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Review Article

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The Oil Industry and Labor Risks

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Introduction

a) Oil and gas are natural products created by the degradation of organic material in geological deposits within the earth's surface. They are made up of mixtures of miles of organic substances, which once processed provide a highly adaptable product, the fossil fuels, a variety of petrochemicals products useful to humans [1].

Basic Petrochemistry Industry (IPB) is the one that performs the first transformation of oil or natural gas and other liquid hydrocarbons, to obtain supplies for the Intermediate Petrochemistry Industry (IPI) and/or other final products.

The main manufactured products are olefins (ethylene, propylene, butylene, etc.), aromatics (benzene, toluene, o-xylene, etc.), syngas, methanol, ammonia, among others. The IPI transforms by-products generated by the IPB into final products and/or inputs from the IPF. Products made by IPI include cyclohexane, styrene, ethylene glycol, phenol, etc. [2].

b) What is the petrochemical industry? It could be defined as follows: "The oil industry comprises of upstream and downstream activities. Upstream activities include exploration and transportation of crude oil and gas to the refining or processing facility, while the downstream industry involves refining, distribution and sale of refined oil" [3].

Volatile Organic Chemicals (VOCs) are common contaminants associated with UOGD and include benzene, toluene, ethylbenzene, and xylene (commonly called BTEX) and others. Workers are potentially exposed to varying concentrations of VOCs through water management and storage. An additional source of VOC exposure at well sites are also unintended fugitive emissions from natural gas production [4].

c) The raw material for gasoline, at least for now, is crude oil, which can contain up to 100,000 compounds ranging from methane to those with 85 carbon atoms. It is a refined product of petroleum, consisting of a mixture of hydrocarbons, additives, and mixing agents. Gasoline composition varies widely, depending on the crude oils used, the refinery processes available, the overall balance of product demand, and product specifications. The typical composition of gasoline hydrocarbons is as follows: 4-8% alkanes; 2-5% alkenes; 25-40% isoalkanes; 3-7% cycloalkanes; 1-4% cycloalkenes; and 20-50% of total aromatics (0.5-2.5% benzene) [5].

d) In its set: what is necessary to investigate always as a risk for the health in the workpeople with activities of extraction of oil and gas?

The activities of perforation and service of oil wells and gas imply the use and production of potentially dangerous materials. They are watched by OSHA, the National Institute for the Safety and Occupational Health (NIOSH), and industrial and safety companies that evaluate the type and scope of the chemicals and other health hazards in the whole industry.

The following must be monitored: The quantity of diesel particles, dangerous chemicals, Hydrocarbons Gases and Vapours (HGV) and low oxygen content environments; hydrogen sulphide, possible contact with silica, noise, fatigue and/or presence of extreme temperatures or of Naturally Occurring Radioactive Material (NORM) [6].

e) Are there any risks for oil ships workers?

The safety of workers is compromised by the absence of basic precautions and work planning, which include, among others: lack of or insufficient training; insufficient or non-existent personal protective equipment; insufficient or no work operations monitoring; and facilities deficiency.

The ship itself represents several potential risks. Basic risk reduction or elimination measures are often ignored and ultimately accidents do occur. Some examples are: (access to non-breathable atmospheres; or working in “very hot” environments or in potentially explosive atmospheres) [7].

Working on the high seas may involve exposure to a series of hazards sequentially or simultaneously (highlighting contact with dangerous substances, noise, vibrations, hot or cold conditions, heavy manual handling activity while working on the drilling floor). And the possible interactions between different stress factors like these, have hardly been explored [8].

f) The importance of occupational health is often overlooked, and people tend to equate occupational diseases with industrialization and large factories in urban areas. This narrow vision hampered the development of occupational health in developing countries. While at work, people face a variety of risks almost as numerous as different types of work, including chemicals, biological agents, and adverse ergonomic conditions, etc. Globally, there are 2.9 billion workers exposed to dangerous hazards in their workplaces.

Therefore, occupational health practice in the oil and gas industry must consider the known risks that exist in an operation location to prevent and control their occurrence [9].

There are health risks in various countries, such as, for example: The Sultanate of Oman, where according to the work of Shikdara et al. (2004): 1) back and neck pain, reaching 48%, fatigue, stress and dissatisfaction; 2) injuries resulting from the use of tools or machines; 3) environment related: heat, humidity, high noise levels (>85 decibels) up to 36% and dust; 38% refer long working hours in the desert, 4) dissatisfaction related to lack of training, or motivation [10].

In Latin American countries, poison, or toxic surveillance, is a fundamental tool for evaluating health and safety risks from various chemicals. It is developed by the National Epidemiological Surveillance Systems. Poisons have been included in the lists of notifiable diseases, such as pesticide, metal and hydrocarbon poisonings, botulism, poisoning by poisonous animals, drug poisonings or drugs of abuse, which are occasionally related to oil workers. It is also desirable to have effective monitoring of exposure to volatile aromatic hydrocarbons (hydrocarbons and to create indicators associated with benzene and toluene exposure) [11].

Workers at oil and gas extraction sites could be exposed to hydrocarbon gases and vapours, oxygen-deficient atmospheres, and fires and explosions when opening tank hatches to manually measure or collect fluid samples in production, return flow, or other tanks (e.g. drip vessels) containing process fluids. Opening tank hatches, often referred to as “thief hatches,” can cause the release of high concentrations of hydrocarbon gases and vapours. These exposures can have immediate health effects, including loss of consciousness and even death. Over the course of five years nine deaths have been reported as associated with working near the open hatches of crude oil production tanks [12-14].

