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Full Length Research Paper

Evaluation of occupational health hazards in Engineering Construction Company

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ABSTRACT

This study evaluated three occupational health hazards (Noise, Suspended particulate matters and heat radiation) associated with road Construction Company in Delta State. The three sections assessed were asphalt plant section, concrete section and workshop section. The method used was direct measurement of the hazards using Sound level meter for noise, Gravimetric sampler for Suspended particulate matters, and Mercury in glass thermometer for heat radiation. The results obtained from the analyses shown that the concrete section recorded the highest average noise level of 78.9dBA, while the asphalt plant section and workshop section had 60 dBA and 75dBA respectively; the three sections fell within FEPA/OSHA standard of 9OdBA for 8 hours work per day. The results of the suspended particulate matters indicates that the concrete section recorded 239.5µg/m^{3,} which fell below FEPA/OSHA standard of 230µg/m^3 for 8hours work per day, asphalt plant section with 105.66µg/m^3 and workshop section has 50.95µg/m^3 respectively. Finally, for heat radiation, the asphalt plant section recorded the highest value with 35.38°C, followed by workshop section with 34.33°C and. Concrete section has the least value of 32.55°C respectively, which fell within the FEPA/OSHA standard of 38°C in 8hours work per day. Among the three sections considered, it was concluded that workers at the concrete section are more exposed to noise hazards of 78.98dBA and suspended particulate matter of 239.5µg/m^3. Compared to workers at the asphalt plant and workshop sections. While, workers at the asphalt plant are more exposed to heat radiation of 35.38°C compared to workers at the concrete and workshop sections. Recommendations were made to improve on safety and health issues in other to reduce the level of exposure of the workers to these hazards.

Keywords: Occupational hazards, construction, noise, particulate matters and heat stress.

INTRODUCTION

Construction workers build, repair, maintain, renovate, modify and demolish houses, office buildings, temples, factories, hospitals, roads, bridges, tunnels, stadiums, docks, airports and more (Jeanne, 1998).

A large portion of construction workers are unskilled laborers; others are classified in any of several skilled trades (Bricklayers, concrete and masons, Carpenters, Electrician Elevator constructor, car Installers of drywall and ceilings, and steel workers, Maintenance workers, Operating engineers etc.) Construction workers are exposed to a wide variety of health hazards on the job. Exposure differs from trade to trade, from job to job, by the even by the hour. Exposure to any one hazard is typically intermittent and of short duration, but is likely to reoccur. A worker may not only encounter the primary hazards of his or her own job, but may also be exposed as a bystander to hazards produced by those who work nearby or upwind. This pattern of exposure is a consequence of having many employers with jobs of relatively short duration and working alongside workers in other trades that generate other hazards. The severity of each ha depends on the concentration and duration of exposure for that particular job. . Hazards present for workers in particular trades are typically of four classes: chemical, physical, biological and social (Jeanne, 1998).

Chemical hazards

Chemical hazards are often airborne and can appear as dusts, fumes, mists, vapors or gases; thus, exposure usually occurs by inhalation, although some airborne hazards may settle on and be absorbed through the intact skin (e.g., pesticides and some organic solvents). Chemical hazards also occur in liquid or semi-liquid state (e.g., glues or adhesives, tar) or as powders (e.g., dry cement). Skin contact with chemicals in this state can occur in addition to possible inhalation of the vapor resulting in systemic poisoning or contact dermatitis. Chemicals might also be ingested with food or water, or might be inhaled by smoking.

Several illnesses have been linked to the construction trades, among them:

- silicosis among sand blasters, tunnel builders and rock drill operators
- asbestosis (and other diseases caused by asbestos) among asbestos insulation workers, steam pipe fitters, building demolition workers and others
- bronchitis among welders
- skin allergies among masons and others who work with cement
- Neurologic disorders among painters and others exposed to organic solvents and lead.

