

CHEMICAL RISK ASSESSMENT IN OIL AND GAS REFINERY INDUSTRY IN GHANA

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Abstract: *safety is paramount quality aspect in oil and gas refinery industrial process when it comes to production, process, distribution and transportation. The safety concept must therefor consider all levels. This paper present potential risk and hazard in oil and gas industry in Ghana as well as integrated method of risk assessment during decision making, process of identifying and evaluation in the industry. The critical indicators that directly influence the risk and hazard, evaluations of risk are identified. This element guides those responsible for safety plans, safety analysis, safety measures and preparation as well as implementation safety plans are discussed in details.*

Keywords: *risk and hazard, risk assessment, safety analysis safety plans, risk management.*

Introduction

The Ghana National Petroleum Corporation (GNPC) is the state agency given the responsibility for the exploration, licensing, and distribution of petroleum in Ghana. The corporation was established in 1983 to replace the Petroleum Department which was an agency under the Ministry of Fuel and Power. The mandate for oil exploration was held to be the Technical Directorate of the Ministry of Fuel and Power and the Geological Survey Department¹. The corporation was established as a state-owned company with the statutory backing of PNDC Laws 64 and 84[1]. The regulatory² related publications by means of which the IAEA establishes safety standards and measures are issued in the GNPC Safety Standards Series. This series covers oil and gas exploration safety, petroleum products disposal safety, transport safety and waste safety, and also general safety (that is, of relevance in two or more of the four areas), and the categories within it are Safety Fundamentals, Safety Requirements and Safety Guides. In the oil refinery equipment consist of storage tanks, pipelines, ammonia refrigeration plant equipment and these comes with high chemical risks. Some are the tanks explosion, pipeline leakage and breakage. This sometimes cause high health and environmental risk. This research proposes the potential chemical hazard from crude oil refinery in Ghana (Tema oil refinery -TOR). chemical hazard identification and effects in the environment. This achieved by various characteristics in crude oil at the refinery, thereby outlined the dangers to workers, people who live around this area of the refinery and the environment. This research present aims to potential chemical risk and hazard associated by the crude oil cracking and long-term effects to workers and area situated. In this document risk management is defined as the process that evaluates the potential for dangers health effects resulting from exposure to chemical under given set of events.

Overview of crude oil processing at the refinery industry

The oil business started with the effective boring of the primary business oil well, and the opening of the main refinery two years after the fact to process the rough into lamp fuel. The advancement of oil refining from straightforward refining to today. advanced procedures have made a requirement for wellbeing and security the executive's methodology and safe work rehearses. Oil refineries may give off an impression of being mind boggling and confounding spots. Refining is the handling of one complex blend of hydrocarbons into various other complex blends of hydrocarbons. The sheltered and precise preparing of raw petroleum into combustible gases and fluids at high temperatures and weights utilizing vessels, hardware, and funneling exposed to pressure and erosion requires significant learning, control, and aptitude. Health and Safety experts, working with compound procedure perceived and arrangements are made for safe working practices and proper defensive measures. These measures may incorporate hard caps, eye protection glasses, safety shoes, hearing protective equipment, respiratory protective devices, for example, heat proof dress where required. Moreover, methodology ought to be set up to guarantee consistence with pertinent guidelines and gauges, for example, peril correspondences, restricted space section, and procedure security the board. Oil refining has advanced constantly because of changing buyer interest for better and distinctive items. The first prerequisite was to deliver fuel as a less expensive. The improvement of the inside burning motor prompted the generation of gas and diesel fuels. The advancement of the plane made a need first for high-octane aviation fuel and after that for rocket and jet fuel, a complex type of the first item such as lamp fuel. Present-day refineries produce an assortment of items including many required as feedstock for the petrochemical business.

Thermal Cracking Processes. With the appearance of large-scale manufacturing and World War I, the quantity of fuel-controlled vehicles expanded drastically and the interest for gas developed appropriately. Nonetheless, refining

[1, 2] GNPC, https://en.wikipedia.org/wiki/Ghana_National_Petroleum_Corporation

[3] OSHA, https://www.osha.gov/dts/osta/otm/otm_iv/otm_iv_2.html

forms delivered just a specific measure of gas from unrefined petroleum. In 1913, the thermal splitting procedure was created, which exposed overwhelming powers to both weight and extreme warmth, physically breaking the expansive particles into smaller particles to deliver extra gas and distillate powers. Another type of warm splitting, was created in the late 1930 to deliver progressively attractive and significant items.

Catalytic Processes. Higher-pressure gas motors required higher-octane gas with better antiknock attributes. The presentation of synergist splitting and polymerization forms in the mid-to late 1930s fulfilled the need by giving improved gas yields and higher-octane numbers. Alkylation, another reactant procedure created in the mid-1940s, delivered all the more high-octane flight gas and petrochemical feedstock for explosives and manufactured elastic. In this way, catalytic isomerization was created to change over hydrocarbons to deliver expanded amounts of alkylation feedstock. Improved impetuses and procedure techniques, for example, hydrocracking and transforming were created all through the 1960s to expand fuel yields and improve antiknock attributes [3]. These reactant forms additionally delivered hydrocarbon atoms with a twofold bond (alkenes) and shaped the premise of the advanced petrochemical industry.

