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Health and Environmental Protection in an Industrial Plant: A Case Study of Ajaokuta Steel Company Limited (ASCL) Foundry Shop

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Abstract

This paper discusses issues as they reflect on the health and environmental protection in an industrial plant with emphasize to Foundry operations of the Ajaokuta steel Company Limited: Industrial Safety, area of safety engineering and public health that deals with the protection of workers' health, through control of the work environment to reduce or eliminate hazards were mentioned. Industrial accidents and unsafe working conditions which can result in temporary or permanent injury, illness or even death were highlighted. Some other areas like: Health Hazard, Noise in Foundry, Vibrations at the place of work, Atmospheric Air pollution and their effects on man were also brought to the fore. Suggestions and recommendations were also proffered to reduce their effect on workers.

Keywords: Health hazard; Environment; Protection; Industrial safety and workers

Introduction

Foundry industry produces heat, gases, dust, noise and a large quantity of waste such as irreclaimable sands, ashes and slag. These individual elements have considerable effect on environment degradation and cause condition unsuitable for human's health.

In Nigeria, the factories ACTS of 1955, came into force on 1st September 1956, the factories (Amendment) ordinance, 1458, which came into operation on 1st April, 1959 made slight changes in some section of the original Act. And again in 1984, yet more changes were made in the factories Act. The factory Act lays down in general terms the minimum standard for safety, health and welfare of factory workers to be maintained in all factories in Nigeria.

Relevant Section of the Acts and Regulation

Part III contains some safety requirements for special causes such as injury to eyes (section 53), but is largely concerned with possible damage to health, such as the effect of abrasive dust on the lungs (section 50) and of harmful substances on the (section 52) of Part IV contains conditions required in the factory for health of the workers (section 13-19) [1-4].The requirement as to safety of personnel at the work place, i.e., safety from personal injuries is contained in Part V of the Act sub-sections 20-44. Part VI has to do with welfare matters (sections 45-49) [5-7].

Health Hazards

The hazards arise from inhalation of dust and fumes in foundry environment. Silicosis, due to inhalation of silica dust of 0.5 to 3 μ size is the most serious health hazard. Prolong inhalation from a few months to about six years can reduce the breathing capacity of human lungs. The common symptoms of silicosis are; heavy breathing, persistent cough, chest pain and blood in the mucus. The lungs affected by silicosis are prone to tuberculosis infection, leading to silicon-tuberculosis. Silicosis is a pulmonary disease caused by inhalation of silica dust [8].

It is considered that there is no permanent cure of silicosis; therefore every effort must be made to avoid inhalation of silica dust. The practice of using silica flour or quartz powder as a parting compound in moulding has been banned in several countries. Inhalation of metallic vapour or fumes in melting and pouring station can lead to severe health problem. This can be serious hazard when metals with high vapour pressures are melted. In a case of the foundry shop of the Ajaokuta Steel Company, the most preventive measures are that fume exhaust systems near the melting unit which was installed and suitable gas masks ware also used by the workers. The foundry ventilation system can greatly reduce these health hazards. High ceiling with high wall ventilators can reduce accumulation of dust and fumes [3].

Noise in the Foundry

Noise plays an important part in everyday life and hearing is one of the two major senses with which we relate to our surroundings and communicate with fellow human, noise over a period of time can cause permanent and irreparable damage to hearing. Such damage develops slowly and is unlikely to be noticed from day to day but the accumulation of damage over the years, when combined with the normal reduction of hearing ability due to ageing, will eventually result in serious hearing difficult. Judgment of loudness of noise may be impaired-sufferers may ask people to speak up and then complain that they are shouting. People suffering from noise damaged hearing may also be afflicted by tinnitus (persistent noise in the ear), a particularly distressing ringing or buzzing sound in the ears which may be intermittent but in some cases can be continuous 24 h per day [5].

Noise pollution and its effects on man (worker)

The problem of human response to noise is complex and individual judgments with respect to loudness or noise tend to vary over a relativity wide range, and this has been a very serious problem in the foundry shop of ASCL.

An excessive noise tends to decrease the efficiency of workers.

(a) It can lead to loss of hearing.

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(b) Speech communicate among worker becomes difficult.

(c) The mental health of the worker may be affected.

