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Evaluation of Occupational Health Hazards among Oil Industry Workers: A Case Study of Refinery Workers

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Abstract: *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. Health Hazards which could result in the development of diseases and sicknesses is categorized into Physical Health Hazard, Chemical Health Hazard, Biological Health Hazard, Mechanical/Ergonomic Health Hazard and Psychosocial Health Hazard. These Health Hazards, usually, could be associated with most industrialized Organization and the Oil and Gas Refinery is not left out.*

Furthermore, in the course of this study, data was collected through open-ended Questionnaires to the workers and the Occupational Health Doctor. Also, Environmental Monitoring/Surveillance was carried out in seven main units of the 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. Environmental Monitoring/Surveillance which includes the use of specialized equipments and good housekeeping were used to identify the different Health Hazards, and also, to assess the risk associated with the Health Hazards identified. Hazard Risk Assessment Matrix was used to identify the Health Hazards and the risks associated with them.

A total of 85 respondents participated in the study. Most of the respondents were in the age range of 31- 40 years and approximately 31% run Shift Duty. Majority of respondents (82.4%) were males, married (64.7%) and had completed tertiary education (81.2%) respectively. Majority of respondents were able to identify the Health Hazards: Physical Health Hazard (74.2%); Chemical Health Hazard (70.9%); Mechanical/Ergonomics Health Hazard (78.8%) but the level of awareness of Psychosocial Health Hazard (48.3%) and Biological Health Hazards (9.6%) were low especially that of the latter. For the evaluation of Occupational Health Practice most of the respondent (78.1%) agreed that management is committed to the health and well-being of their workers. With the Environmental Monitoring, it was deduced that the above named first three Health Hazards and the Biological Health Hazard are prevalent in the Refinery. With the Hazards Risk Assessment Matrix, the level of risk these identified Health Hazards pose on the workers was 3D, 5E, 3C and 0A respectively

However, workers' susceptibility to work related-diseases depends on a lot of factors, and it usually takes some time before the manifestation of the illnesses and diseases on the worker could be diagnosed. Consequently, Health Effect Management Process which is an element in Occupational Health and Safety Management System (OHS-MS) amongst others is recommended management protocol that would assist the management of an Oil and Gas Refinery protect, promote and rehabilitate the health and well-being of their workers.

I. Introduction

1.1 Background of Study

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 [Meswani, 2008]. 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 (Berenice and others, 1998). 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 (Spee, 2006). 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. Risk factors leading to injuries are present in every work place. Among all occupations, industrial and agricultural workers have the highest risks (WHOa, 1983; WHOb, 1996).

Therefore occupational health practice in the oil and gas industry must take cognizance of the known hazards that exists 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 in this part of Nigeria. Thus the aim of this study was to identify and assess the health hazards among refinery workers and recommend management protocols that would control and prevent these hazards from impacting on the health and well being of the workers (Aliyu, and Saidu, 2011)

The joint international labour organisation 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 (Navy and Marine Corps Public Health Centre, 2010). 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 (wiseGEEK, October, 2013). 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 (BusinessDictionary.com, October, 2013).

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 psychological ones such as stress. Occupational hazards like exposure to chemical, biological and radiological agents are also concern. In people who work in jobs with recognised occupational safety hazards, special training is often provided so that the people are made aware of the hazards (wiseGEEK, October, 2013).

1.2 Statement of Problem

The human, social and economic costs of occupational accidents, injuries and diseases and major industrial disasters have long been cause for concern at all levels from the individual workplace to the national and international. Measures and strategies designed to prevent, control, reduce or eliminate occupational hazards and risks have been developed and applied continuously over the years to keep pace with technological and economic changes. Yet, despite continuous if slow improvements, occupational accidents and diseases are still too frequent and their cost in terms of human suffering and economic burden continues to be significant. A recent ILO report estimated that 2 million occupational fatalities occur across the world every year (ILO,

2003b), the highest proportions of these deaths being caused by work-related cancers, circulatory and cerebrovascular diseases, and some communicable diseases. The overall annual rate of occupational accidents, fatal and non-fatal, is estimated at 270 million (Hämäläinen, Takala and Saarela, 2006). Some 160 million workers suffer from work-related diseases and about two-thirds of those are away from work for four working days or longer as a result. After work-related cancers, circulatory diseases and certain communicable diseases, accidental occupational injuries are the fourth main cause of work- related fatalities. Recent data from the ILO and from the World Health Organization (WHO, October, 2013) indicate that overall occupational accident and disease rates are slowly declining in most industrialized countries (ILO, 2003a) but are level or increasing in developing and industrializing countries (Alli, 2008).

Poor performance in occupational health and safety (OHS) can take a heavy financial toll on any business, not to mention the human cost of work-related illness, injury, and fatality. This is the primary aim of an effective Occupational Health Safety – Management System (OHS – MS). The implementation of such a system can also help your business to deal with the legal imperatives, ethical concerns, industrial relations considerations relating to workplace safety, and to improve its financial performance.

1.3 Research Objectives

The purpose of this study is to:

1. Identify the Occupational Health Hazards among Refinery Workers.
2. Determine the awareness of the workers on Occupational Health hazards.
3. Assess the risk associated with the Health Hazards.
4. Evaluate the Occupational Health Practice in the Refinery.
5. Recommends control to prevent and mitigate the effects of the Health Hazards on the health and well-being of the workers.

1.4 Significance of Study

This study will help to create awareness of the Occupational Health Hazards prevalent among Refinery workers and improve the Occupational Health and Safety Management System of the Organisation. Occupational safety and health is good for business as well as being a legal and social obligation (OSH, October, 2013). Enterprises appreciate that OSH prevents people from being harmed or made ill through work, but it is also an essential part of a successful business. Occupational safety and health helps demonstrate that a business is socially responsible, protects and enhances brand image and brand value, helps maximise the productivity of workers, enhances employees' commitment to the business, builds a more competent, healthier workforce, reduces business costs and disruption, enables enterprises to meet customers' OSH expectations, and encourages the workforce to stay longer in active life (EU-OSHA, 2013).

The worth of this study cannot be underestimated and over-emphasized owing to the fact that it will propose a value-added Occupational Health and Safety Management System (OHS-MS) approach in the Oil and Gas Refinery. The proposed approach wherein the OHS-MS elements as shown below will be duly exploited;

1. Leadership and Commitment
2. Policy and Strategic Objectives
3. Organization and Resources
4. Evaluation and Risk Management
5. Planning
6. Implementation and Monitoring
7. Audit
8. Management Review

1.5 Scope of Study

The Research Study identifies health hazards and delineates the awareness of Occupational Health Hazards of the workers of Refinery. In addition, it includes the health risks assessment of the hazards to the workers, evaluation of the risk on the health of the workers and possible control to prevent and mitigate the impact of the hazards on the health and well-being of the workers.

1.6 Limitations

Occupational Health Practices in Nigeria is not very popular which made the study very challenging as some of the workers found it hard to respond for fear of losing their jobs. Also, as structured Organisation, getting approval to carry out the study was a huge task. In addition letting out some useful information alongside using their equipments did not just come by. Occupational Health Practices need to be properly promoted and projected by the necessary government and corporate bodies, who in turn should partner with Organisations in the encouragement of such studies.

II. Literature Review

2.1 Overview of the Petroleum Industry

The petroleum industry began with the successful drilling of the first commercial oil well in 1859, and the opening of the first refinery two years later to process the crude into kerosene. The evolution of petroleum refining from simple distillation to today's sophisticated processes has created a need for health and safety management procedures and safe work practices. To those unfamiliar with the industry, petroleum refineries may appear to be complex and confusing places. Refining is the processing of one complex mixture of hydrocarbons into a number of other complex mixtures of hydrocarbons. The safe and orderly processing of crude oil into flammable gases and liquids at high temperatures and pressures using vessels, equipment, and piping subjected to stress and corrosion requires considerable knowledge, control, and expertise.

Safety and health professionals, working with process, chemical, instrumentation, and metallurgical engineers, assure that potential physical, mechanical, chemical, and health hazards are recognized and provisions are made for safe operating practices and appropriate protective measures. These measures may include hard hats, safety glasses and goggles, safety shoes, hearing protection, respiratory protection, and protective clothing such as fire resistant clothing where required. In addition, procedures should be established to assure compliance with applicable regulations and standards such as hazard communications, confined space entry, and process safety management.

Petroleum refining has evolved continuously in response to changing consumer demand for better and different products. The original requirement was to produce kerosene as a cheaper and better source of light than whale oil. The development of the internal combustion engine led to the production of gasoline and diesel fuels. The evolution of the airplane created a need first for high-octane aviation gasoline and then for jet fuel, a sophisticated form of the original product, kerosene. Present-day refineries produce a variety of products including many required as feedstock for the petrochemical industry.

Distillation Processes. The first refinery, opened in 1861, produced kerosene by simple atmospheric distillation. Its by-products included tar and naphtha. It was soon discovered that high-quality lubricating oils could be produced by distilling petroleum under vacuum. However, for the next 30 years kerosene was the product consumers wanted. Two significant events changed this situation: (1) invention of the electric light decreased the demand for kerosene, and (2) invention of the internal combustion engine created a demand for diesel fuel and gasoline (naphtha).

Thermal Cracking Processes. With the advent of mass production and World War I, the number of gasoline-powered vehicles increased dramatically and the demand for gasoline grew accordingly. However, distillation processes produced only a certain amount of gasoline from crude oil. In 1913, the thermal cracking process was developed, which subjected heavy fuels to both pressure and intense heat, physically breaking the large molecules into smaller ones to produce additional gasoline and distillate fuels. Visbreaking, another form of thermal cracking, was developed in the late 1930's to produce more desirable and valuable products.

Catalytic Processes. Higher-compression gasoline engines required higher-octane gasoline with better antiknock characteristics. The introduction of catalytic cracking and polymerization processes in the mid-to late 1930's met the demand by providing improved gasoline yields and higher octane numbers. Alkylation, another catalytic process developed in the early 1940's, produced more high-octane aviation gasoline and petrochemical feedstock for explosives and synthetic rubber. Subsequently, catalytic isomerization was developed to convert hydrocarbons to produce increased quantities of alkylation feedstock. Improved catalysts and process methods such as hydrocracking and reforming were developed throughout the 1960's to increase gasoline yields and improve antiknock characteristics. These catalytic processes also produced hydrocarbon molecules with a double bond (alkenes) and formed the basis of the modern petrochemical industry.

Treatment Processes. Throughout the history of refining, various treatment methods have been used to remove nonhydrocarbons, impurities, and other constituents that adversely affect the properties of finished products or reduce the efficiency of the conversion processes. Treating can involve chemical reaction and/or physical separation. Typical examples of treating are chemical sweetening, acid treating, clay contacting, caustic washing, hydrotreating, drying, solvent extraction, and solvent dewaxing. Sweetening compounds and acids desulfurize crude oil before processing and treat products during and after processing. Following the Second World War, various reforming processes improved gasoline quality and yield and produced higher-quality products. Some of these involved the use of catalysts and/or hydrogen to change molecules and remove sulfur. A number of the more commonly used treating and reforming processes are described in this chapter of the manuals

2.2 Overview of Occupational Health

Occupational health is a means of protecting and maintaining the physical, psychological and social health of workers and their families. It can also be viewed as the study of factors or conditions influencing the

health and well being of workers not only in the place of work but also at home with the aim of promoting health, safety and welfare of the workers and their family.