Treatment Processes. Since the commencement of refining, different treatment strategies have been utilized to evacuate nonhydrocarbons, polluting impurities, and different constituents that unfavorably influence the properties of completed items or decrease the productivity of the transformation forms. Treating can include synthetic response and additionally physical detachment. Average instances of treating are compound improving, acid treating, dirt reaching, acidic washing, hydrotreating, drying, dissolvable extraction, and dissolvable dewaxing. Improving mixes and acids desulfurize raw petroleum before handling and treat items amid and in the wake of preparing.

Methodology

This research was based on risk management model by (Book, H. T. O.,2004.) to identify potential risk in the oil refinery industry (Tema oil refinery). This will help create consciousness prevailing in the environment and people around this refinery and also ameliorate the occupational and safety management standards of the industry. The chemical risk and hazard course by the oil refinery industry to the environment and people can never be undermined, the fact is, it will go a long way to improve the occupational health and safety management approach in the oil and gas refinery which currently is been advocated all country to save the environment from this fatal danger.

(Book, Galeev, Ponikarov, Boroush, 2017; Boroush, M., Garant, R.1998) proposed in his book, the approach wherein OHSM elements shown below should be followed diligently.

- 1 Identifying risks
- 2 Assessing risks
- 3 Evaluating risk
- 4 Addressing the risk
- 5 Reviewing and reporting
- 6 Recommends and control risk

3 CHEMICAL RISK IN THE OIL AND GAS REFINERY INDUSTRY

3.1 HEALTH RISK ASSOCIATED WITH EXPOSURE TO HAZARD OF EXTREME TEMPERATURE.

Extreme cold and heat are among the physical health hazards noted in various ³ sections of oil refinery. While cold was noted for some sections of the establishments including the Topping Unit (Area One), the Reforming Unit (Area Two), the Fluid Catalytic Cracking Unit (FCCU)[6], where most engineering and technical repair works are carried out, the various maintenance workshops, the Power plant utility (PPU) where power that drives the industrial operations are generated and the associated waste water treatment plants, the FSE (Fire, safety and environment), most importantly the fire section, the warehouse, the Fire stack area, Human beings must maintain thermal and other bio-physiological factors in the body within relatively narrow limits. The stability between man and the environment is very important when one is working in extreme thermal condition. The metabolic heat produced by metabolic activities is lost to the environment by peripheral vasodilatation and sweating to maintain the body temperature at 37°C, if this is not considered the chemical heat can cause injuries even death to staffs that work around that area.

3.2. HEALTH RISK ASSOCIATED WITH AIR POLLUTION FROM OIL REFINERY

To get the end product from crude oil, it requires high processing procedure, such as heating of catalyst and hydrocarbons which gives dangerous and poisonous gases as part of the discharged effluents in form of micro solids liquids gases vapors and fumes in the environment and people around by inhaling these toxics into their body. Such as hydrofluoric acid (HF) which is added in the conversion process in refineries as catalyst. Besides HF is one of the deadly chemicals when it gets into your body through the air or on the body it courses corrosion on the skin (this is due to its lower boiling point and higher harmful potential). In wake of this high risk, the American Petroleum Institute has issued a Recommended Practice explicitly for HF alkylation units (API RP 751). This for both acute poisonous for long term effects on human and the environment where this operation is. Effects of these chemical toxicity comprises respiratory

[3] Alkylation unit, https://en.wikipedia.org/wiki/Alkylation_unit.

system, organ damages such as liver, kidney, bones, brain etc. On the environment it causes dead vegetation. Chemicals from the oil refinery have caused and will continue to cause huge suffering to humans in the form of acute poisoning, and damage to the environment.

3.3 HEALTH RISK ASSOCIATED WITH RESERVOIR AND PIPELINE BREAKAGE AND SPILLAGE.

Water pollution can be defined as the presence of solid, liquid or gaseous contaminants at higher concentrations that is above the permissible level, thus altering water quality. Waste discharge from the refinery are also wrongfully disposed which ends up in the river bodies and any sources directly or indirectly (by rainfall which is being by pressure and end up in the rivers).

The addition of excess material or heat to water is harmful to living organisms and also negatively affects the use of water.

Leak of liquids from production, processes, reservoirs or pipelines to the ground can also contribute to underground water pollution. Also affecting the aquatic animals in this rivers and lakes. It's also causes massive explosion and fire that destroys properties and death.

3.4 HEALTH RISK ASSOCIATED WITH SOIL POLLUTION

Solid waste containing various amounts of different toxins is produced from different processes, such as sludge in storage facilities. The main concern for the disposal of waste materials on the ground is that the toxic contaminants in the soil can enter the food chain, contaminate water and damage ecological habitats.