The important sources of noise are grinders, the knock out grids, tumbling drums and ventilation in the fettling section for these reasons; the fettling section of the Ajaokuta Steel Company's foundry is built in a separate area from the foundry shop proper. The other sources of noise are compressed – air operated machines and tools, the cranes, the Electric Arc furnace during the process of melting, the mouldings machines are not left out in noise pollution others are the pneumatic rammers, the jolting machine and the Muller mixers [1-3].

Vibration at Work Place

Exposure to vibration at work through the use of hand held power tools and machinery such as chipping hammers, grinders, chain saws, pneumatic rammers, can give rise to an industrial disease known as the Hand Arm Vibration Syndrome (HAVS).

Its best known effect is Vibration White Finger (VWF) or Dead Hand, an important of the blood circulation in the hands and fingers, but damage to nerves and muscles can also occur. The symptoms include the balancing of the fingers, numbers, tingling and reduced grip strength and manual dexterity.

Vibration transmitted

Hand Transmitted Vibration (HTV) may also result in pain and stiffness in the hands, joints, wrists and elbows. Operators of vehicles such as tractors, fork lift trucks, overhead cranes and other machines, may be exposed to vibration received through other parts of the body, chiefly the seat. This Whole Body Vibration or (WBV) as it is called has been associated with the development of such disorder as lower back pain and spinal complaints. There is a risk that those exposed may have to retire early as a result of back problems.

Inform workers and control the risk

The workstation platform is the last stage at which vibration reduction can be applied where, practicable; the installation of carefully selected, ergonomically well designed, suspension seats can reduce vibration significantly. Mechanical and pneumatic suspension seats, which reduce the vibration exposure of the user, are available for many vehicles. In many cases they can be retro-fitted.

Person exposed to vibration and their supervisors can play an important part in minimizing vibration health risk. To participate effectively they will need to know:

a) About the hazard and the risk;

b) What action is being taken to minimize the risks?

c) How to recognize and report signs of injury.

d) What they can do to help.

If vibration exposure cannot be reduced to below recommended action levels by engineering controls, the use of management and ergonomic measures could be considered. Vibration exposure and associated risks to health could for example, be reduced by:

i. Improving the ergonomic design of workplaces, processes, equipment and tasks;

ii. Reducing the duration of exposure by job rotation.

iii. Avoiding uninterrupted exposure over a long period.

Atmospheric Pollution

The foundry operations burns significant portion of chemicals and particulate matter as released into the atmosphere. Although a vast number of substances contribute to air pollution, the most common air pollutants contain carbon, sulphur and nitrogen. These chemicals interact with one another and with ultraviolet radiation in heat emission from the melting process in dangerous ways that can cause serious health problems to the workers.

Industrial effluents

The organization of castings of either steel or cast iron products are associated with consumption of industrial quantities of charging and additional metals, fuels, oxygen, electric energy and water. Apart from the final cast products the products of castings are slag, exhaust gases, water from cooling systems and melting dust.

In general sense, the term industrial effluents covers all forms of industrial waste products, gaseous, liquid and solids. In a narrower sense, industrial effluent as result of factory production into streams or reservoirs.

Sources of atmospheric pollution

In the foundry shop of the Ajaokuta Steel Company, there are some types of furnaces that are used for the process of melting all kinds of steel and cast iron products. (Two 6T Electric Arc Furnaces, One 10T Induction Furnace, One 1T Induction Furnace, Centrifugal Casting Machine and 100 Kg Crucible Furnace). During the melting process large quantity of melting dust are emitted which worsen labour condition in the shop and is the source of atmospheric pollution. The melting dust formed during the melting process consists mainly of iron oxides, but in some cases non-ferrous metal may be present in it [6].

For instance the use of scrap containing zinc plated iron results in an elevated concentration of zinc in the dust, in the form the other sources of atmospheric pollution in the foundry shop include exhaust wastes from the charge materials, like pig iron, scrap, charcoal, limestone, graphite electrode and the Ferro-alloys, the stock yard, the teeming section and ladle preparation and inspection section also constitute to atmospheric pollution because of the gaseous waste discharge. Thus sulphur compounds, cyanide concentration, inorganic and organic synthetic chemical and melting dust are some of the main pollutions of the atmosphere from the foundry shop. These elements are very dangerous to the health and also constitute problems to the environment.