The study by Witter R et al. (2014), reports an industry occupational mortality rate 2.5 times higher than the construction industry and 7 times higher than the general industry in the US. The most common fatal events were due to road accidents (29.3%) and being hit by an object (20.1%); most of the deaths were associated with non-use of seat belts, light duty trucks were involved with the highest frequency (single vehicle laps).

From OSHA’s perspective, throughout the United States, various safety violations related to work in confined spaces, electrical wiring, and personal protective equipment, among others, were recorded [15].

There is more experience from the Occupational Medicine services, in the following occupational diseases: Since the 1980s, the effect of benzene as a myelotoxic agent has been studied. Studies such as those carried out by McHale et al. support the idea that benzene and/or its metabolites cause chromosomal aberrations in lymphocytes in peripheral blood of chronically exposed humans (highest levels of chromosomal changes commonly observed in AML, including (5q- /- 5 or 7q-/- 7, +8) and T lymphocytes in peripheral blood, from highly exposed workers). AML-related chromosomal changes are also produced by benzene metabolites in human cell cultures, including CD34 progenitor cell cultures. Together, these data provide strong evidence for the induction of AML by benzene through previously proposed genetic pathways [16].

The Subrahmanyam et al. report, (1990) say it is now known that phenol, the main metabolite of benzene, is metabolized to hydroquinone by cytochrome P-450 enzymes in the liver, and is converted to hydroquinone by myeloxidase present in the bone marrow and the peripheral leukocytes, resulting in its accumulation in the bone marrow [17].

Benzene is a fuel component derived from crude oil and gasoline and is a solvent used in multiple industries (plastics and rubber). Cigarette smoking can also increase exposure to benzene present in tobacco smoke. Finally, transportation will contribute with 85% of the benzene in the atmosphere.

The national standard amount of benzene in the ambient in Iran is reported to be 1.5 ppb. The study carried out by Bahrami et al. (2001) showed that the average concentration of benzene measured in Tehran’s ambient air reached 127.6 ppb.

The literature review agrees with the findings that air benzene concentration values from service stations or industrial settings, where concentrations exceeded allowable limits, were associated with increased occurrence of leukemia and changes in hematological parameters [18,19].

Kirkeleit et al (2008) report a three times higher risk of AML in Norwegian deep-water oil field operators. This agrees with those reported by Glass et al. that showed a sevenfold increased risk of acute non-lymphocytic leukemia among oil workers exposed to 48 p.p.m. for years. More recently, Stenehjem et al. (2015), published that in a cohort of 24,917 Norwegian men, who worked on the high seas between 1965 and 1999, it was found that most of those workers were exposed to benzene for 15 years (with average intensity and cumulative exposure values between 0.040 p.p.m. and 0.948 p.p.m./year). There was evidence of related risk patterns, for acute myeloid leukemia (AML) and multiple myeloma mainly [18,20].

Occupational exposure to chemical hazards and toxic substances can cause a variety of health risks ranging from irritation to carcinogenicity. Gas station workers who are part of vehicle fuelling and refuelling activities are the most exposed to volatile organic compounds such as Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) from fuel vapours during the fuel distribution, and the vehicle's exhaust gas emissions.

The Salem et al. report, (2018), showed that due to the long exposure interval, average benzene levels (3.69 ± 1.88 ppm) were extremely high in the environment of gasoline stations compared to the recommended exposure limits in Egypt (0.5 ppm during 8 hrs of exposure). In the USA, the Occupational Safety and Health Administration (OSHA) allows only 1 ppm. It is also mentioned that in other Asian countries, very high levels of benzene, toluene, ethylbenzene or xylenes have been reported in Thailand (11.28 ± 5.03, 56.13 ± 73.96, 7.17 ± 9.20 and 10.59 ± 6.32 μg / m^3, respectively), Brazil (mean values 144.5, 157.0, 35.8, and 46.7 μg / m^3; respectively) and northern India (7.94 ± 1.45, 4.29 ± 0.69, 5.10 ± 1.08 ppm; respectively) [21].

It is then possible to reaffirm the concept that Benzene causes acute myeloid leukemia, and probably other hematological malignancies, due to the multiple works among others of Li G. (2006), Infante P. (2009), Dabaja B et al (1999), Mc Hale C (2012) [22-25].

Oil refineries employ hundreds of thousands of workers worldwide, with exposure to various well-established human carcinogens such as benzene, untreated mineral oils, polycyclic aromatic compounds, and various metals (including arsenic, lead, chromium, nickel) in addition to asbestos. In 1989, the International Agency for Research on Cancer (IARC) evaluated work at oil refineries as "probably carcinogenic to humans (Group 2A)".

In the study carried out by Bonzini (2019) it was shown that in a cohort of 5,112 male workers employed between 1949 and 2011, these workers had a higher risk than the general population and there were pleural cancer (6 deaths), brain cancer (14 deaths) and Lymphatic Leukemia (LL) (8 deaths). All pleural cancers occurred after 10 years of latency and the highest risk was observed among workers with a duration of ≥20 years; It highlights an excess of brain cancer found in patients with shorter duration and latency [26].

The Shell Health Surveillance System (HSS) in the period from 1981 to 1989, studied 14,170 employees and found that adjusted morbidity was 24.8 for respiratory diseases, 129.4 respiratory disease in general, 114.9 injuries and/or poisonings and 11.5 for all types of malignancies (all expressed in 1,000 people/year). The prevalence is higher in women than in men [27].

Studies by Hameed (2009) also confirm that women who had been professionally exposed to benzene, suffered from decreased ovarian size as well as menstrual problems, though it is not known whether fertility decreases or not [28].

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