4 MEASURE TO ENSURE THE SAFETY OF THE WORKER, COMMUNITY AND THE ENVIRONMENT

The oil and gas refinery are one the dangerous and riskiest industries when it comes to health and safety of its workers and the environment. Which includes fire outbreak, air pollution, soil pollution, aqua pollution and even death to workers and the community situated. Following the construction of crude oil refinery resources in Ghana in 1960 by Italian company and in 1977, the government of Ghana with collaboration with industry staff has made a stringent measure to protect or minimize the risks imposed by the refinery industry through its process. The safety of the environment through the EPA the government has set up regulation to check their day to day operation and safety measure if they are implemented to protect the environment (EPA ACT 1994-490). also, by this Act the EPA makes sure the oil refinery industry to conduct environmental impact assessment at the area in which they operate. (disposal and treatment waste, prevention of pollution and potential hazards to the community).

The refinery also is to conduct and demarcate or create a safe zone and this are enforced through the (petroleum exploration and production Acts 2016-919). The Ghana Labor Act 2003, (Act 651) section 119 to section 120 touches on health and safety and it is designed to improve safety conditions. Workmen's Compensation Law 1987 (PNDCL 187) is also designed to compensate workers for on- the - job injuries. Organizations' health and safety is an area which deals with protection of workmen regarding their health, safety and welfare.

RISK MANAGEMENT

Risk management is fundamental as well as technical approach in identification, assessment and implementation of risk. This approach helps the safety personnel to operate in order to prevent or reduce potential hazard that might occurred safety personnel investigate any lack of operation safety issues and advising the company management. Industries with strong safety programs include a person or group that is tasked for advising management at all top levels of any company or organization on both long-term decisions during design and development in the company and on the safety implications of decisions during operations. In most other industries, a safety engineer would have been resident nearby the company and involved in all the real time safety-related decision making. There so many software programs that are used in determining potential explosion and damage in the refinery, it calculate type of chemical and its potential damage when it occurs, such as **PHAST and SAFETI -DNVGL, TOXI+Risk (Russian software), ALOHA etc.**

Figure 1 explains the structure through which implementation of safety practices are ensured in the oil and gas refinery industry, environment and communities around which they operate in Ghana. Environmental protection agency and Ghana national and petroleum commission were created independently but reports are shared to the ministry of energy to ensure awareness of potential risks in the refinery industry as well as safe workplace for the workers and the community (environment) as a whole. However, EPA can conduct their duties direct in the company top management if their operation has some effects to the environment.

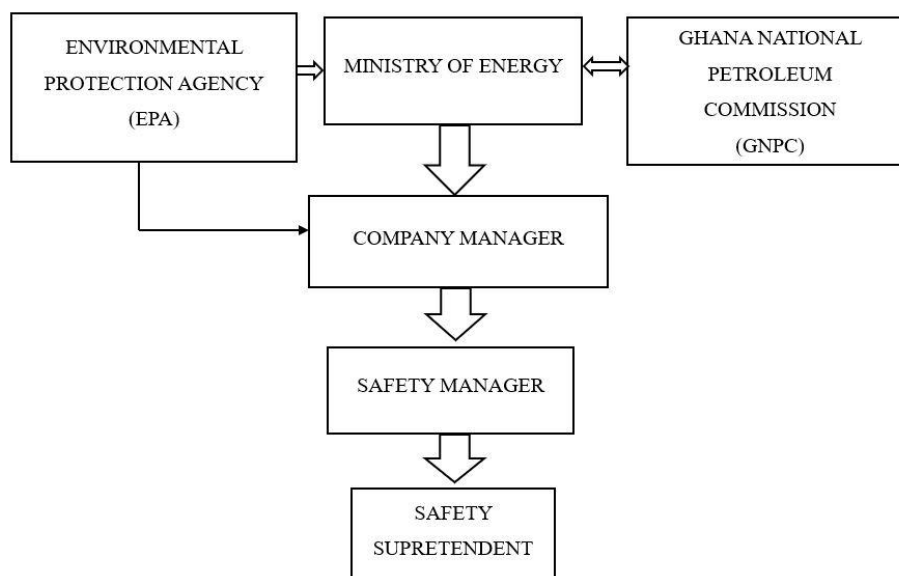


Fig. 1. Chain of command structure in implementation of safety in refinery industry in Ghana

Conclusion

These tools (risk analysis, risk evaluation and risk management) based on hyper potential risk practices of important industries in the oil, gas and related energy sector of the Ghanaian economy. Nevertheless, it suggests that even though there are a number of legislative instruments area covers included aspects of safety in the oil, gas and related energy industries, no legislation exists that exclusively caters for the unique safety practices of that sector of industry. Furthermore, Act are inadequate to provide guidelines to ensure safety and healthy work environment in the industry. In spite of the absence of specific national safety standards for the industry, the organizations adopt varied international safety guidelines for the operation of their plants. EPA Ghana that has the national mandate to monitor safety practices in the industries and the environment to exercising that responsibility with regard to the industries and their activities. Fire prevention, pipeline oil spillage and reservoir leakages are to be observed and controlled to be taken very serious by all the companies' investigation and implementation.

Finally, effective compensation and penalties should be enforced in other for the company to more carefully during their operation these goes to the government agencies responsible to ensure this safety rules and regulations are followed.

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