

## Health, Safety and Environmental Issues in Nigerian Manufacturing and Processing Industries

A.J. Alawode, J.T. Stephen and G.J. Adeyemi

Department of Mechanical Engineering, University of Ado-Ekiti, Ado-Ekiti, Nigeria

**Abstract:** Environmental pollution is a major adverse consequence of the rapid urban growth, increased economic activities and industrial development witnessed globally and particularly in Nigeria for the past few years. Various forms of pollution pose threat to the health and safety of mankind and its environment. This study, therefore, carries out an assessment of the health, safety and environmental issues in Nigerian manufacturing and processing industries with a view to re-awakening and re-sensitizing environmentally conscious industrial activities and municipal waste disposal attitudes towards a safe and healthy environment. Diverse forms of occupational hazards, air and water pollution and waste management and disposal challenges are discussed and the health, safety and environmental attitudes of Nigerian industries, municipalities and the public in general are reviewed. Workers in many Nigerian companies are exposed to a lot of occupational hazards and our air and water pollution control and waste management and disposal systems need to be improved to comply with international standards. Suggestions are therefore made towards an improved health and safety status of the environment by recommending industrial health, safety and environmental policies for Nigerian companies. Measures of minimizing occupational hazards and ways of actualizing efficient and effective industrial waste management and disposal systems are also recommended.

**Key words:** Health, safety, environment, industrial waste, pollution

### INTRODUCTION

Raw materials are extracted from their natural habitats by mining, drilling, harvesting, etc. These raw materials are then purified, refined and converted into bulk forms such as metals, cements, petroleum, rubber, fibres, etc. However, there are associated adverse effects in the course of manufacturing and processing, using the products and disposing of the wastes. Both positive and adverse societal impacts of our modern manufacturing technologies have great consequences on economics, health, safety and environment. These impacts are international in scope because the resources required for a new technology often come from many different countries, the economic prosperity resulting from technological development is global in extent and environmental impacts may extend beyond the boundary of a single country.

It is therefore, imperative for all manufacturing and processing industries and the community at large to be committed to environmental quality and the protection and safety of our existence. For industries, government agencies, the ultimate goals should be the design of processes and systems that reduce job hazards, minimize treatment for pollution control and optimize recycling of

all wastes for reuse to avoid environmental degradation. This philosophy is both logical and necessary in a society like Nigeria that is rapidly depleting her non-renewable natural resources (particularly). How well this goal is attained will depend in great measure on how the stakeholders concerned i.e., government, industries and the community in general copes with the challenges presented.

Therefore, the objective of this study is to carry out an assessment of the Health, Safety and Environmental (HSE) issues in Nigerian manufacturing and processing industries with a view to re-awakening and re-sensitizing environmentally-conscious industrial activities and waste disposal attitudes of the populace towards a healthy, safe and sustainable society. Various forms of occupational hazards, air and water pollution and waste management and disposal challenges will be discussed and the health, safety and environmental attitudes of Nigerian industries, municipalities and the public in general will be reviewed.

### ENVIRONMENTAL POLLUTION AND OCCUPATIONAL HAZARDS

Industrial activities are usually accompanied with job risks/occupational hazards, air and water pollution and waste management disposal challenges.

**Air pollution:** Air pollution is the addition of harmful substances to the atmosphere resulting in damage to the environment, human health and quality of life. Apart from human activities, air pollution also comes from sources like emissions from forest fire and volcanic eruption. Air pollution makes people sick-it causes breathing problems and promotes cancer-and it harms plants, animals and the ecosystems in which they live. Some air pollutants return to Earth in the form of acid rain and snow, which corrode statues and buildings, damage crops and forests and make lakes and streams unsuitable for fish and other plant and animal life.

Most air pollution comes from one human activity: burning fossil fuels-natural gas, coal and oil-to power industrial processes and motor vehicles. Among the harmful chemical compounds this burning puts into the atmosphere are carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide and tiny solid particles-including lead from gasoline additives-called particulates. When fuels are incompletely burned, various chemicals called Volatile Organic Chemicals (VOCs) also enter the air. Pollutants also come from other sources. For instance, decomposing garbage in landfills and solid waste disposal sites emits methane gas and many household products give off VOCs. Solvent (VOC) air emissions make up the vast majority of smog output.