The joint International Labour Organization (ILO) and the World Health Organization (WHO) constituted in 1950 and revised in 1995, defined Occupational Health as the "promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation". ILO further summarized Occupational Health definition as the "prevention of departure from health among workers caused by their working conditions; the promotion of workers in their employment from risks resulting from factors adverse to health, the placing and maintenance of the worker in occupational environment adapted to their physical and psychological well-being; and the adaptation of work to man and man to his work. Dr. Yakemi describe it as the health investment for workers to help them spend their working lives in a healthy way both mentally and physically and enable them enjoy better health in latter life as well. It is the sum total of all the activities and programmes that are aimed at preventing, protecting and maintaining the highest level of health and safety among workers in any work environment which can be industrial, non-industrial or private or organizational.

2.2.1 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. The following summary of major workplace hazards has been extracted from the (Global strategy on occupational health for all, 1996).

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:

1. Noise
2. Illumination
3. Vibration
4. Radiation (ionizing and non-ionizing)
5. Microclimatic conditions in the case of extreme heat and cold. (WHO, June 2013)

Figure 2.1

Mechanical and Ergonomics Hazards: 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 relatively 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. (WHO, June 2013)

Figure 2.2

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 (particularly among agricultural and forestry workers) are the most common occupational diseases resulting from such exposures. Blood-borne diseases such as HIV/AIDS and hepatitis B are now major occupational hazards for healthcare workers.

This can be classified into:

1. Human tissue and body fluids
2. Microbial pathogens (in laboratory settings)
3. Genetically modified organisms
4. Animals and animal products
5. Organic dusts and mists

Figure 2.3

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:

1. Particles, fibers, fumes and mist: Carbon Black, Welding Fume, Oil Mist
2. Metals and metalloids : Arsenic, Cadmium, Chromium, Mercury, Zinc
3. Organic, solvents and compounds: Acetone, hydrocarbons, Benzene
4. 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, haematopoietic 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 (WHO, June 2013).

Figure 2.4

Psychosocial Hazards: Psychosocial hazards comprises of the psychological and social hazards. Psychological 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 (for example, police or prison work), isolated work or excessive responsibility for human or economic concerns, can also have adverse psychological effects. Psychological 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 psychological conditions (psychotraumas) have been observed among workers involved in serious catastrophes or major 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 psychological 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:

1. Violence and aggression
2. Lone working
3. Shift and night work
4. Long working hours
5. Time zone changes

Figure 2.5

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 (WHO, June 2013).

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.

2.2.2 Occupational Health Development in Ancient Times

The historical development of Occupational Health dates back to the ancient days. During that period, industrialization was in rudimentary form.

Unmechanized farming was the main occupation for all nations. Slave labour was extensively used to build many of the wonders of the ancient world in Britain, USA, Egypt, Rome and numerous other countries. For example, in Britain, slaves were used to build underground and surface rail lines, some architectural buildings and their designs among others. Apart from slaves, prisoners of war were also used. They were subjected to harsh conditions in underground mines and queries. They died in large numbers due to poor health and poor working conditions. The inhuman treatment and poor health care continued till the 16th and 17th centuries when the early medical pioneers in the field of health and safety at work emerged (Asogwa, 2000). Among them were Georgius Agricola and Bernadino Ramazzine.

According to (Asogwa, 2007), Georgius Agricola (1494 - 1555) wrote an article titled - "De Re Metallica". It was published in 1556 after his death).

This article focused on the working conditions in mines and industries especially mining accidents and illnesses. He observed that the major hazards in mining were radiation from radioactive rocks and silicosis.

Another medical personnel concerned with the health of workers was an Italian, Bernadino Ramazzine (1633 - 1714). His contributions in the field of workers' health earned him the title, "Father of Occupational Medicine".

He stressed that the occupation of the patient must be sort in clinical clerkship in addition to those direct questions about the persons occupation, advocated by the Greek, Hippocrates. When he was 67 years old, he published his first great work "De Morbis Artificum Diatriba" - the first systematic study of trade diseases. Ramazzini wrote as follows (Asogwa, 2000). "there are many things a doctor, on his first visit to a patient ought to find out either from the patient or from those present.

When a doctor visits a working class's home, he should be content to sit on a three legged stool, if there isn't a guided chair, and he should take time for his examination, and to the questions recommended by Hippocrates in his work, "Affections". I may venture to add one more question: What occupation does he follow? ("Quid aitem exerceat?").

In the main, it is only when dealing with the common people that the doctor must think of dangerous trades. Hence, Ramazzines' motto - "Medcina

Munus Plebios Curantis est interrogate quas artes exercent" (translated roughly to mean that the doctor treating commoners should enquire about their job). The actions of these pioneer doctors brought some changes in the life of the employees.

2.2.3 Development of Occupational Health in Nigeria

Development of occupational health in Nigeria followed the pattern in other developing countries. Originally, the main occupation was unmechanized agriculture and animal husbandry. The workforces were mainly women and children. Payment for work was not known. Workers were exposed to many types of health hazards. Treatment then was not organized. Later, manufacturing including construction came into being.

Modern occupational health, reported (Achalu, 2000) started as a result of colonization and industrialization by Britain. The first occupational health services in Nigeria was introduced by the Medical Examination Board of Liverpool Inferminary in 1789 with the main aim of caring for the health of British slave dealers from Africa to Britain. However, after the abolition of slave trade, the Royal Niger Company of Britain increased its exploration and trading activities in Nigeria. The Company organized its own health services which were later inherited by the United African Company (UAC).

During the British colonial rule, many of their soldiers were dying of malaria. This led Colonel Lugard to establish health services to take care of the health and welfare of soldiers and other colonial administrators. Later, during the Second World War, the Medical Corps was separated to cater for the military alone leading to the creation of Public Health Service which became the nucleus of the National Health Service.

After the world war, many industries started emerging chief among them were construction of rail lines and coal mining. This attracted employment of many Laborers especially young men. These workers commonly worked 12-14 hours shift; 7 days a week under unspeakable conditions of grime, dust, physical hazards, accidents, smoke, heat and noxious fume among others. Feeding was very poor; workers were dying in their forties and fifties. People had no knowledge between work conditions and health. They accepted work related illnesses and injuries as part of the job and lived shorter lives. Employers attributed workers' poor health and early death to workers' personal habits on the job and their living conditions at home. Little or no attention was paid to prevention of the hazards in work places. Payment was very poor and dismissal very common because job seekers were many. Workers' reaction to poor conditions at work resulted in killing of coal miners in Enugu. That exposed the working conditions of coal miners and the origin of worker's day in Nigeria. These

developments and awareness lead to the establishment of some occupational health services in some Nigerian industries and occupational health legislations Act in Nigeria.

The earliest practices that can be regarded as occupational health services in Nigeria were carried out by British Companies like UAC, John

Holt. This was followed by establishment of some occupational health services by Nigerian governments in the Railway Corporation and Coal Mines. Such services included pre-employment and periodic medical examination, treatment of minor illnesses and accidents. In some cases, general practitioners were hired on part time basis, especially in urban centres to take care of the sick injured workers. The increased industrialization and its impact on health, safety and welfare of workers lead to the creation of occupational health unit in the Federal Ministry of Health and the Institute of Occupational Health in Oyo State Ministry of Health. These agencies organized courses for managers, safety officers, medical officers, occupational hygienists, and other personnel involved with the protection, maintenance and promotion of health and welfare of workers in Nigeria.

2.2.4 International Occupational Health

As industrialization spread from one country to another, according to (Asogwa, 2007) so also did the diseases and ailments associated with different trades. Gradually, occupational health was being recognized as a distinct area of medicine deserving special attention in those countries that were the pioneers of industrialization in Europe and America. Many different approaches were followed in these countries but the final goal was essentially the same. The main aim and goal were to safeguard lives and ensure that the well-being of working people are protected maintained and promoted. The oldest international bodies in modern times concerned with global health and safety of people at work are the International Labour Organisation (ILO) and the World Health Organisation.

2.2.5 The International Labour Organization (ILO)

The International Labour Organization (ILO) was founded in 1919 in Geneva, Switzerland under the League of Nations to promote International Labour standard and improvement of working conditions. The ILO programmes, as well as international labour Standards in the form of conventions and recommendations, were approved and adopted by the annual international Labour Conference held in Geneva. The Conference consists of two governments, one employer and one worker representative from each member states (Reich and Okubo, 1992). Hence ILO is said to be a tripeptide body made up of representatives from governments, employers and employees (Asogwa, 2007). The International labour Office with regional offices in Africa, Asia, Europe, Latin America, the Middle East and a number of governing body execute the programmes under supervision of the governing body, half of whose members were elected from governments and a quarter from employer and worker groups (Reich and Okubo, 1992). ILO's health work included safety and health of all types of workers especially from chemical and other industrial risks, hygiene of seamen, social and medical insurance systems and workmen's compensation. In compliance with multidisplinary approach, it collaborates with the World Health organisation (WHO) in holding a number of Joint Expert Committee meetings in the field of occupational health and safety and publishes inter alia International Medicine guide for slips and ship sanitation.

The International Programme for the Improvement of Working Conditions and Environment (known as PTA PIACT) activities, emphasize that the improvement of occupational safety and health and working conditions should be considered as a complex problem in which various factors are interrelated, such as protection against risks in the working environment, adaptation of work processes to the physical and mental capabilities of workers, improvement of work schedules and job content (ILO, 1984, Copper, 1990). A multidisciplinary approach is stressed.

2.2.6 The World Health Organisation (WHO)

The World Health Organisation (WHO) is the specialized agency of the United Nations founded in 1948 with headquarters in Geneva Switzerland.

It has the responsibility for global health. Its major role in the field of occupational health started with the report of the First Joint WHO/ILO Committee on occupational Health in 1950 which stated the purpose of occupational health as follows (Asogwa (2007).

"Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention among workers of departures frown health caused by their working conditions the protection of the workers in their employment from risks resulting from factors adverse to health, the placing and maintenance of the workers in an occupational environment adapted to his physiological and psychological equipment and to summaries; the adaptation of work to man and each man to his job".

Occupational health, as in other areas of Public Health, lays emphasis on preventive medicine. Occupational health practice is comprehensive. Some of the preventive measures could only be achieved by safe working environment, other conditions that encourage and promote healthful living; and ergonomics in machine design and operations (Reich and Okubo, 1992).

2.2.7 Future Trends

The major goal for occupational health is to promote and maintain the highest level of physical, mental, social and emotional health of all workers. In practice, this goal is only beginning to be realized in selected work places. Nevertheless, it is a worthy investment and an essential objective in the realization of a productive working community (Allender and Spradley, 1992).

The rapid and fundamental changes in businesses in the 1990s have added three critical issues that affect the occupational health practice. First, increasing worldwide competition requires business to remain competitive by reducing and/or controlling operating costs at the lowest level possible.

Secondly, there has been an increase in technological hazards that require sophisticated approaches as well as knowledge of toxicology, epidemiology, ergonomics and public health principles. Third, health care costs continue to escalate at faster rates than most company profits (Vail, 1997).

