impacts at the global level very difficult. Some estimates have been based on the occupational injuries and diseases reported in official statistics. But a large number of injuries and diseases caused by workplace hazards are not reported. Adjustment is therefore necessary. Making such adjustment, ILO and WHO estimate that there may be as many as 250 million occupational injuries each year, resulting in 330 000 fatalities.

**Occupational Health Diseases**

Occupational health disease can be defined as a compensable disease contacted by the worker due to exposure to hazards in the work places. Employees in oil and gas companies exposed to various chemicals and gases produced and used in various segments of activities. These chemicals and gases caused for occupational diseases of the lungs, skin and other organs, depending on the duration of exposures. The present informative article is intended to focus on the occupational diseases being faced by oil and gas company employees, its effects on their health, family life and some remedies have been discussed to overcome the problems related to their health. During the years 2003-2009, the annual rate of occupational diseases in the oil and gas industry was 27.5 percent per 100000 employees i.e. it was more than seven times higher than the rate for all US workers. In the year 2010-11, oil and gas industry employed 4,35,000 employees. The annual fatality rate in this industry is highly variable and this variation is correlated with the level of drilling activity in the company. It was observed that, the rate of occupational diseases are higher whenever there is growth in number of active drilling and work over rigs. This is because of increased proportion of untrained and inexperienced employees, longer overtimes, and utilization of outdated old equipments with fewer safeguards. Employees of oil and gas companies are generally engaged in various functions of which lead to various diseases. These functions contained chemical hazards (i.e. toxic, corrosive carcinogens, asphyxiates, irritant and sensitizing substances), physical hazards (i.e. noise, vibration, radiations and higher temperature) and ergonomic hazards (i.e. manual handling dangerous activities and repetitive motions, awkward postures). In all segments, many chemical products are used and also produced. The employees exposed to chemicals and gases produced in the oil and gas companies. It develops occupational diseases of the lungs, skin and other organs if employees are associated for a longer period with these chemicals. Some adversely affected elements have been highlighted in the following paragraphs.

**Hydrogen Sulphide**

Hydrogen Sulphide is an important element of oil and natural gas deposits. It is also found in some mineral rocks. Hydrogen Sulphide is a very toxic gas which is colorless and smells like rotten eggs. This gas can adversely affect on the eyes, nose, throat and lungs of the employee. The body of employee may tremble and death may follow within minutes as a result of breathing failure.

**Asbestos**

In the process of refining oil, asbestos is used. Refining oil requires the oil to be boiled, which releases gases and allows for chemicals to separate. In this process asbestos is use to reduce the risk of fire, preventing of burns. It is also used to resist the chemical reactions on the health of the employees. Inhaling small tiny asbestos fibers can cause inflammation and scaring that may lead to the development of Mesothelioma, cancer and other asbestos related diseases. Asbestos is also used in clothing of oil employees for the protection against heat and the risk of fires. Any damage occurred to the protective clothing; the asbestos fibers are released and potentially inhaled by employees. There is chance of disease like cancer. It is strongly associated with asbestos exposure. Even though, the use of asbestos is banned in some oil producing countries, it is still widely used in many other oil producing countries.

**Drilling Fluids**

In the process of drilling, a large volume of fluid is circulated through the well and into open, partially enclosed or, completely enclosed systems at elevated temperatures. When these fluids are agitated during the circulation process, there is a potential for exposure of employees and subsequent health effects. These effects include dizziness, headaches, nausea (associated with exposure to hydrocarbons) and drowsiness, as well as dermatitis and sensitization from repeated skin contact with the drilling fluids. Apart from this, exposure to oil mists can cause irritation and inflammation of the respiratory system. Some of the mildly refined base oils have also been associated with cancer, as a result of the aromatic compounds in the oil mists.