Air pollution is in the forms of smog and acid precipitation, ozone depletion and global warming. Smog is intense local pollution usually trapped by a thermal inversion. Before the age of the automobile, most smog came from burning coal. Burning gasoline in motor vehicles is the main source of smog in most regions today. Powered by sunlight, oxides of nitrogen and volatile organic compounds react in the atmosphere to produce photochemical smog. Smog contains ozone, a form of oxygen gas made up of molecules with three oxygen atoms rather than the normal two. Ozone in the lower atmosphere is a poison-it damages vegetation, kills trees, irritates lung tissues and attacks rubber. Environmental officials measure ozone to determine the severity of smog. When the ozone level is high, other pollutants, including carbon monoxide, are usually present at high levels as well.

Several pollutants attack the ozone layer. Chief among them is the class of chemicals known as chlorofluorocarbons (CFCs), formerly used as refrigerants (notably in air conditioners), as agents in several manufacturing processes and as propellants in spray cans. CFC molecules are virtually indestructible until they reach the stratosphere. Here, intense ultraviolet radiation breaks the CFC molecules apart, releasing the chlorine atoms they contain. These chlorine atoms begin reacting

with ozone, breaking it down into ordinary oxygen molecules that do not absorb UV-B. The chlorine acts as a catalyst-that is, it takes part in several chemical reactions-yet at the end emerges unchanged and able to react again. A single chlorine atom can destroy up to 100,000 ozone molecules in the stratosphere. Other pollutants, including nitrous oxide from fertilizers and the pesticide methyl bromide, also attack atmospheric ozone. (Microsoft Encantar, 2006).

Humans are bringing about another global-scale change in the atmosphere: the increase in what are called greenhouse gases. Like glass in a greenhouse, these gases admit the Sun's light but tend to reflect back downward the heat that is radiated from the ground below, trapping heat in the Earth's atmosphere. This process is known as the greenhouse effect. Carbon dioxide is the most significant of these gases-there is 31% more carbon dioxide in the atmosphere today than there was in 1750, the result of our burning coal and fuels derived from oil. Methane, nitrous oxide and CFCs are greenhouse gases as well.

Global warming will have different effects in different regions. A warmed world is expected to have more extreme weather, with more rain during wet periods, longer droughts and more powerful storms. Although, the effects of future climate change are unknown, some predict that exaggerated weather conditions may translate into better agricultural yields in areas such as the western United States, where temperature and rainfall are expected to increase, while dramatic decreases in rainfall may lead to severe drought and plunging agricultural yields in parts of Africa, for example (Microsoft Encantar, 2006).

**Water pollution:** Water is very vital for the survival and sustenance of mankind and its environmental. No wonder, water is naturally abundant for the continual existence of all living things on the planet earth. However, industrial activities and unhygienic attitudes of the public have contaminated water meant for domestic and industrial purposes. Water Pollution is the contamination of streams, lakes, underground water, bays, or oceans by substances harmful to living things. Water is necessary to life on earth. If severe, water pollution can kill large numbers of fish, birds and other animals, in some cases killing all members of a species in an affected area. Pollution makes streams, lakes and coastal waters unpleasant to look at, to smell and to swim in. Fish and shellfish harvested from polluted waters may be unsafe to eat. People who ingest polluted water can become ill and with prolonged exposure, may develop cancers or bear children with birth defects.

The major water pollutants are chemical, biological, or physical materials that degrade water quality. Pollutants can be classed into 10 categories, each of which presents its own set of hazards. These categories are petroleum products, pesticides and herbicides, heavy metals, metalloids, hazardous wastes, inorganic compounds, organic compounds, sediments, infectious organisms and thermal pollution.

**Soil pollution:** Soil is a mixture of mineral, plant and animal materials that form during a long process that may take thousands of years. It is necessary for most plant growth and is essential for all agricultural production. Soil pollution is a buildup of toxic chemical compounds, salts, pathogens (disease-causing organisms), or radioactive materials that can affect plant and animal life.