Until the late 1800s, agriculture was the main industry in both developed and developing countries. Now, the trend, especially in United States and in Nigeria is towards the service industries. This demands an increase in the number and proportion of service workers.

The environment - both physical and social, is also changing. Today's worker is exposed to various air and water pollutants over extended period of time; to food additives and preservatives, to complex laundry and cleaning compounds and to many other hazards. Industrial workers came into contact with many new substances utilized in processes. Many workers come to work with all kinds of psychological and physiological tendencies to certain kinds of health problems such as alcohol and drugs. Many workers are emotionally or physiologically dependent on certain drugs and some may combine drugs with alcoholic beverages thereby compounding the original problems. Many come to work with alcohol already in their systems. They drink because of stress from inner conflicts or problems either at home or in their work environment.

Current occupational health nurse and community health practitioners' practices will continue to evolve to meet future needs. The focus will shift from one-on-one health services to a new role involving broader business and research skills. Future role will involve:

1. Analysis of trends (health promotion, risk reduction and health expenditures).
2. Developing programmes suited to corporate needs.
3. Recommending more efficient and most effective in-house health services.
4. Determining cost-effective alternatives to health programmes
5. Collaborating with others to identify problems and propose solutions.

2.3 Occupational Health Disease

Occupational health disease can be defined as a compensable disease contacted by the worker due to exposure to hazards in the work places.

(Adobe, 1996) defined it as any condition arising from work place exposures which compromises worker's physical, mental and social well-being.

Asogwa (2007) defined it as diseases associated with particular processes or agents which the worker is exposed to in the course of his work.

Osanyigbemi was quoted by (Achlu, 2000) defined occupational disease as those diseases which occur with characteristic frequency and regularity in occupations where there are specific hazards. It can also be explained as any chronic ailment that occurs as a result of occupational activities. By the definitions, it means that there must be interaction of the worker with the environment before the disease can occur.

2.3.1 Classification of Occupational Diseases

Occupational diseases can be classified in different forms. Classification put forward by (Asogwa, 2007) and (Park, 2002) is according to the target organ systems of the body and they include:

1. Occupational diseases of the respiratory system
2. Occupational diseases of the liver
3. Occupational diseases of the cardiovascular system
4. Occupational diseases of the Gastro-intestinal system
5. Occupational diseases of the Genito-urinary system
6. Occupational diseases of the skin or dermatologic system
7. Occupational diseases of the musculoskeletal system
8. Occupational diseases of the haemopioetic system

9. Occupational diseases of the physical agent.

The occupation or the nature of work performed by a person exposes him or her to health hazards associated with that occupation. Diverse occupations exist. They include traditional manufacturing industries (automobile. automotive and appliances); service industries (banking, health care, and restaurant); education, agriculture, construction, mining, and newly high technology firms like computer chips manufacturing companies and many others.

2.4 Occupational Health and Safety – Management System (OHS – MS)

Occupational Health Hazards could impact on the health and well-being of the workforce if not properly and adequately monitored and controlled by the management of an Industry or Company. It is obvious that staff and management of industries shy away from identifying the Health Hazards that are prevalent amongst them, for the workers, the fear of losing their jobs and for management, to avoid National and International Occupational Safety and Health Policies. But most of the Occupational diseases that result from exposure to hazards in Nigerian industries are largely due to ignorance. Hence, the general well-being of the workforce is an overriding condition of all decisions made in the company's management of occupational health. As the workforce is the major asset of the Company, without which no production can be made. Thus, apart from social, moral and legal obligations, it is vital to maintain and keep the workforce fit and healthy. This involves promoting and protection of the health of the workforce from all agents hazardous to health that may be inherent in all activities in the work environment and sometimes outside the work environment (Oluwagbemi, 2011).

OHS – MS is the Management Protocol that should be followed in Occupational Health and Safety in order to protect, promote and rehabilitate the health and well-being of workers in the workplace.

A positive health and safety organisational culture is underpinned by strong leadership by management together with the active involvement and participation of workers in which everyone accepts their rights, roles and responsibilities in relation to health and safety, and works collaboratively to prevent ill-health and injury, and to promote health and wellbeing. Effective leadership is required to provide strategic direction for the management of safety and health and to motivate staff to engage effectively in ensuring good safety and health performance. The commitment to effective worker participation needs to be visible and communicated to the entire workforce. An effective safety and health management system should be based on risk assessment, with the objective of identifying key occupational hazards and key at-risk groups and developing and implementing appropriate prevention measures. Effective worker participation and employee involvement in risk assessment and planning, and introducing measures is particularly important (Worker participation practices: a review of EU-OSHA case studies).

Leaders play a key role in influencing the management of safety and health in a number of different ways. These can include: establishing effective governance for OSH management; setting out a strategy, policy and targets and monitoring progress; providing examples of good practice through their own behaviour; establishing a positive safety and health culture and the engagement of all staff in safety and health matters; ensuring that safety and health remains a priority during the day-to-day operations; empowering individual employees to take preventive actions, as well as behaving in a healthy and safe way; providing employees with the necessary safety training, tools and equipment; and involving employees in safety and health decisions (Ernst & Young, 2001). Occupational safety and health leadership is about securing the health, safety and welfare of workers by reducing risks, and protecting them and others from harm or illness arising out of work activities (Mullen & Kelloway, 2011). Leadership has been argued to be one of the key determinants of employee well-being (Kelloway & Day, 2011), and is fundamental to promoting and sustaining a safe and healthy workplace.

III. Methodology

3.1 The Study Area

Warri Refining and Petrochemical Company Ekpan, located in Delta State, is a subsidiary of the Nigerian National Petroleum Corporation (NNPC), an oil company involved in refining crude into fuel, kerosene and other by-products. The study area is located around latitude 5031'N and 6011'N and between longitude 5044'E and 5047'E (Atubi, 2011). The area is approximately 100 square kilometres see Fig. 3.1.

Following the feasibility studies undertaken by BEICIP, an international oil and gas consulting and software solution provider firm from Paris , in 1974 for the Federal Government of Nigeria with the objectives to establish the demand and consumption patterns of petroleum products and also determine the size of a new refinery to be constructed, a tendering exercise involving international engineering contractors resulted in the award of a contract to Snamprogetti Spa of Milan , Italy , in 1975.

The contract was for the design, procurement and construction of a new grassroots petroleum refinery in Warri. The design capacity of the refinery was 100,000 bpd and the project duration was 30 months. This project was completed and the Warri Refinery was commissioned in 1978. The Federal Government of Nigeria decided to expand the capacities of the fuels units in the existing refineries at Warri and Kaduna by de-bottlenecking. This project was completed in 1985 and the Warri Refinery was de-bottlenecked to a new capacity of 125,000 bpd. NNPC's long term plans for the development of a petrochemicals industry, were formulated in 1977, and were structured in 3 phases. The 1st phase comprised of 3 plants: a linear alkyl benzene plant (LAB) in Kaduna, and the carbon black and polypropylene plants in Warri. The 35,000 MTA Polypropylene and 18,000 MTA Carbon Black Plants built in Ekpan, Warri were commissioned in 1988. The Warri Refinery and the Ekpan Petrochemical Plant were merged in 1988 to become the Warri Refining and Petrochemical Company Limited

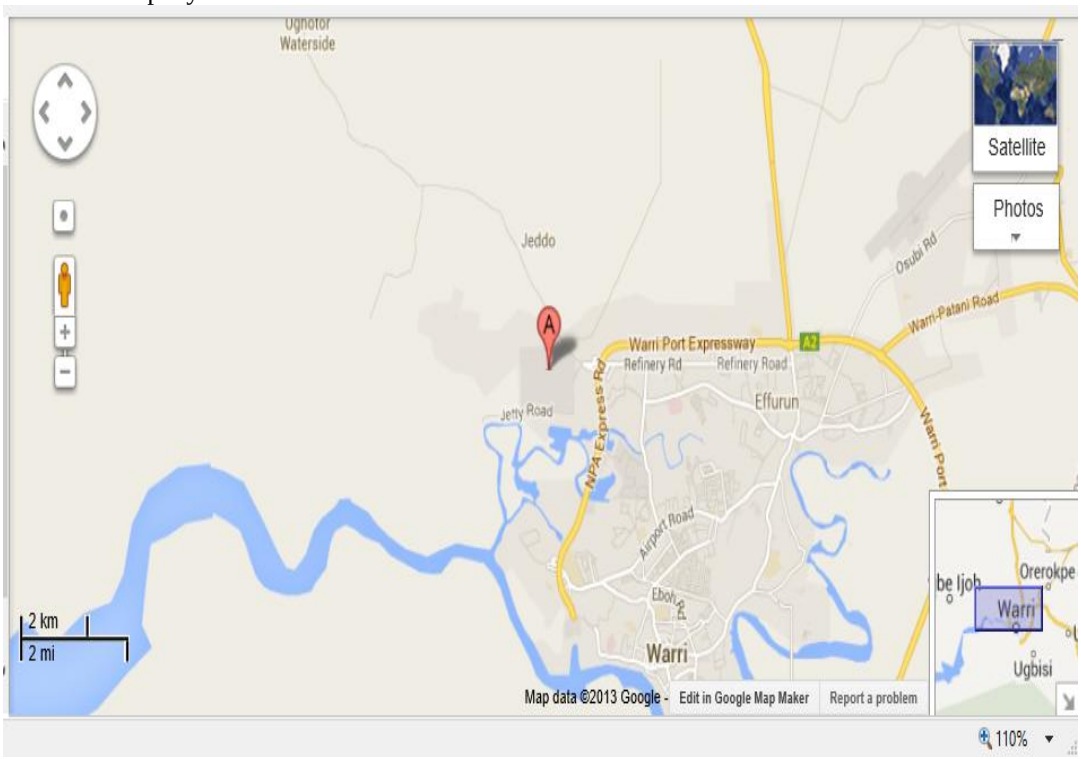

Figure 3.1: Map of Warri Refining and Petrochemical Company. Source: Google Map (2013).

Fuel Plant

- Crude Distillation Units (CDU)
- Vacuum Distillation Unit (VDU)
- Gas Plant
- Nephtha Hydrotreating Unit (NHU)
- Catalytic Reforming Unit (CRU)
- Kerosene Hydrotreating Unit (KHU)
- Fluid Catalytic Cracking Unit (FCC)
- Merox Treating Unit
- HF Alkylation Unit

Petroleumchemical Plant

- Polypropylene Plant (PPP)
- Carbon Black Plant

Power Plant and Utility

- Gas Turbine Plant
- Demineralization Water Treatment Plant
- Nitrogen Plant
- Refinery Effluence Treatment Facility
- Cooling Water System.

Other facilities are the Waste Water Transmission Plant, Plant Clinic, the Administrative Block, and Maintenance Works for both Plants etc. (wrpcnnpcng, 2013).

Photograph 3.1: Gas Emission. (Source: wrpcnnpcng, June, 2013)

Photograph 3.2: Storage Tanks and Plant Towers in a Refinery. (Source: wwpcnnpcng, June, 2013).