Methods of controlling atmospheric pollution

Many methods of controlling atmospheric pollution are available and practiced. The method of removal of pollutants after generation and before dispersion is the most useful for an effective control of air pollutant in the foundry shop. Dust collectors of the following main types are mostly employed for the purpose:

(a) Inertia dust collectors of this type can be divided into two groups.

(b) Dust collectors with settling chambers whose operation are based on gravitational settling of dust participles from the gas flow due to deceleration of the flow motion (which is attained by abrupt widening of the cross-section of a gas dust) the dust further moves to a scrubber underground and there the dust are filtered before the dust are sent through the provision for the distribution of the dust through the exhauster and to the atmosphere.

The gas flows around that body while solid particles carried by it impinge the body surface owing to their inertia and retained on it. The principle underlies the operation of a scrubber and cloths filters. Exhaust gases from the foundry melting process are often purified by scrubber of the Ventura-type.

Worker's Safety

Workers must be trained in personal safety measures. They must be trained to wear gloves, apron (asbestos heat resistant material) and suitable shoes, nose respiratory masks and helmets. The general tendency, however is to avoid wearing them, as they are uncomfortable in a hot environment, workers must wear suitable goggles in pouring and fettling section to avoid eye injuries. Workers are also prone to accidents during pouring while handling hot metal, improper lifting of heavy weights (in moulds for instance) in normal foundry shop like our can lead to spinal injuries. Proper and adequate lighting, particularly at moulding and pouring stations is essential to avoid accidents and to improve quality of work. A periodical review (at least once in three months) of accidents, safety measure and worker safety training program should be undertaken by foundry engineer.

Recommendations

a) Based on the data pertaining to the emissions it will be required to calculate the ground level concentrations for each component before installation. The obtained results must be analyzed and compared with the ones adopted in Nigeria air quality standards.

b) Machinery must be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level taking account of technical progress and the availability of means of reducing noise, in particular at source.

c) Health surveillance where there is a significant risk to the health of employee as a result of exposure to vibration at work a program of appropriate health surveillance might need to be provided in accordance with the requirements of management of health and safety a work regulations.

d) The key point for foundry management is that foundry equipment and machinery should in future be supplied with better and more detailed information on noise and vibration level than is currently the case allowing a positive and informed machinery purchasing policy to operate effectively.

e) The noise assessment should have advised the employer on which parts of his premises need to be marked as ear protection zone.

f) Ear protection must be suitable to protect against the level of noise to which employee are exposed.

g) The management has a duty to ensure the full and proper use of anything provided in complying with the regulation expect for ear protection provided for those employee exposed between the first and second action level.

h) The management also has a duty to ensure that anything provided under the regulations is properly maintained. This would cover, for example, ear protection, signs, indicating ear protection zones, noise control measures, e.g. noise enclosure, pneumatic silencers, etc.

i) The management of the Steel Company and that of Foundry shop must not compromise standard as regards the use of faulty equipment particularly the industrial exhauster as this could be inimical to the health and safety of the workers.

j) The inhalation of silica dust may also result too difficult of breathing, persistent cough, chest pain and blood in the mucus, therefore the management of ASCL and that of foundry shop should make a yearly chest x-ray to reveal the incidence of these diseases.

k) To reduce the air pollutants emissions to the atmosphere in the process of operation of the Foundry equipment the provision of the dust generating main process and auxiliary equipment with dust catchers is envisaged.

Conclusion

In conclusion, it is worthy to state here that foundry environment can be extremely harsh and the importance of maintaining noise control measures, controlling of atmospheric environment, minimizing the vibration effect on the workers and ear protection is crucial to continuing effective control of noise exposure. However, the subject of noise and its transmission is complex; hearing loss often goes unnoticed being confined initially to a limited frequency range, before becoming more severe and extensive. The management of foundry should make the right choices in its efforts to reduce generation of an exposure to noise and vibration at the shakeout, Electric Arc Furnace, Muller mixers and other equipment.

The characteristics feature of any modern production process is the generation of a considerable amount of various types of waste which differ from each other by physical and chemical properties, quantities, by the character of their influence on the environment and population. Part of these wastes may be used by own plant as in their production or in some other industries. The rest of the waste should be managed in a manner that would exclude or minimize as far as possible the adverse impact of waste on the environment. Finally, the management should envisage an air pollution monitoring system, to give recommendations on arrangement of stationary monitoring stations.

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