Unhealthy soil management methods have seriously degraded soil quality, caused soil pollution and enhanced erosion. Treating the soil with chemical fertilizers, pesticides and fungicides interferes with the natural processes occurring within the soil and destroys useful organisms such as bacteria, fungi and other microorganisms.

**Solid wastes:** Solid wastes are unwanted solid materials such as garbage, paper, plastics and other synthetic materials, metals and wood. Billions of tons of solid waste are thrown out annually. Cities in economically developed countries produce far more solid waste per capita than those in developing countries. Moreover, waste from developed countries typically contains a high percentage of synthetic materials that take longer to decompose than the primarily biodegradable waste materials of developing countries.

Areas where wastes are buried, called landfills, are the cheapest and most common disposal method for solid wastes worldwide. But landfills quickly become overfilled and may contaminate air, soil and water. Incineration, or burning, of waste reduces the volume of solid waste but produces dense ashen wastes (some of which become airborne) that often contain dangerous concentrations of hazardous materials such as heavy metals and toxic compounds. Composting, using natural biological processes to speed the decomposition of organic wastes, is an effective strategy for dealing with organic garbage and produces a material that can be used as a natural fertilizer. Recycling, extracting and reusing certain waste materials, has become an important part of municipal solid waste strategies in developed countries.

Expanding recycling programs worldwide can help reduce solid waste pollution, but the key to solving severe solid waste problems lies in reducing the amount

of waste generated. Waste prevention, or source reduction, such as altering the way products are designed or manufactured to make them easier to reuse, reduces the high costs associated with environmental pollution.

**Hazardous wastes:** Hazardous wastes are solid, liquid, or gas wastes that may be deadly or harmful to people or the environment and tend to be persistent or non-degradable in nature. Such wastes include toxic chemicals and flammable or radioactive substances, including industrial wastes from chemical plants or nuclear reactors, agricultural wastes such as pesticides and fertilizers, medical wastes and household hazardous wastes such as toxic paints and solvents.

The use, storage, transportation and disposal of hazardous substances pose serious risks to our health and environment. Even brief exposure to some of these materials can cause cancer, birth defects, nervous system disorders and death. Large-scale releases of hazardous materials may cause thousands of deaths and contaminate air, water and soil for many years. The world's worst nuclear reactor accident took place near Chernobyl, Ukraine, in 1986. The accident killed at least 31 people, forced the evacuation and relocation of more than 200,000 more and sent a plume of radioactive material into the atmosphere that contaminated areas as far away as Norway and the United Kingdom.

Hazardous wastes of particular concern are the radioactive wastes from the nuclear power and weapons industries. To date there is no safe method for permanent disposal of old fuel elements from nuclear reactors. Most are kept in storage facilities at the original reactor sites where they were generated. With the end of the Cold War, nuclear warheads that are decommissioned, or no longer in use, also pose storage and disposal problems (Microsoft Encantar, 2006).

**Noise pollution:** Unwanted sound, or noise, such as that produced by airplanes, traffic, or industrial machinery, is considered a form of pollution. Noise pollution is at its worst in densely populated areas. It can cause hearing loss, stress, high blood pressure, sleep loss, distraction and lost productivity.

Sounds are produced by objects that vibrate at a rate that the ear can detect. This rate is called frequency and is measured in hertz, or vibrations per second. Most humans can hear sounds between 20 and 20,000 hertz, while dogs can hear high-pitched sounds up to 50,000 hertz. While high-frequency sounds tend to be more hazardous and more annoying to hearing than low-frequency sounds, most noise pollution damage is related to the intensity of the sound, or the amount of energy it

has. Measured in decibels, noise intensity can range from zero, the quietest sound the human ear can detect, to over 160 decibels. Conversation takes place at around 40 decibels, a subway train is about 80 decibels and a rock concert is from 80-100 decibels. The intensity of a nearby jet taking off is about 110 decibels. The threshold for pain, tissue damage and potential hearing loss in humans is 120 decibels. Long-lasting, high-intensity sounds are the most damaging to hearing and produce the most stress in humans.