3.2 Data collection

This was a cross-sectional descriptive study. Some of the workers (both shift and non-shift) within the seven (7) Industrial Departments constituted the study population. Each Department constitutes units from which the respondents were randomly selected.

Structured open-ended and self administered questionnaire was used to collect data on; socio-demographic characteristics of respondents, types of Occupational Health Hazards, awareness of the Health Hazard, knowledge of occupational illnesses and diseases and measures taken to prevent and/or control the risk pose by Health Hazards on the workers. Qualitative data collection through questionnaire to determine the risk associated with the hazards. Environmental monitoring/evaluation and Health Risk Assessment (HRA) Tool were carried out with a view to assess the risk associated with the Health Hazards identified, aesthetics and general housekeeping. Consent to undertake the study was obtained through a letter to the management and informed consent of the study participants who were assured of the confidentiality of information collected.

One hundred (100) questionnaires were sent out; 86 were returned representing a response rate of 86%. 85 questionnaires out of the 86 were found suitable for the analysis representing 97.7%. This is considered very

sufficient for the study base on the assertion of (Moser and Kalton, 1971) that the result of a survey could be considered as biased and of little significant if the return rate was lower than 30-40%.

Environmental Monitoring/Surveillance was also done to identify the different Health Hazards and assess the risk associated with them. Furthermore, a Health Hazard Risk Assessment Matrix is used to also identify and assess the risk associated with the different Health Hazards. Hazard Risk Assessment (HRA) is seen by some as a art rather than a science because of its partially subjective nature. It is defined as an identification of Health Hazards inherent in activity and the estimation of the extent of the risks involved taking into consideration whatever control measures that are in place (Oluwagbemi, 2011).

3.2.1 Questionnaire Design

The design of the questionnaire was in two (2) sections. Section A gives bio data of the respondent. Section two is further divided into six (6) subsections where multiple choice questions are set to identify the different categories of Health Hazards, determine the awareness of the workers on the Health Hazards. Evaluate the Occupational Health Practice in the Refinery and precautionary measures used to prevent and mitigate the effect of the risk of the Health Hazards on the health and well-being of the workers. The section of the questionnaire was designed in the following format: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) rating such as 4, 3, 2 and 1 respectively assigned to the options. These questionnaires were administered to workers of the Refinery. A sample of the questionnaire is presented in Appendix 7.

3.3 Instrumentation

CEL-6X0 Noise Level Meter was used to determine the noise level (Photograph 3.1). It was used at different strategic locations in the Plant: Carbon Black Plant (CBP), Polypropylene Plant (PPP), Petrochemical Utility (PC Utility), Fuel Plant, Power Plant and Utilities and the Waste Water Transmission (WWT) Plant. The noise level measurement involves taking the instrument to the location that is suspected to be noisy and putting it on, then it takes its readings. The microphone, windshield, preamplifier, display screen, soft keys and the calibrator are all components of the Noise Level Meter that enables it to abstract the noise and makes it reading. Noise level is usually measured in decibel (dBA).

Photograph 3.33: CEL-6X0 Sound Level Meter (Source: Google)

1 – Windshield (Covering Removable Microphone) 2 – Fixed Amplifier 3 – ON/OFF Key 4 – Display 5 – Soft Keys 6 – Navigation Cursor Keys 7 –Run/Stop Key.

For ambient air, the Aerocet 531S Mass Particle Counter/Dust Monitor (Photograph 3.1) and the RKI GX-2009 (Photograph 3.1) are used for the measurement of dust particles and gases in the air respectively. The AEROCET 531S is a full–featured, battery operated, handheld particle counter or mass monitor. In the count mode the unit will measure particle counts at fixed sizes of 0.5u, 1.0u, 5.0u and 10.0u. In the mass mode the unit will measure PM1, PM2.5, PM4, PM7, PM10 and TSP mass concentration levels. It also has various

communication options. This instrument can store up to 6,000 sample events including data from the optional ambient temperature (AT) / relative humidity (RH) probe (MOI G3120). Sample history events can be viewed on the LCD display, printed on the optional printer (MOIG3115) and download to a computer.

Photograph 3.34: Aerocet 531S Mass Particle Counter/Dust Monitor (Source: Google)

The start button is used to switch it on and the equipment is held in the hand at a about a meter. And the dust particles in the air are measured.

GX-2009 is an advanced detection system consisting of four gas sensors. The GX-2009 personal four-gas monitor detects the presence of combustible gas, oxygen (O_2), carbon monoxide (CO), Ammonium (NH_3) and hydrogen sulphide (H_2S) simultaneously.

The GX-2009 is made to come out of its startup sequence and enters Measuring Mode by turning it on. The trigger of the Quick Check cylinder is held down for a second and released to measure the gases in the air.

Photograph 3.5: RKI GX-2009 Multi-Gas Detector (Source: Google)

3.4 Method of Data Analysis

Microsoft Excel was used to analyze the data obtained from the questionnaires, and raw data was obtained through environmental monitoring to assess the risk on the Health Hazards; both data were presented using tables and charts. Descriptive statistical methods were also used to analyze the data obtained from the questionnaires and their responses were recorded in a frequency table. Bar and Pie charts were constructed showing the respective percentages representing the respondents view on each question.

Evaluation of respondents' rating is made possible by the application of Kendall's W statistic same as Kendall's coefficient of concordance (Nwaogazie, 2011). Kendall's Coefficient of Concordance (W) was used to test the degree of agreement between the result from the environmental monitoring measurement and response of workers of WRPC from the questionnaires to:

a. Identify the different Health Hazards among the workers of the Refinery;
b. Assess the risk associated with the Health Hazards;
c. Determine the awareness of the workers on the Health Hazards;
d. Evaluate the Occupational Health Practice of the Refinery.

Kendall's Coefficient (W) is a non-parameteric statistics. It is a normalization of the statistics of Friedman test, and can be used for assessing agreement amongst taters. Its value ranges from Zero (no agreement) to unity (complete agreement) (Nwaogazie, 2011).

Consider an object i given a rank, r_{ij} by respondent number j; and we further assume that there are a total of n objects and in respondents. Then the total rank given to object m is (Nwaogazie, 2011)

$$R_i = \sum_{j=1}^{m} r_{ij} \qquad \text{.....} \qquad 3.1$$

The mean value of the total rank is given in Equation (3.2) as:

$$\bar{R} = \frac{1}{2} m(n+1) \qquad \text{.....} \quad 3.2$$

The sum of the squared of deviation S_d is given in Equation (3.3) as

$$S_d = \sum_{i=0}^{n} (R_i - \bar{R})^2 \qquad \text{.....} \qquad 3.3$$

Kendall's W is defined (Nwaogazie, 2011), using Equation (3.4)

$$W = \frac{12}{\left[m^2 n(n^2 - 1)\right]} S_d \quad \text{..... 3.4}$$

The application of equation (3.1) through (3.4) is demonstrated in chapter 4

IV. Results And Discussion

4.1 Results

The Tables below shows a summary of the environmental monitoring on Ambient Air, Noise Level and Particulate Mass reading respectively for five (5) days from strategic sampling points.

4.1.1 Data Analysis for Environmental Monitoring

When analysing the data taken from the sampling points, the average of all measurements was calculated for the five days to give a true representative of the data.

Table 4.1.1: Average of Ambient Air Mass at Study Locations.

S/N	Locations	O_2 (%)	LEL-Methane (%)	CO (ppm)	**NH_3 (ppm)**	**H_2S (ppm)**
NIOSH REL. TWA		19.5 – 23.5	10.0	35.0	25.0	10.0
1	Gas Collection Point	22.9	0.0	6.3	0.0	0.0
2	Gas Loading Area	21.4	2.0	11.0	0.0	0.0
3	Old Admin Block	21.5	0.0	0.0	0.0	0.0
4	Main Gate	23.3	0.0	0.0	0.0	0.0
5	Maintenance WS	20.9	0.0	0.0	0.0	0.0
6	Gate 5	20.9	0.0	0.0	0.0	0.0
7	WWT Plant	20.6	0.0	0.0	0.0	2.0
8	Utility-Refinery	20.7	0.0	0.0	0.0	0.0
9	FCC Unit	23.7	4.0	17.2	0.0	6.0
10	Reforming Unit	22.1	0.0	16.6	0.0	0.0
11	Topping Unit	22.7	0.0	2.0	0.0	0.0
12	Carbon Black	20.9	0.0	0.0	0.0	0.0
13	PP Plant	20.9	0.0	0.0	0.0	0.0

Table 4.11.**2:** Average of Noise Level at Study Locations.

S/N	Location	Noise Level (Dba)	Max Allowable Limit
1	**CARBON BLACK PLANT**		
	Blower Area	94.12	85.00
	Bagging Area	67.70	85.00
	Control Room	55.82	65.00
2	**POLYPROPELENE PLANT**		
	Area I	76.28	85.00
	Area II	77.42	85.00
	Control Room	56.08	65.00
3	**PETROCHEMICAL UTILITIES**		
	Compressor Area	101.40	85.00
	Cooling Tower	80.90	85.00
	Control Room	61.66	65.00
4	**FUEL PLANT**		
	Topping Unit	89.30	85.00
	Reforming Unit	90.82	85.00
	FCC	90.24	85.00
	Control Room	60.46	65.00
5	**POWER PLANT & UTILITY**		
	Stream Turbine	102.54	85.00
	Gas Turbine	98.88	85.00
	Utilities	99.22	85.00
	GT Control Room	63.46	65.00
6	**WWT PLANT**		
	Plant Area	66.28	85.00
	Control Room	54.10	65.0
	FIRE HOUSE		
7	Office Area	64.3	65.00
	Control Room	56.6	65.00

Table 4.11.3: Average of Particulate Mass at Study Locations.

S/N	Location	PM 1.0	PM2.5	PM 7.0	PM 10.0	TSP
Unit		Mg/m^3	Mg/m^3	Mg/m^3	Mg/m^3	Mg/m^3
1	Blower Area	0.00175	0.0056	0.01278	0.0186	0.0208
2	Bag Filter Area	0.0016	0.008	0.023	0.0272	0.031
3	Wet Pellet Mixer/Surge Tank	0.0056	0.017	0.0246	0.0356	0.0398
4	PC Sliding Gate	0.0044	0.0043	0.0144	0.0176	0.0210
5	CB Warehouse	0.0012	0.0042	0.0172	0.0248	0.0344
6	Control Room	0.0004	0.0016	0.0044	0.006	0.0088
7	PC WWTP Sub Station	0.0008	0.0044	0.0132	0.0156	0.0174
8	Area Around Envt. Block	0.0008	0.0042	0.0132	0.0118	0.019

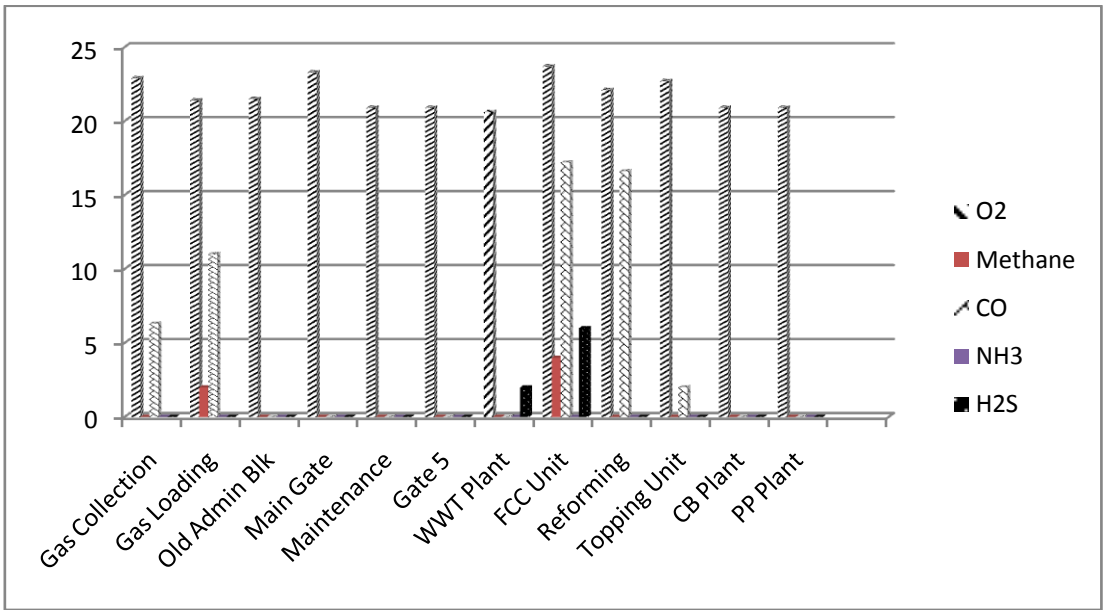

Figure 4.1.1: Average of Ambient Air.