Elevated death rates from cancer of the lung and respiratory tree have been found among asbestos insulation workers, roofers, welders and some woodworkers. Lead poisoning occurs among bridge rehabilitation workers and painters, and heat stress (from. wearing full-body protective suits) among hazardous-waste cleanup workers and roofers. White finger appears among some jackhammer operators and other workers who use vibrating drills (e.g., stopper drills among tunnellers). Alcoholism and other alcohol-related disease is more frequent than expected among construction workers. Specific occupational causes have not been identified, but it is possible that it is related to stress resulting from lack of control over employment prospects, heavy work demands or social isolation due to unstable working relationships (Jeanne, 1998).

Physical hazards

Physical hazards are present in every construction project. These hazards include noise, heat and cold, radiation, vibration and barometric pressure. Construction work often must be done in extreme heat or cold, in windy, rainy, snowy, or foggy weather or at night. Ionizing and non- ionizing radiation is encountered, as are extremes of barometric pressure (Ridley, 1994).

The machines that have transformed construction into an increasingly mechanized activity have also made it increasingly noisy. The sources of noise are engines of all kinds (e.g., on vehicles, air compressors and cranes), winches, rivet guns, nail guns, paint guns, pneumatic hammers, power saws, sanders, routers, planers, explosives and many more. Noise is present on demolition projects by the very activity of demolition. It affects not only the person operating a noise making machine, but all those close- by and not only causes noise-induced hearing loss, but also masks other sounds that are important communication and for communication and for safety.

Pneumatic hammers, many hand tools and earth-moving and other large mobile machines also subject workers to segmental and whole body vibration (Allan, 2005).

Heat and cold hazards arise primarily because a large portion construction work is conducted while exposed to the weather, the principle source of heat and cold hazard Roofers are exposed to the sun, often with no protection, and often must heat pots of tar, thus receiving both heavy radiant and convective heat loads in addition to metabolic heat from physical labor. Heavy equipment operators may sit beside a hot engine and work in an enclosed cab with windows and without ventilation. Those that work in an open cab with no roof have no protection from the sun. Workers in protective gear, such as that needed for removal of hazardous waste, may generate metabolic heat from hard physical labour and get little relief since they may be in an airtight suit. A shortage of potable water or shade contributes to heat stress as well. Strains and sprains are among the most common injuries among construction workers. These, and many chronically disabling musculoskeletal disorders (such as tendonitis, carpal tunnel syndrome and low-back pain) occur as a result of traumatic injury (David and Charles, 1989).

Biological hazards

Biological hazards are presented by exposure to infectious

Microorganisms, to toxic substances of biological origin or animal attacks. Excavation workers, for example, can develop histoplasmosis, an infection of the lung caused by a common soil ‘fungus. Since there is constant change in the composition of the labour force on any one project, individual workers come in contact with other workers and, as a consequence, may become infected with contagious diseases influenza or tuberculosis, for example. Workers may also be at risk of malaria, yellow fever or Lyme disease if work is conducted in areas where these organisms and their insect vectors are prevalent. Toxic substances of plant origin come from poison ivy, poison oak, poison sumac and nettles, all of which can cause skin eruptions. Some wood dusts are carcinogenic, and some (e.g., western red cedar) are allergenic. Attacks by animals are rare but may occur whenever a construction project disturbs them or encroaches on their habitat. This could include wasps, hornets, fire ants, snakes and many others. Underwater workers may be at risk from attack by sharks or other fish (Arthur and Eden, 1993).

Social hazards

Social hazards stem from the social organization of the industry. Employment is. intermittent and constantly changing, and control over many aspects of employment is limited because construction activity is dependent on many factors over which construction workers have no control, such as the state of an economy or the weather. Because of the same factors, there can be intense pressure to become more productive. Since the workforce is constantly changing, and with it the hours and location of work, and many projects require living in work camps away from home and family, construction work such as heavy workload, limited control and limited social support are the very factors associated with increased stress in other industries. These hazards are not unique to any trade, but are common to all construction workers in one way or another (Jeanne, 1998).