Solutions to noise pollution include adding insulation and sound-proofing to doors, walls and ceilings; using ear protection, particularly in industrial working areas; planting vegetation to absorb and screen out noise pollution and zoning urban areas to maintain a separation between residential areas and zones of excessive noise.

**Industrial wastes:** Wastes originating in business activities of the industrial world are referred to as industrial wastes. These wastes are generally produced in line with the end products or during the processing procedures of the industries.

Water constitutes the major component of liquid wastes in industries. All industries use water to various extents, some take in a greater amount of water than raw materials (e.g., breweries). Some need comparatively large amount in their finishing operations than in the manufacturing process. Very little of the water needed in industry forms part of the finished products and as very little of the water evaporates or sinks into the ground, the bulk of the water is discharged into the environment as wastewater containing various dissolved and suspended substances (Onipede and Bolaji, 2004).

**Occupational hazards:** To be effective in recognizing and evaluating on-the-job hazards and recommending controls, health, safety and environment stakeholders must be familiar with the characteristics of occupational hazards. Major job risks can include air contaminants and chemical, biological, physical and ergonomic hazards (OSHA 3134, 1998).

**Air contaminants:** Air contaminants are commonly classified as either particulate or gas and vapour contaminants. The most common particulate contaminants include dusts, fumes, mists and aerosols. Dusts are formed or generated from solid organic or inorganic materials by reducing their size through mechanical processes such as crushing, grinding, drilling, abrading or blasting.

Fumes are formed when materials from a volatilized solid condenses in cool air and in most cases, the solid

particles resulting from the condensation react with air to form oxides. Mists, finely divided liquids suspended in the atmosphere, are generated by vapours condensing to liquid or by breaking up a liquid into a dispersed state such as by splashing, foaming or atomizing. Aerosols are also a form of a mist characterized by highly respirable but minute liquid particles.

Other forms of air pollutants are acetylene, nitrogen, helium and argon from welding operations and carbon monoxide generated from the operation of internal combustion engines or by its use as a reducing gas in a heat-treatment operations. Another example is hydrogen sulphide formed during decomposition of materials containing sulphur under reducing conditions.

**Chemical hazards:** Air-borne chemical hazards such as concentrations of mists, vapours, gases, fumes, or solids exist. Some are toxic through inhalation, some can be irritating and/or toxic by absorption through the skin or through ingestion and some are corrosive to living tissue.

The degree of workers' risk from exposure to any given substance depends on the nature and potency of the toxic effects and the magnitude and duration of exposure.

**Biological hazards:** These include bacteria, viruses, fungi and other living organisms that can cause acute and chronic infections by entering the body either directly or through cuts in the skin. These types of hazards are not common in industries involving materials engineering. Workers dealing with plants, animals, food processing and laboratory and medical analyses may be exposed to biological hazards.

**Physical hazards:** Physical hazards include excessive levels of ionizing and non-ionizing electromagnetic radiation, noise, vibration, illumination, heat and structural collapse. Examples of working places characterized with physical hazards are mining and quarry sites, civil and building engineering construction sites, factory floors, machining and welding workshops to mention a few.

**Ergonomic hazards:** The science of ergonomics studies and evaluates a full range of tasks including, but not limited to, lifting, holding, pushing, walking and reaching. Many ergonomics problems result from technological changes such as increased assembly line speeds, adding specialized tasks and increased repetition; some problems arise from poorly designed job tasks. Any of those conditions can cause ergonomic hazards such as excessive vibration and noise, eye-strain, repetitive motion and heavy lifting problems. Improper design tools

or work areas also can be ergonomic hazards. Repetitive motions or repeated shocks over prolonged period of time as in jobs involving sorting, assembling and data entry can often cause irritation and inflammation of the tendon sheath of the hands and arms, a condition known as carpal tunnel syndrome.