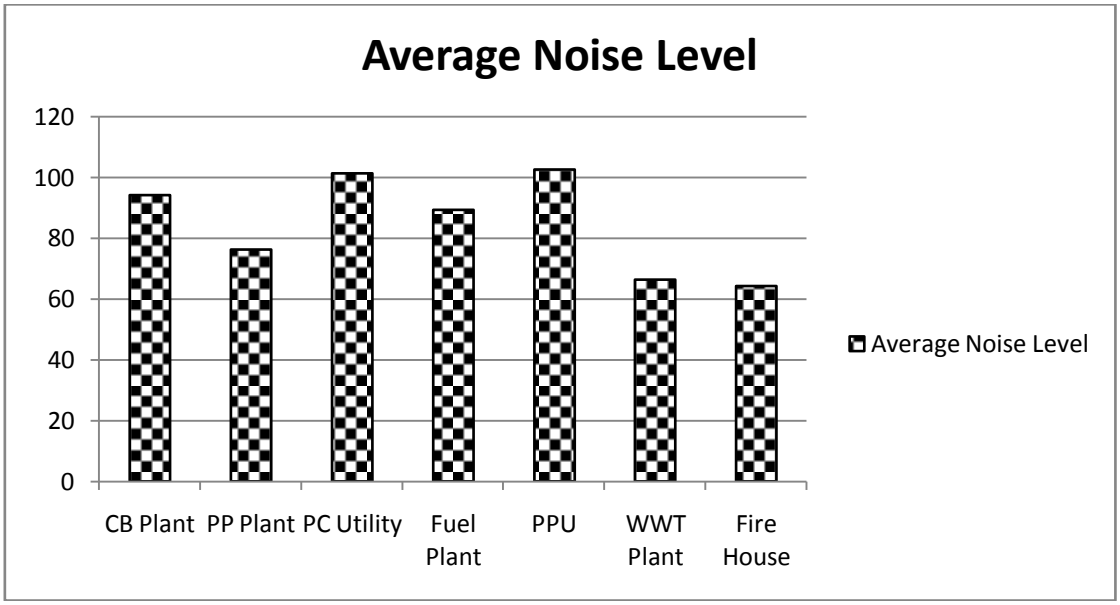

Figure 4.1.2: Average of Noise Level.

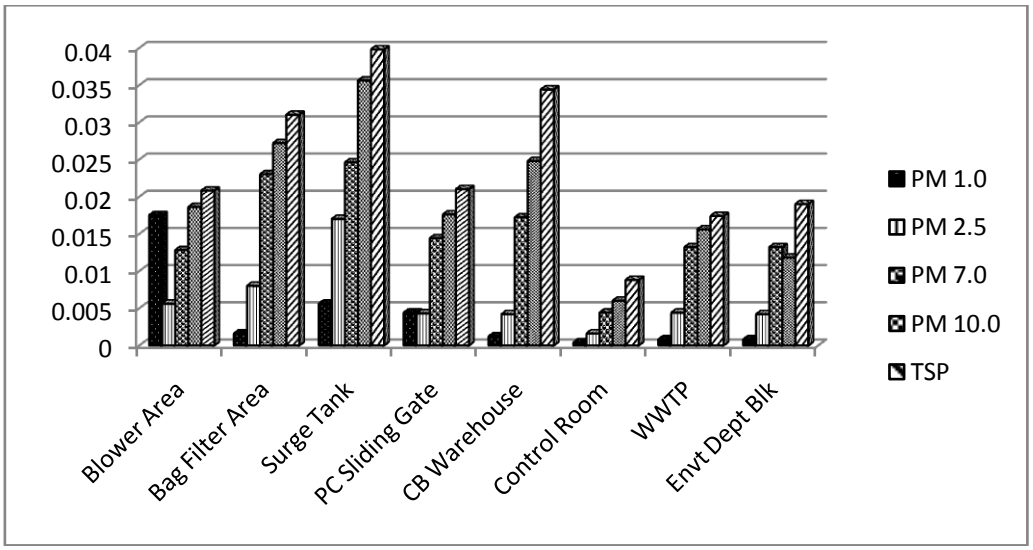

Figure 4.1.3: Average of Particulate Mass.

4.2 Data Analysis of Questionnaires

Table 4.2.1: Socio-demographic Characteristics of Respondents

Age group (yrs)	No. (n=85)	%
<20	3	3.5
21-30	24	28.2
31-40	34	40.0
41-50	21	24.7
>50	3	3.5
SEX		
Female	15	17.6
Male	70	82.4
Marital Status		
Married	55	64.7
Single	30	35.3
Educational Status		
Primary	0	0.0
Secondary	16	18.8
Tertiary	69	81.2
Shift		
No Shift	59	69.4
Shift	26	30.6

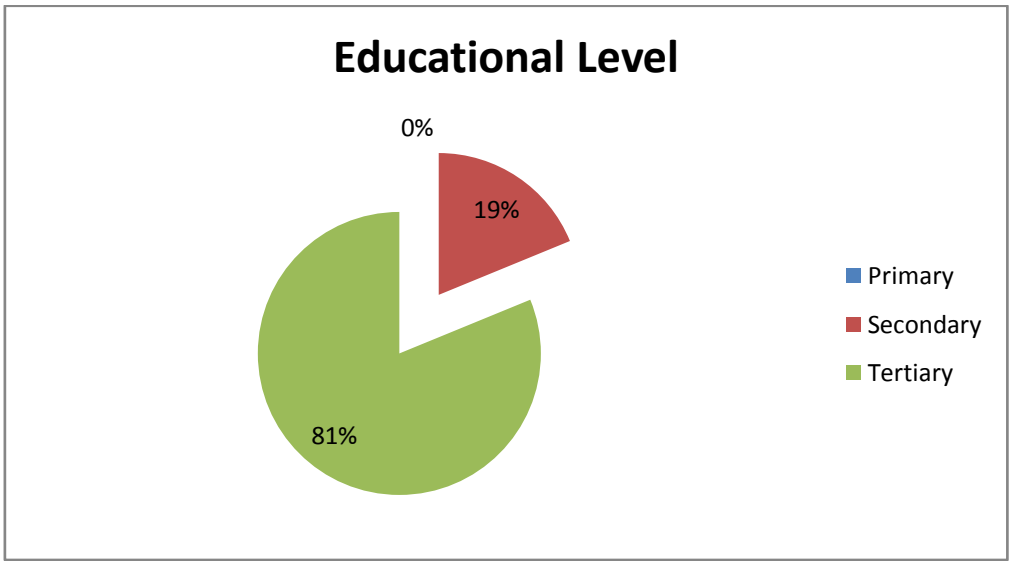

Figure 4.2.1: Education Level of Respondents.

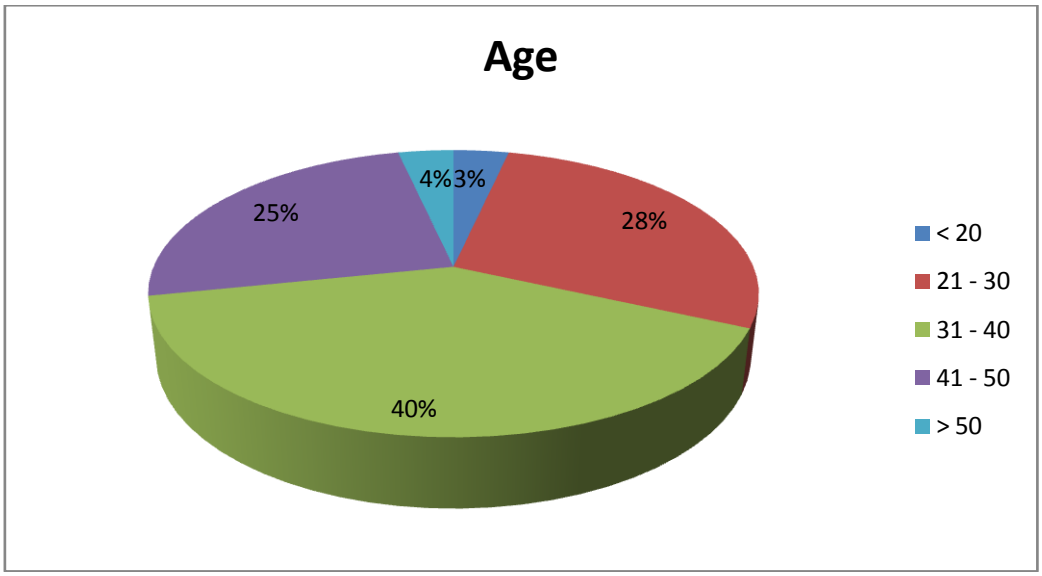

Figure 4.2.2: Age Range of Respondents.