Background of Study

Three occupational health hazards (noise, particulate and heat) parameters were assessed in the construction company.

Noise

Noise pollution is excessive, displeasing human, animal or machine-created environmental noise that disrupts the activity or balance of human or animal life. The word noise comes from the Latin word nauseas, meaning seasickness.

The source of most outdoor noise worldwide is mainly construction and transportation systems, including motor vehicle noise, aircraft noise and rail noise. Poor urban planning may give rise to noise pollution, since side- by-side industrial and residential buildings can result in noise pollution in the residential area (Jeanne, 1998).

Health effects

Noise is unwanted sound that can damage physiological and psychological health. Noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects. Furthermore, stress and hypertension are the leading causes to health problems, whereas tinnitus can lead to forgetfulness, severe depression and at times panic attacks. Chronic exposure to noise may cause noise-induced hearing loss. Older males exposed to significant occupational noise demonstrate significantly reduced sensitivity than their non-exposed peers, though differences in hearing sensitivity decrease with time and two groups are indistinguishable age. A comparison of Maaban tribesmen, who were insignificantly exposed to transportation or industrial noise, to a typical U.S. population showed that chronic exposure to moderately high levels of environmental noise contributes hearing loss.

High noise levels can contribute to cardiovascular effects and exposure to moderately high levels during a single eight hour period causes a statistical rise in blood pressure of five to ten points and an increase in stress and vasoconstriction leading to the increased blood pressure noted above as well as to increased incidence of coronary artery disease. Noise pollution is also a cause of annoyance. A 2005 study by Spanish researchers found that in urban areas households are willing to pay approximately four Euros per decibel per year for noise reduction (Jeanne, 1998).

Wildlife health

Noise can have a. detrimental effect on animals, increasing the risk of death by changing the delicate balance in predator or prey detection and avoidance, and interfering the use of the sounds in communication especially in relation to reproduction and in navigation. Acoustic overexposure can lead to temporary or permanent loss of hearing (Jeanne, 1998).

An impact of noise on animal life is the reduction of usable habitat that noisy areas may cause, which in the case of endangered species may be part of the path to extinction. Noise pollution has caused the death of certain species of whales that beached themselves after being exposed to the loud sound of military sonar.

Noise also makes species communicate louder, which is called Lombard vocal response. Scientists and researchers have conducted experiments that show whales' song length is longer when submarine- detectors are on. If creatures do not 'speak' loud enough, their voice will be masked by anthropogenic sounds. These unheard voices might be warnings, finding of prey, or preparations of net-bubbling. When one species begins speaking louder, it. will mask other species' voice, causing the whole ecosystem to eventually speak louder (Jeanne, 1998).

Mitigation and control of noise

There are a variety of strategies for mitigating roadway noise including: use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design. An important factor in applying these strategies is a computer model for roadway noise, that is capable of addressing local topography, meteorology, traffic operations and hypothetical mitigation. Costs of building-in mitigation can be modest, provided these solutions are sought in the planning stage of a roadway project.

Exposure of workers to Industrial noise has been addressed since the 1930s. Changes include redesign of industrial equipment, shock mounting assemblies and physical barriers in the workplace (Suter, 1992).

Particulates Matters

Suspended particulate matter is a nearly ubiquitous in construction work Although particulate levels in North America and Western Europe rarely exceed 50 micrograms of particulate matter per cubic meter (µg/m^3) of air, levels in many Central and Eastern European cities and in many developing nations are much higher, often exceeding 100µg/m^3.

Particulate air pollution is a complex mixture of small and large particles of varying origin and chemical composition. Larger particles, ranging from about 2.5 microns to 100 microns in diameter, usually comprise smoke and dust from industrial processes, agriculture, construction, and road traffic, as 'well as plant pollen and other natural sources. Smaller particles those less than 2.5 microns in diameter generally come from combustion of fossil fuels. These particles include soot from vehicle exhaust, which is various chemical contaminant or metals, and fine sulfate and nitrate aerosols that form when $S0_2$ and nitrogen oxides condense in the atmosphere. The largest source of fine particles is coal-fired power plants, but auto and diesel exhaust are also prime contributors, especially along busy transportation corridors (Luigi, 1983).