### **REVIEW OF HSE ATTITUDES OF NIGERIAN INDUSTRIES AND MUNICIPALITIES**

In the past few years, Nigeria has witnessed rapid urban growth; increased economic and technological development and these have also brought about increasing industrial development coupled with various forms of environmental pollution (FEPA, 1991).

**Occupational hazards:** In many Nigerian industries, workers are exposed to occupational hazards everyday because of the partial commitment of the management to their safety. Many industrial establishments employ workers without equipping them with the necessary kits to perform their jobs in a healthy and safe way. In chemical laboratories and industries, many workers are exposed to chemical hazards because some containers of hazardous substances in their workplaces do not have appropriate warning and identification labels. In occupations where animals are involved, experience has shown that the provision of facilities for workers personal hygiene is inadequate thereby exposing workers to biological hazards. Sometimes workers are exposed to physical hazards in workplaces like civil and building engineering construction sites, quarry sites and machining and welding workshops not because of inadequate protection kits but due to the ineffectiveness and carelessness of the workers themselves. In many Nigerian factory floors, a first visit would show clearly poor design of workplaces and job tasks, excessive vibration and noise, prolonged repetitive motion in jobs like sorting, assembling and data entry to mention but a few. These pose ergonomic hazards to workers and reduce workers' efficiency.

**Waste management and disposal:** One of the most crucial matters confronting the society in general and industries in particular is the issue of industrial waste disposal. Everyday, the consequences of waste management and disposal on public health are usually expressed in both the print and electronic media. Advocates of environmental protection have drawn the attention of the national policy makers to the health hazards and potential dangers to natural resources caused by the inadequate management of wastes (FEPA, 1991; Anand, 1999).

The urban and industrialized areas of the country are usually characterized by waste management problems. Many industrialized cities in Nigeria still have insufficient waste management methods; poorly controlled open dumps and illegal roadside dumping spoils scenic resources and pollutes soil and water resources. This situation has both physical and social consequences because many peoples apparently are simply disposing of their wastes as cheaply and quickly as possible. In fact, many do not see dumping of their garbage on the roadside as a threat to public health and an invitation for outbreak of diseases like cholera and dysentery, etc. (Onipede and Bolaji, 2004).

Many factories in Nigeria are located on riverbanks and use the rivers as open sewers for their effluents. A recent study of the effects of effluents from two breweries on Ikpoba rivers in Benin City shows increase in pH, dissolved oxygen, biological oxygen demand (BOD) and massive increase in suspended solids (Adeparusi, 2003).

Solid waste disposal methods such as burning on open ground or roadside, dumping into drains, water bodies (streams, lakes, oceans) and all other forms of indiscriminate dumping are regarded as environmentally unfriendly and therefore constitute threats to public health directly or indirectly (Rand *et al.*, 2000).

All industries produce solid wastes and wastewater in varying quantities and conditions and the accumulation of these solid wastes in heaps at dumping sites or discharge of wastewater on the soil or streams create pollution in a very short time. Hence, industries join municipalities in contributing to the cultural pollution of the landscapes, streams and other bodies of water. As these wastes are necessary end products of industries, the only solution to abating their nuisance effects is satisfactory waste management treatment and disposal methods (Onipede and Bolaji, 2004).

**Air and water pollution:** Nigerian atmosphere has been contaminated with continual air emission of volatile organic solvents (VOCs) that form a major constituent of smog. Also, green house gas (GHG) mostly carbon dioxide are continually emitted into the atmosphere through exhaust fumes from industries, internal combustion engines including vehicles and electricity generating sets and natural gas flaring which is a common phenomenon in Nigeria Oil and Gas Industry. Also, many ozone-depleting chemicals (ODCs) like carbon fluorochloride (CFC), carbon tetrachloride and methyl chloroform have not been phased out in Nigerian manufacturing industries and on-site equipment such as refrigeration units and fire protection systems.

As stated earlier, many factories in Nigeria are located on riverbanks and use the rivers as open sewers for their effluents. Many factories in Lagos even channel their wastewater directly into the lagoon thereby affecting aquatic life and poisoning the fish to be consumed by the public. Also, many air and soil contaminants are dissolved by rain and they often find their way into streams, rivers, seas and ocean.