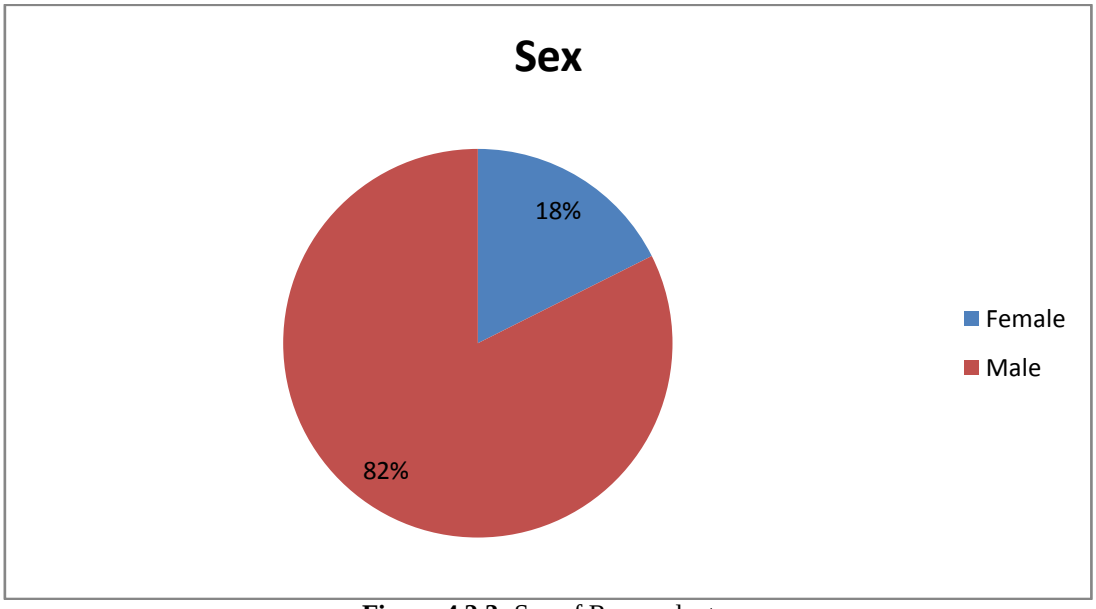

Figure 4.2.3: Sex of Respondents.

4.3 Calculations

In demonstration of equation 3.1, 3.2 and 3.3 below:

$$R_i = \sum_{j=1}^{m} r_{ij}$$

$$\bar{R} = \frac{1}{2} m(n+1)$$

$$S_d = \sum_{i=0}^{n} (R_i - \bar{R})^2$$

Table 4.2.2: Kendall's W-Statistics on Identification of Physical Health Hazard

S/N	PHYSICAL HEALTH HAZARDS	Mean	Rank	Ri	R	(Ri-R)2
1.	The noise level in my workplace is relatively high	3.2	4	272	467.5	38220.25
2.	Loss of hearing could result from exposure to loud noise	3.364706	3	286	467.5	32942.25
3.	My job function has to do with working with object, tools, equipment, machine, chemical etc that has high temperature	2.811765	8	239	467.5	52212.25
4.	Extreme heat could cause body cramp	3.105882	5	264	467.5	41412.25
5.	My workplace shakes as a result of vibration from workplace machines and equipments	2.447059	10	208	467.5	67340.25
6.	Vibration could disorder the spine and causes fatigue	2.929412	7	249	467.5	47742.25
7.	My workplace is adequately lighted	3.541176	1	301	467.5	27722.25
8.	Inadequate illumination could affect the eyes	2.988235	5	254	467.5	45582.25
9.	Radiations like in welding, radioactive substances etc could be emitted as I perform my job function	3.447059	2	293	467.5	30450.25
10.	Radiation could cause cancer and premature skin aging	2.647059	9	225	467.5	58806.25
						442430.5

$$\bar{R} = \frac{1}{2} m(n+1)$$

=0.5 x 85 x 11 =467.5

$$W = \frac{12}{\left[m^2 n(n^2-1)\right]} S_d$$

=12 x 442430.5/7152750 = 0.742(74.2%)

Table 4.2.3: Kendall's W-Statistics on Identification of Chemical Health Hazard.

S/N	CHEMICAL HEALTH HAZARDS	Mean	Rank	Ri	R	(Ri-R)2
11.	Working with chemical substances is part of my job function	2.6470	9	225	467.5	58806.25
12.	The substances are solvent, mist, fume and gases	2.7058	8	230	467.5	56406.25
13.	The substances are dust, particles, metal and metalloid	2.5529	10	217	467.5	62750.25
14.	The chemical/gases are flammable, poisonous and corrosive	3.0352	6	258	467.5	43890.25
15.	The hazardous chemicals are sometimes inhaled, ingested, injected and spill over my skin	2.9058	7	247	467.5	48620.25
16.	Eating where there are chemical is highly prohibited	3.4235	3	291	467.5	31152.25
17.	Chemical substances should be carefully handled and labeled	3.6	2	306	467.5	26082.25
18.	Chemical hazards are likely to affect ones' health when they are exposed to them for a long period of time	3.6352	1	309	467.5	25122.25
19.	Exposure to chemical hazards could cause reproductive disorder, cardiovascular disease, respiratory diseases, renal diseases etc	3.2941	5	280	467.5	35156.25
20.	The health impact of chemical hazards could lead to loss of life	3.3176	4	282	467.5	34410.25
						422396.5

$$\bar{R} = \frac{1}{2} m(n+1)$$

=0.5 x 85 x 11 =467.5

$$W = \frac{12}{\left[m^2 n(n^2-1)\right]} S_d$$

=12 422396.5/7152750 = 0.709(70.9%)

Table 4.2.4: Kendall's W-Statistics on Identification of Ergonomic Health Hazard.

S/N	MECHANICAL/ERGONOMIC HEALTH HAZARDS	Mean	Rank	Ri	R	(Ri-R)2
21.	I sometimes take a awkward posture while working	2.8235	4	240	425	34225
22.	I sometimes work in height	2.8471	3	242	425	33489
23.	When performing my job functions I stand for a long while	2.7529	5	234	425	36481
24.	The work material at my duty post is obsolete	2.5529	7	217	425	43264
25.	I lift heavy objects manually The chair, desk and other working tools and materials arrangements in my workplace is very comfortable and convenient with my job functions	2.5765	6	219	425	42436
26.	I sit most time when I am on duty	2.3176	9	197	425	51984
27.	My work is repetitive and monotonous	2.4118	8	205	425	48400
28.	Ergonomic hazards could cause deformity of one's body	3.1176	1	265	425	25600
29.	Mechanical/Ergonomic hazards could cause back, neck and body pain	3.1059	2	264	425	25921
						341800

$$\bar{R} = \frac{1}{2}m(n+1)$$

=0.5 x 85 x 10 =425

$$W = \frac{12}{\left[m^2 n(n^2-1)\right]} S_d$$

=12 x 341800/5202000 = 0.788(78.8%)

Table 4.2.5: Kendall's W-Statistics on Identification of Biological Health Hazard

S/N	BIOLOGICAL HEALTH HAZARDS	Mean	Rank	Ri	R	$(Ri-R)^2$
30.	Microbes could be found in some substances I work with in my work station	2.7059	2	230	255	625
31.	I generate hazardous waste while working	2.6353	3	224	255	961
32.	Some of this hazardous waste could impact on the health of workers	2.5176	4	214	255	1681
33.	Biological hazards could cause tubercolosis, pneumonitis, pneumonoconiosis etc	2.9529	1	251	255	16
34.	Proper environmental hygiene is lacking in my place of work	2.2824	5	194	255	3721
						7004

$$\bar{R} = \frac{1}{2}m(n+1)$$

=0.5 x 85 x 6 =255

$$W = \frac{12}{\left[m^2 n(n^2-1)\right]} S_d$$

=12 x 7004/867000 = 0.096(9.6%)

Table 4.2.6: Kendall's W-Statistics on Identification of Psychosocial Health Hazard.

S/N	PSYCHOSOCIAL HEALTH HAZARDS	Mean	Rank	Ri	R	(Ri-R)2
35.	My workload is very challenging	2.9647	2	252	297	2025
36.	I would like to be transferred to another unit/department	2.2706	3	193	297	10816
37.	I work in isolation	2.0235	5	172	297	15625
38.	I am constantly talked down by my Superior	2.0471	4	174	297	15129
39.	I am faced with some kind of aggression and harassment in my place of work	2.0118	6	171	297	15876
40.	Psychosocial hazard could cause hypertension, anxiety, boredom etc	3.0235	1	257	297	1600
						61071

$$\bar{R} = \frac{1}{2}m(n+1)$$

=0.5 x 85 x 7 =297

$$W = \frac{12}{\left[m^2 n(n^2-1)\right]} S_d$$

=12 x 61071/1517250 = 0.483(48.3%)

Occupational Health Hazards

Psychosocial	48.3	17.1
Biological	9.6	3.4
Ergonomic	78.8	28
Chemical	70.9	25.2
Physical	74.2	26.3
Total	281.8	100

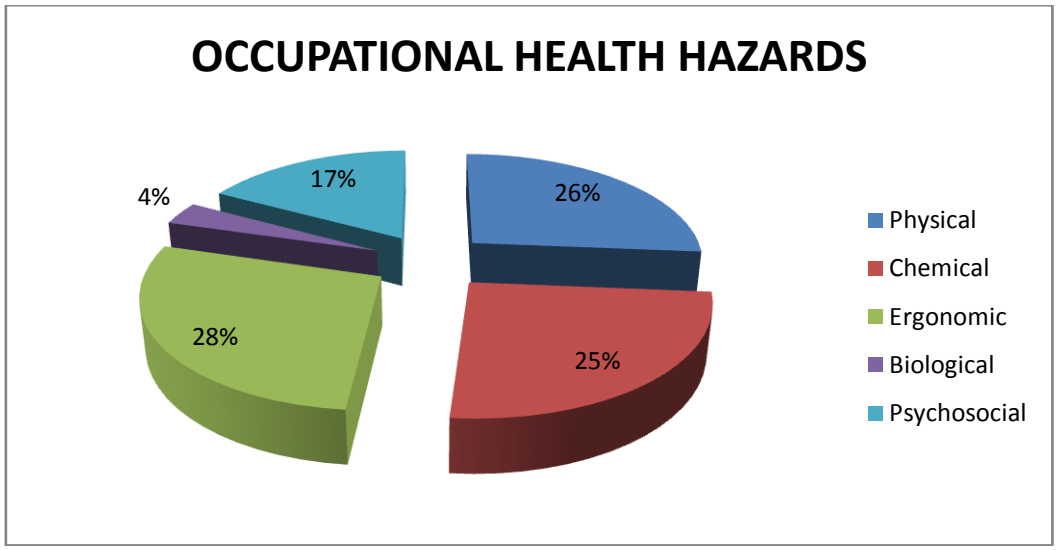

Figure 4.2.4: Occupational Health Hazards

Table 4.4.7: Kendall's W-Statistics on Evaluation of Occupational Health Practice

S/N	PRECAUTIONARY MEASURE	Mean	Rank	Ri	R	(Ri-R)2
41.	I had a pre-employment training when newly employed	2.6235	10	223	467.5	59780.25
42.	I had a pre-employment entrance health examination when newly employed	2.7647	7	235	467.5	54056.25
43.	My employer periodically calls for a health examination monitoring/surveillance on their employees	2.7412	8	233	467.5	54990.25
44.	Personal Protective Equipment (PPE) provided by Management is adequate and appropriate	3	6	255	467.5	45156.25
45.	My employer periodically send the employees for trainings to update and upgrade their efficiency and effectiveness	2.6706	9	227	467.5	57840.25
46.	There is a First Aid Box in my workplace	3.1882	2	271	467.5	38612.25
47.	There is an HSE Policy that is duly signed by the Managing Director in my workstation	3.1412	3	267	467.5	40200.25
48.	Implementation of the HSE Policy is taken seriously by Management	3.2353	1	275	467.5	37056.25
49.	Management is completely committed to the health and well-being of their workers	3.0941	5	263	467.5	41820.25
50.	There is a very functional and active Occupational Health Safety System in place in my Company	3.1176	4	265	467.5	41006.25
						470518.5

$$\bar{R} = \frac{1}{2} m(n+1)$$

=0.5 x 85 x 11 =467.5

$$W = \left[\frac{12}{m^2 n(n^2-1)}\right] S_d$$

=12 x 470518.5/7152750 = 0.789(78.9%)

4.4 Discussion of Findings

A total of 85 respondents participated in the study. Most of the respondents were in the age range of 31- 40 years (Table 4.3.1). Majority of respondents (82.4%) were males, married (64.7%) and had completed tertiary education (81.2%) respectively. Approximately Thirty-one percent of respondents operate on shift duty. Majority of respondents were able to identify the Health Hazards: Physical Health Hazard (74.2%); Chemical Health Hazard (70.9%); Mechanical/Ergonomics Health Hazard (78.8%) but the level of awareness of Psychosocial Health Hazard (48.3%) and Biological Health Hazards (9.6%) are low especially that of the latter. Which implied that for the former, the level of the hazard is minimal, but for the latter, with the particulate mass measurement (Table 4.2.3), it could be deduced that it (organic dust) is prevalent in the environment and it could impact on the health of the staff. For the evaluation of Occupational Health Practice most of the respondent (78.1%) agreed that management are committed in the health and well-being of their workers.