**Silica**

It is primary element of sand and rock. It contains minerals like granite, sand, fill dirt and top soil. Hydraulic fracturing sand contains up to 99 percent silica. A disease like silicosis is caused
by the longer breathing of fine crystalline silica dust. The particles are deposited in the lungs of employees, causing thickening and scarring of the lung tissues. Employees associated with silicosis disease may have no any symptoms, but later, as the disease progresses, employees experience shortness of breath, sever cough and weakness. These symptoms can worsen overtime and may lead to death. Crystalline silica exposure has also been linked to lung cancer. The employees engaged in the following functions are at the risk of breathing silica dust – abrasive blasting using silica containing products, cementing operations, drilling using dry product additives which contain quartz, shale dryers maintenance, hydraulic fracturing which contained loading- unloading, moving or storing sand; and sweeping or moving sand or gravel containing silica.

**Mercury**

Mercury is found in various chemicals. It is natural element in oil and gas and may be present at high concentrations in some formations. It is likely separated from geological storage due to heat and pressure and migrated as a vapor, to the oil and gas storage. Mercury in liquid nature can condense within heat exchangers separators, coolers, valves and piping. When this equipment is used for the purpose of maintenance or repair, employees can be exposed to the vapors of mercury. The risk of exposure to mercury is related with the functions like - vessel cleaning, welding, pipefittings, hydro excavating and electrical work, buffing and polishing. A long term exposure to mercury vapor adversely affects the central nervous system of employees’ body. Due to this, employees may face the diseases like stupor, tremors and problems related to vision and hearing. Apart from this, employees may face the nervousness, personality changes etc. and most important thing is that, if an employee is contacted with mercury, it can adversely affect his kidneys and cause irritation and burns to the skin and eyes.

**Diesel Exhaust**

In the oil and gas companies, diesel engines are used to generate power for operations of many types of vehicles, heavy equipments, power generators etc. The exhaust of these engines includes carbon monoxide and oxides of nitrogen. The exhaust also contains a mixture of many other gases. The diesel exhaust can affect on worker health. This can also cause diseases for eyes, nose and throat. Long term health issues can include respiratory diseases, lung cancer and cardiovascular problems.

**Radioactive Materials**

There are many radioactive materials which are found naturally in the environment and in the earth crust. These materials include uranium, radium, radon and thorium. In the oil and gas companies, these materials may be available in the form of liquids and gases from some geological formations. The concentration of these higher levels, because of human activities in the oil and gas company. Special precaution is necessary for handling, transporting and disposing of these materials. Scale from oil recovery brine, may contain radium at much higher concentrations than the original water source. Drilling fluids and sludge may also contain these radioactive materials. Employees of oil and Gas Company can be exposed to these radioactive materials through external source (irradiation) or internal source that is through inhalation, ingestion or absorption. The effects of the exposure to these materials on the employees health, depends on the intensity of the radiation and the duration of the exposure. It is obvious that, the long term exposure to the radioactive materials, above exposure limits has been associated with certain forms of cancer. Radioactive materials can also be found in well heads, production manifolds, gas and oil separator flow lines, valves, storage tanks and dehydrators and desalinates etc. Apart from the gases and other chemicals, there are some factors which are adversely affects the health of the employees of oil and Gas Company. These factors are availability of limited and enclosed work space and hazardous noise.

**CONCLUSION**

Petroleum refineries are complex integrated systems which are capital intensive and a constant flow production infrastructure. Due to the complexity of this infrastructure, it is essential to consider precise, engineered operation procedures to assure the safety of petroleum refinery operations and to protect people working within this infrastructure. However, the pressure of daily demand and commitment to target in operations of most refineries around the globe has led to a strong push of safety boundaries, which has led to numbers of occurrences of major accidents. Therefore, the regular occurrence of mishapes in the petroleum refineries has increased the risk of disruption to petroleum refinery operations. Despite the lessons learnt from historical cases of accident in petroleum refineries, risk management lapses still persist, because after a few years, the lessons learnt from previous accidents are forgotten.

**REFERENCES**