### **SUGGESTIONS AND RECOMMENDATIONS TOWARDS A SAFE AND HEALTHY ENVIRONMENT**

Many rules and regulations have been enacted worldwide towards creating and sustaining a safe and healthy environment. The United States is a leading nation in enacting, enforcing and adhering to health, safety and environmental policies, rules and regulations. The HSE acts include Occupational, Safety and Health Acts of 1970, National Environmental Policy Act of 1970, Rivers and Harbors Acts of 1899, Atomic Energy Act of 1954 and Marine Protection, Research and Sanctuaries Acts of 1977.

Also in Nigeria, the Federal Environmental Protection Agency was established in 1991 with regulations towards a safe and healthy Nigeria. However, many industries and establishments do not strictly adhere to comply with these regulations. Even there has not been a serious enforcement of the environment protection rules and regulations by the Federal and State Governments. A comprehensive code of environment, health and safety principles (AF and PA, 2000) are hereby recommended for Nigerian industries towards a safe and healthy environment.

#### **Recommended industrial policies towards a safe and healthy environment:**

- Making HSE consideration priorities in operating existing facilities, as well as in planning new operation. This could be achieved by: striving to eliminate health, safety and environmental concerns in company operations to seek out areas for continual improvement, developing, implementing and enforcing policies, plans and procedures in order to achieve compliances with health, safety and environmental laws and regulation, making health, safety and environmental considerations an integral part of strategic planning and capital budgeting processes in order to anticipate and manage future concerns and initiating corrective action immediately if a situation which may lead to significant adverse effects on employees, the public or the environment arises.

- Recognizing, in developing and designing products to meet customers needs, the HSE effects of product manufacture, distribution, use and disposal by: developing programmes and monitor their effectiveness in reducing health, safety and environmental concerns in product manufacture, distribution, use and disposal, continuing to be financially committed to health, safety and environmental protection, providing customers and communities with important information relating to the health, safety and environmental concerns of product manufacture, distribution, use and disposal and considering available measures, including source reduction or substitution, external treatment and engineering controls, in deciding how best to prevent or reduce pollution, particularly when constructing new facilities, making major modifications to existing ones, or designing new products.
- Monitoring their HSE performance and report regularly on these matters to their Board of Directors by: developing internal health, safety and environmental goals and programmes, with mechanisms in place to assess operations and progress, designating a responsible individual(s) at each manufacturing location to be accountable for health, safety and environmental activities and report to an appointed upper management individual(s) or committee(s) and coordinating activities and information on health, safety and environmental matters among local managers, corporate environment staff and senior management.
- Training employees in their HSE responsibilities and promoting awareness and accountability on these matters by: developing and implementing education, training and communication programmes on health, safety and environmental policies and procedures for employees stressing the importance of compliance with the law, conducting regular reviews of employees compliance with applicable regulations and company requirement, encouraging and recognizing individual and team efforts to improve health, safety and environmental performance, taking appropriate disciplinary action against employees who fail to follow health, safety and environmental policies, procedures and regulatory requirements and encouraging employees to participate in internal company deliberations, activities and technical organizations which focus on health, safety and environmental concerns, as well as to pursue continuing education in these areas.

- Improving HSE performance through support of research and development that advance the frontier of knowledge.
- Communicating with employees, customers suppliers, the community, public officials and shareholders to build greater understanding on health, safety and environmental matters by: responding accurately and promptly to questions and concerns of interested parties particularly in the event of a situation which may require corrective action, seeking out interested parties regularly and communicating on industry activities and performance, working with others to address concerns and to reach consensus on important issues, carefully evaluating criticisms and complaints concerning industry activities, supporting educational initiatives on health, safety and environmental both through individual programmes and cooperative ventures and regularly evaluating the effectiveness of the communication efforts.
- Participating constructively in the development of public policies on health, safety and environmental matters by working with government entities in the development of public policies that are based on sound scientific principles and economically achievable technologies.
- Continuing to pursue energy conservation, increased energy efficiency, greater utilization of alternatives to fossil fuels and opportunities to co-generation of electricity from wood residues and hydropower.
  - Measures against radiation, noise and heat.
  - Hazards on workers.