The findings from this study revealed that this is a male (82.4%) dominated occupation. This is not surprising considering the nature of work involved in petroleum refining. This is consistent with the findings in

earlier studies (Jinadu, 1980; Warrel, 1975; Aliyu and others, 2006). Majority of the respondents had completed tertiary education; they also knew and were aware (81.2%) of the Occupational Health Hazards they are exposed to. The high literacy level among these workers agreed with the report of [Asuzu, 1992] that 73% of the workers in a construction industry have completed at least high school.

The study showed that the workers were exposed to a wide variety of hazards which can be broadly classified as; physical, chemical and mechanical/ergonomics. The most common Occupational Health Hazards among respondents were noise, gas/chemical like Oxygen (O_2), Carbon Monoxide (CO), Methane (C_2H_4), Ammonium (NH_3), Hydrogen Sulphide (H_2S) and Carbon Dust. The volatile nature of petroleum hydrocarbons makes it highly reactive to give out gaseous vapours. And the ambient temperature can significantly increase the environmental levels of these vapours. Thus making the workers highly exposed to gas/chemical hazards as a result of their presence in the air.

A similar environmental exposure has been observed among service station attendants [Perriago and other, 2006]. Sixty percent of respondents were exposed to noise. However no worker reported occupational noise- induced hearing loss. Occupational exposure to high noise levels has been reported to depend on a variety of factors including occupation and industry, workplace factors and use of protective devices etc [http://www.who.int/publications/cra/chapters/vol.2 (cited June, 2008)].

High noise levels can cause masking of warning signs, annoyance and fatigue. Other harmful effects of noise are hypertension, hyperacidity, palpitations and disturbed relaxation and sleep. The handling of heavy machinery, uncomfortable ergonomic postures and probably working long hours makes the workers vulnerable to health diseases and illness. Back or neck pain, finger or toes turning white, stiffness, painful joint, numbness in hands, wrists, forearms, shoulders, knees and feet and swelling or inflammation are some illnesses that could result from Mechanical/Ergonomics Health Hazard. The Chemical Health Hazard which could be ingested, inhaled, injected and/or absorbed through the skin could be systemic and causes some occupational diseases and/or illnesses like renal disorder, respiratory diseases, reproduction disorder etc and also carcinogenous. Organic dust in the form of carbon black which is a type of Biological Health Hazards All of these could depend on the multiplicity, duration, and multitude of exposure, physical properties and age, lifestyle, genetic factor, race/tribe, gender and medical status of the individual.

The Occupational Health Practice at the Study Area has been acknowledged to be effective by the workers (78.9%) through the study survey that was carried on them. And the ability to provide a service, giving clients/patients what they want is one of the three dimensions of health service quality (WHO, 2002). Almost all the workers were aware of safety measures in the workplace and majority had had a formal training on Occupational Health and Safety.

V. Summary, Conclusion And Recommendations

5.1 Summary

The study was carried out in Warri Refining and Petrochemical Company (WRPC) and data for noise level, ambient air for gases/chemical, particulate mass for carbon dust was collected from strategic locations of the seven main departments of the Refinery using the different specialized equipments already discussed in Chapter 3. Also, questionnaires were used to extract operational data from the workers of the Refinery.

The study was to identify Occupational Health Hazards associated with Refinery workers with the aim of determining the awareness of the workers on this health hazards, assess the risk associated with the hazards identified and evaluate the Occupational Health Practices in the Refinery.

The Occupational Health Hazards identified that could affect the health and well-being of Refinery workers are:

1. Physical Health Hazard – Noise.
2. Chemical Health Hazards – O_2, CO, NH_3, C_2H_4 and H_2S.
3. Mechanical/Ergonomic Health Hazards – obsolete machines and equipments.
4. Biological Health Hazard – Organic dust (carbon black).

Kendell's W – Statistics was used to measure the level of agreement of the workers on their awareness and exposure to the health hazards. Table 4.4.1 to 4.4.6 gave a detail analysis of the measurements with the level of agreement in percentage (%).

5.2 Conclusion

Identification of Occupational Health Hazards, the awareness of the workers on the health hazards, the risk associated with them and the effectiveness of the Occupational Health Practices is crucial in the promotion, protection and rehabilitation of the health and well-being of people working in the Refinery. From this study, it could be deduced that these were achieved as the Occupational Health Hazard among Refinery workers were identified, it was seen that most of the workers were aware of the health hazards that is prevalent in their workplace. The Occupational Health Practice was seen to be effective as there is a Plant Clinic in the Industrial Layout of the Refinery which has two (2) full-time Occupational Health Doctors, an Industrial Hygienist (not

professional), six (6) nurses that run shift, a Pharmacist and an Assistance, Radiographer and an Assistance, a Medical Laboratory Technologist and Hospital Administrator for records keeping.

5.3 Recommendations

Occupational Health and Safety Management System which should be an integral part of production processes of an organization should not be toyed with by the Staff and Management of the any industrial and production organisation and the Oil and Gas Refinery should not be seen lacking in this area. It is to this regard that it is imperative with a form of urgency that the following recommended Management Protocol should be added to the already existing practices by Management and Staff of the Refinery

However, work related-illnesses and diseases could be caused by two major factors: workers' susceptibility and the workplace environment and conditions.

Table 5.1: Factors of Work Related-Illness and Diseases

WORKERS SUSCEPTIBILITY FACTORS	WORKPLACE FACTORS
Genetic	Multiplicity of Exposure
lifestyle	Duration of Exposure
Age	Physical Properties
Race	Magnitude of Exposure
Gender	Timing of Exposure
Medical History	Threshold Limit

And it could usually take some time before the manifestation of the diseases on the worker could be diagnosed. Hitherto, Health Effect Management Process which is an element in Occupational Health and Safety Management System (OHS-MS) amongst Leadership and Commitment, Policy and Strategic Objectives, Organization, Responsibilities, Resources, Standards and Documents, Planning and Procedures, Implementation and Monitoring, Audit and Review is recommended management protocol that would assist an Oil and Gas Refinery Management protects, promotes and rehabilitates the health and well-being of their workers.

Consequently, three main strategies are used to achieve OHS-MS which are Health Promotion, Protection and Rehabilitation in the workplace.

1. Health Promotion includes;

a. Health Risk Assessment which is a management tool that allows the workplace comply with her occupational policy, helps the workers do their jobs without damage to their health, enables the workplace meet her legal responsibilities, enables the workplace show due diligence in the protection and promotion of the health of the workers, provides an auditable platform and involves the work force in protecting the health of the workers.
b. Biological Monitoring/Medical Surveillance that involves periodic medical examination including pre-employment medical examination, health assessment and biological test. Sickness absence monitoring, reporting of occupational diseases and illnesses and ethical and legal issues.
c. Training
d. Physical Activities
e. Strict enforcement and implementation of the Organizational Occupational Health and Safety Policies with strategic planning should be put in place to imbibe Behavioural Occupational Health and Safety culture in the staff of the Refinery.
f. Management Commitment and Resources though advocacy.

2. Health Protection;

a. Elimination: using a hazardous material from use in the workplace so that no further exposure is possible.
b. Substitution: replacing a very hazardous material with a less hazardous one.
c. Modification: changing a process or procedure to eliminate or reduce emissions.
d. Containment: using physical barrier or containment to separate materials or environment from work areas.
e. Ventilation: removing or diluting hazardous materials in the air by removing the contaminated air and replacing it with outside air.
f. Workplace Practice: Work practices are procedures that limit worker exposure by reducing exposure times or keeping workers away from contaminants. The following are some common work practices; Scheduling, Good Housekeeping and Personal Hygiene Practices, Policies and Procedures
g. Personal Protective Equipment (PPE): Equipment such as gloves and goggles are used to protect workers from hazards. PPE is less effective because the hazard is still present and workers are not protected if the PPE fails. PPE should only be used if necessary after other control measures are implemented or if other controls are not practicable.

3. Health Rehabilitation;

a. Immediate Support and Initial Administrative Processes
b. Duty of Care - Safe Return Home After Injury
c. Book Keeping and Reporting Injuries/Illnesses
d. Effective Early Communication

5.4 Contribution to Knowledge

Most Refinery workers, though aware of the Occupational Health Hazards associate with their work, they are not necessarily aware of the occupational diseases and illnesses that are linked with these hazards. As a result of this study some the workers are made to be aware of these sicknesses and diseases which will guide them towards being compliance to the Occupational Health and Safety Practices and Policies of their company.
The factors determining the risk of exposure of Individuals to the Health Hazards necessarily should be a follow up study.

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Appendices

Appendix 1: Air Ambient Monitoring Data Collection Table.

S/N	Locations	O_2 (%)	LEL-Methane (%)	CO (ppm)	**NH_3 (ppm)**	**H_2S (ppm)**
NIOSH REL. TWA		19.5 – 23.5	10.0	35.0	25.0	10.0
1	Gas Collection Point	22.9	0.0	0.0	0.0	0.0
2	Gas Loading Area	22.2	2.0	9.0	0.0	0.0
3	Old Admin Block	21.5	0.0	0.0	0.0	0.0
4	Main Gate	23.3	0.0	0.0	0.0	0.0
5	Maintenance WS	20.9	0.0	0.0	0.0	0.0
6	Gate 5	20.9	0.0	0.0	0.0	0.0
7	WWT Plant	20.6	0.0	0.0	0.0	2.0
8	Utility-Refinery	20.7	0.0	0.0	0.0	0.0
9	FCC Unit	22.7	4.0	12.0	0.0	0.0
10	Reforming Unit	20.9	0.0	28.0	0.0	0.0
11	Topping Unit	21.9	0.0	2.0	0.0	0.0
12	Carbon Black	20.9	0.0	0.0	0.0	0.0
13	PP Plant	20.9	0.0	0.0	0.0	0.0

Appendix 2: Noise Level Monitoring Data Collection Table.

S/N	Location	Noise Level (Dba)	Max Allowable Limit
1	**CARBON BLACK PLANT**		
	Blower Area	94.9	85.0
	Bagging Area	74.3	85.0
	Control Room	53.4	65.0
2	**POLYPROPELENE PLANT**		
	Area I	72.8	85.0
	Area II	83.4	85.0
	Control Room	54.1	65.0
3	**PETROCHEMICAL UTILITIES**		
	Compressor Area (E751)	104.1	85.0
	Cooling Tower	80.7	85.0
	Control Room	60.3	65.0
4	**FUEL PLANT**		
	Topping Unit	91.5	85.0
	Reforming Unit	91.9	85.0
	FCC	95.5	85.0
	Control Room	60.9	65.0
5	**POWER PLANT & UTILITY**		
	Stream Turbine	99.7	85.0
	Gas Turbine	100.3	85.0
	Utilities	103.0	85.0
	GT Control Room	63.8	65
6	**WWT PLANT**		
	Plant Area	64.5	85.0
	Control Room	52.8	65.0
7	**FIRE HOUSE**		
	Office Area	63.2	65.0
	Control Room	60.2	65.0

Appendix 3: Particulate Mass Monitoring Data Collection Table.

S/N	Location	PM 1.0	PM2.5	PM 7.0	PM 10.0	TSP
Unit		Mg/m^3	Mg/m^3	Mg/m^3	Mg/m^3	Mg/m^3
1	Blower Area	0.003	0.007	0.011	0.011	0.015
2	Bag Filter Area	0.003	0.009	0.016	0.016	0.020
3	Wet Pellet Mixer/Surge Tank	0.004	0.009	0.018	0.020	0.022
4	PC Sliding Gate	0.000	0.001	0.001	0.002	0.003
5	CB Warehouse	0.001	0.003	0.003	0.003	0.004
6	Control Room	0.000	0.000	0.000	0.001	0.001
7	PC WWTP Sub Station	0.000	0.002	0.002	0.003	0.003
8	Area Around Envt. Block	0.001	0.004	0.006	0.006	0.006

Appendix 4: Kendall's W-Statistics on Identification of Health Hazards

S/N	MECHANICAL/ERGONOMIC HEALTH HAZARDS	Mean	Rank	Ri	R	(Ri-R)2
21.	I sometimes take a awkward posture while working	2.8235	4	240	425	34225
22.	I sometimes work in height	2.8471	3	242	425	33489

23.	When performing my job functions I stand for a long while	2.7529	5	234	425	36481
24.	The work material at my duty post is obsolete	2.5529	7	217	425	43264
25.	I lift heavy objects manually The chair, desk and other working tools and materials arrangements in my workplace is very comfortable and convenient with my job functions	2.5765	6	219	425	42436
26.	I sit most time when I am on duty	2.3176	9	197	425	51984
27.	My work is repetitive and monotonous	2.4118	8	205	425	48400
28.	Ergonomic hazards could cause deformity of one's body	3.1176	1	265	425	25600
29.	Mechanical/Ergonomic hazards could cause back, neck and body pain	3.1059	2	264	425	25921
						341800

Appendix 5: Health Risk Assessment Matrix

	CONSEQUENCES				INCREASING LIKELIHOOD				
Severity	People	Assets	Environment	Reputation	A Never heard of in the Industry	B Heard of in the Industry	C Has happened in the Company or more than once per year in the Industry	D Has happened at the location or more than once per year in the Company	E Has happened more than once per year at the location
0	No injury or health effect	No damage	No effect	No impact					
1	Slight injury or health effect	Slight damage	Slight effect	Slight impact					
2	Minor injury or health effect	Minor damage	Minor effect	Minor impact					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate impact					
4	PTD* or up to 3 fatalities	Major damage	Major effect	Major impact					
5	More than 3 fatalities	Massive damage	Massive effect	Massive impact					
PTD* = Permanent Disability									

Appendix 6: Health Risk Assessment Questionnaire

Health Risk Assessment Questionnaire

Key Respondent

Occupational Health Doctor

1. What are the different departments/sections/units in your Company?
2. What is the strength of the workforce of your Company?
3. Is there a difference between an Occupational Safety Hazard and Occupational Health Hazard?
4. Is noise, vibration, extreme temperature, radiation and poor illumination which are all Physical Health Hazards identified with your Company?
5. What are the risks associated with the Physical Health Hazards?
6. Do the risks affect people?
7. Have you ever heard that the risks have affected someone in the Oil and Gas Industry?
8. Has someone suffered the risks in your Company?
9. Do people suffer these risks more than once per year in the Oil and Gas Industry?
10. Have these risks affected someone in your Company?
11. The risks have happened more than once per year in my Company.
12. The effects of these risks, are they slight, minor, major, single fatality and/or multiple fatality?
13. Is O_2, CO, H_2S, NH_3 etc which are Chemical Health Hazards identified with your Company?
14. What are the risks associated with the Chemical Health Hazards?
15. Do the risks affect people?
16. Have you ever heard that the risks have affected someone in the Oil and Gas Industry?
17. Has someone suffered the risks in your Company?
18. Do people suffer these risks more than once per year in the Oil and Gas Industry?

19. Have these risks affected someone in your Company?
20. The risks have happened more than once per year in my Company.
21. The effects of these risks, are they slight, minor, major, single fatality and/or multiple fatality?
22. Is the catalyst, carbon black etc which are Biological Health Hazards identified with your Company?
23. What are the risks associated with the Biological Health Hazards?
24. Do the risks affect people?
25. Have you ever heard that the risks have affected someone in the Oil and Gas Industry?
26. Has someone suffered the risks in your Company?
27. Do people suffer these risks more than once per year in the Oil and Gas Industry?
28. Have these risks affected someone in your Company?
29. The risks have happened more than once per year in my Company.
30. The effects of these risks, are they slight, minor, major, single fatality and/or multiple fatality?
31. Are obsolete working tools, poor housekeeping etc which are Mechanical/Ergonomic Health Hazards identified in your Company?
32. What are the risks associated with the Mechanical/Ergonomic Health Hazards?
33. Do the risks affect people?
34. Have you ever heard that the risks have affected someone in the Oil and Gas Industry?
35. Has someone suffered the risks in your Company?
36. Do people suffer these risks more than once per year in the Oil and Gas Industry?
37. Have these risks affected someone in your Company?
38. The risks have happened more than once per year in my Company.
39. The effects of these risks, are they slight, minor, major, single fatality and/or multiple fatality?
40. What is your assessment of Management/Workers relationship in your Company?

Thank you.

Appendix 7: Occupational Health Hazards Questionnaire

OCCUPATIONAL HEALTH HAZARDS AMONG REFINERY WORKERS

SECTION A: BIODATA

1. Age: <20 ☐ 21 – 30 ☐ 31 – 40 ☐ 41 – 50 ☐ >50

2. Sex: M ☐ F ☐

3. Department: .....

4. Tribe: Hausa ☐ Yoruba ☐ Ibo ☐ Ijaw ☐ Itsekiri ☐ Ihobo ☐ Others ☐

5. Religion: Islam ☐ Christianity ☐ Others ☐

6. Educational Level: Primary ☐ Secondary ☐ Degree ☐ Masters ☐ Others

7. Marital status: Married ☐ Single ☐ Divorce ☐ Widow/er ☐

8. Number of wives: One ☐ Two ☐ More ☐

9. How long have you been working in WRPC? < 5 ☐ – 9 ☐ 10 – 14 ☐ 15> ☐

10. Nature of Employment: Backup ☐ Full Time ☐ Contractor ☐ Casual ☐

11. Do you run shift? Yes ☐ No ☐

Section B: Health Hazards Identification
SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree

	(A) PHYSICAL HEALTH HAZARDS	SA	A	D	SD	NON
1.	The noise level in my workplace is relatively high					
2.	Loss of hearing could result from exposure to loud noise					
3.	My job function has to do with working with object, tools, equipment, machine, chemical etc that has high temperature					
4.	Extreme heat could cause body cramp					
5.	My workplace shakes as a result of vibration from workplace machines and equipments					
6.	Vibration could disorder the spine and =causes fatigue					
	My workplace is adequately lighted					
7.	Inadequate illumination could affect the eyes					
		SA	**A**	**D**	**SD**	**NON**
8.	Radiations like in welding, radioactive substances etc could be emitted as I perform my job function					
9.	Radiation could cause cancer and premature skin aging					
	(B) CHEMICAL HEALTH HAZARDS					
10.	Working with chemical substances is part of my job function					
11.	The substances are solvent, mist, fume and gases					
12.	The substances are dust, particles, metal and metalloid					
13.	The chemical/gases are flammable, poisonous and corrosive					
14.	The hazardous chemicals are sometimes inhaled, ingested, injected and spill over my skin					
15.	Eating where there are chemical is highly prohibited					
16.	Chemical substances should be carefully handled and labeled					
17.	Chemical hazards are likely to affect ones' health when they are exposed to them for a long period of time					
18.	Exposure to chemical hazards could cause reproductive disorder, cardiovascular disease, respiratory diseases, renal diseases etc					
19.	The health impact of chemical hazards could lead to loss of life					
	(C) MECHANICAL/ERGONOMIC HEALTH HAZARDS					
20.	I sometimes take a awkward posture while working					
21.	I sometimes work in height					
22.	When performing my job functions I stand for a long while					
23.	The work material at my duty post is obsolete					
24.	I lift heavy objects manually The chair, desk and other working tools and materials arrangements in my workplace is very comfortable and convenient with my job functions					
		SA	**A**	**D**	**SD**	**NON**
25.	I sit most time when I am on duty					
26.	My work is repetitive and monotonous					
27.	Ergonomic hazards could cause deformity of one's body					
28.	Mechanical/Ergonomic hazards could cause back, neck and body pain					
	(D) BIOLOGICAL HEALTH HAZARDS					
29.	Microbes could be found in some substances I work with in my work station					
30.	I generate hazardous waste while working					
31.	Some of this hazardous waste could impact on the health of workers					
32.	Biological hazards could cause tubercolosis, pneumonitis, pneumonoconiosis etc					
33.	Proper environmental hygiene is lacking in my place of work					
	(E) PSYCHOSOCIAL HEALTH HAZARDS					
34.	My workload is very challenging					
35.	I would like to be transferred to another unit/department					
36.	I work in isolation					
37.	I am constantly talked down by my Superior					
38.	I am faced with some kind of aggression and harassment in my place of work					
39.	Psychosocial hazard could cause hypertension, anxiety, boredom etc					
	(F) PRECAUTIONARY MEASURE					
40.	I had a pre-employment training when newly employed					
41.	I had a pre-employment entrance health examination when newly employed					
42.	My employer periodically calls for a health examination monitoring/surveillance on their employees					
43.	Personal Protective Equipment (PPE) provided by Management is adequate and appropriate					
44.	My employer periodically send the employees for trainings to update and upgrade their efficiency and effectiveness					

		SA	A	D	SD	NON
45.	There is a First Aid Box in my workplace					
46.	There is an HSE Policy that is duly signed by the Managing Director in my workstation					
47.	Implementation of the HSE Policy is taken seriously by Management					
48.	Management is completely committed to the health and well-being of their workers					
49.	There is a very functional and active Occupational Health Safety System in place in my Company					

Thank you.