The time of exposure of workers to ionizing radiation should be reduced to the minimum because danger from radiation increases with the amount of time one is exposed to it. Workers should also be kept at a reasonably far distance from source of radiation because distance also is a valuable tool in controlling exposure to both ionizing and non-ionizing radiations. Radiation levels from some sources can be estimated by comparing the squares of the distances between the worker and the source. For example, at a reference point of 10 feet from a source the radiation is 1/100 of the intensity at 1 foot from the source.

Sometimes limiting exposure times to non-ionizing radiation or increasing the distance from the source is not effective. Laser radiation, for example, cannot be controlled effectively by imposing time limits. An exposure that is faster than the blinking of an eye can be hazardous. Increasing the distances from a laser source may require miles before the energy level reaches a point where the exposure would not be harmful. Hence, shielding also is a way to protect against radiation. The greater the protective mass between a radioactive source and the workers, the lower the radiation exposure.

Another physical hazard, radiant heat exposure in factories such as steel mills, can be controlled by installing reflective shields and by providing protective clothing.

Noise, another significant physical hazard, can be reduced by installing equipment and systems that have been engineered, designed and built to operate quietly, by enclosing or shielding noisy equipment, by making sure that equipment is in good order and properly maintained with all worn or unbalanced parts replaced; by mounting noisy equipment on special mounts to reduce vibration and by installing silencers mufflers, or baffles (OSHA 3134, 1998).

#### **Measures against ergonomic hazards on workers:**

Ergonomic hazards are avoided primarily by the effective design of a job or jobsite and better-designed tools or equipment that meets workers' needs in terms of physical environment and job tasks. During worksite analysis, the industrial hygienist measures and identifies exposures, problem tasks and risks in jobs, operations and work activities. Through thorough worksite analyses, employers can set up procedures to correct or control ergonomic hazards by using the appropriate engineering controls (e.g., designing or re-designing work stations, lighting, tools and equipment); teaching correct work practices (e.g., proper lifting methods); employing proper administrative controls (e.g., shifting workers among several different tasks, reducing production demand and increasing rest breaks) and if necessary providing and mandating the use of personal protective equipment. Evaluating working conditions from an ergonomics standpoint involves looking at the total physiological and psychological demands of the job on the workers. The benefits of a well-designed, ergonomic work environment can include increased efficiency, fewer accidents, lower operating costs and more effective use of personnel (OSHA 3134, 1998).

#### **RECOMMENDATIONS FOR EFFECTIVE INDUSTRIAL WASTE MANAGEMENT SYSTEMS**

The following recommendations are made for the improvement of the industrial waste management and disposal in Nigeria:

- Wastewater from industries should be treated to remove the major water pollutants like heavy metals, metalloids, inorganic and organic compounds that can cause health hazards to both mankind and aquatic life. After water treatment and purification, the water could then be suitable for domestic use, specialized industrial applications and even safe to be discharged to the environment.

- Effective solid waste management and disposal techniques should be adopted to reduce the quantity of the waste, reuse or recycle waste products or by composting and/or incinerating on site to make it suitable for discharging to the environment.
- Attention should be given to possible collective handling of industrial wastes to reduce cost and to ensure effective handling.

### CONCLUSION

This study has made an assessment of the health, safety and environmental issues in Nigerian manufacturing and processing industries in order to re-awake and re-sensitize environmentally, conscious industrial activities and municipal waste management and disposal attitudes. Nigerian industries are therefore advised to adhere to a comprehensive code of health, safety and environmental principles and policies and measures against radiation, noise heat and ergonomic hazards are suggested. Industrial wastewater should be treated to remove the major pollutants that can cause health hazards to both mankind and aquatic life. Effective solid waste management and disposal techniques should also be adopted to reduce the amount of waste, reuse or recycle waste products or by composting and/or incinerating on site. Also, collective handling of industrial waste should be encouraged to reduce cost and allow effectiveness.

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