The health effects of particulates are strongly linked to particle size. Small particles, such as those from fossil fuel combustion, are likely to be most dangerous, because they can be inhaled deeply into the lungs, settling in areas where the body's natural clearance mechanisms can't remove them. The constituents in small particulates also tend to be more chemically active and may be acidic as well and therefore more damaging. Numerous studies associate particulate pollution with acute changes in lung function and respiratory illness, this resulting in increased hospital admissions for respiratory disease and heart disease, school and job absences from respiratory infections, or aggravation of chronic conditions such as asthma and bronchitis. But the more demonstrative and sometimes controversial evidence comes from a number of recent epidemiological studies. Many of these studies have linked short-term increases in particulate levels, such as the ones that occur during pollution episodes, with immediate (within 24 hours) increases in mortality. This pollution- induced spike in the death rate ranges from 2 to 8 percent for every 50µg/m^3 increase in particulate levels. These basic findings have been replicated on several continents, in cities as widely divergent as Athens, São Paulo, Beijing, and Philadelphia. During major pollution events, such as those involving a 200-p increase in particulate levels, an expert panel at the World Health Organization (WHO) estimated that daily mortality rates could increase as much as 20 percent. These estimates should be viewed with caution, however, because some of those who die during a pollution episode were already sick, and the pollution may have hastened the death by only a few days.

In the aggregate, pollution-related effects like these can have a significant impact on community health. WHO has identified particulate pollution as one of the most important contributors to health within Europe, In those cities where data on particulates were available, WHO estimated that short- term pollution episodes accounted for 7 to 10 percent of all lower respiratory illnesses in children, with the number rising to 21 percent in the most polluted cities. Furthermore, 0.6 to 1.6 percent of deaths were attributable to short-term pollution events, climbing to 3.4 percent in the cities with the dirtiest air.

Health effects restricted to occasional episodes when pollutant levels are particularly high. Numerous studies suggest that health effects can occur at particulate levels that are at or below the levels permitted under national and international air quality standards. In fact, 4ccording to the WHO and other organizations, no adverse health effects, especially for the more susceptible populations.

This situation has prompted a vigorous debate about whether current air quality standards are sufficient to protect public health (Jeanne, 1998).

Heat Stress

"Heat stress" is the net (overall) heat burden on the body from the combination of the body heat generated white working, environmental sources (air temperature, humidity, air movement radiation from the sun or hot surfaces/sources) and clothing requirements. [Reference 2008 TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. (Cincinnati, 2008).

In Road construction work, foundries, steel mills, bakeries, smelters, glass factories, and furnaces, extremely hot or molten material is the main source of heat In outdoor occupations, such as construction, road repair, open-pit mining and agriculture, summer sunshine is the main source of heat In laundries, restaurant kitchens, and canneries, high humidity adds to the heat burden. In all instances, the cause of heat stress is a working environment which can potentially overwhelm the body's ability to deal with heat.

Most people feel comfortable when the air temperature is between 20℃ and 27℃ and the when relative humidity ranges from 35 to 60%. When air temperature or humidity is higher, people feel uncomfortable. Such situations do not cause harm as long as the body can adjust and cope with the additional heat.. Very hot environments can overwhelm the body's coping mechanisms leading to a variety of serious and possibly fatal conditions (Luigi, 1983).

How does the human body react to hot environments?

The healthy human body maintains its internal temperature around 37℃. Variations, usually of less than

1°C, occur with the time of the day, level of physical activity or emotional state. A change of body temperature exceeding 1°C occurs only during illness or when environmental conditions surpass the body ability to cope with extreme temperatures.

As the environment warms-up, the body tends to warm-up as well. The body's internal thermostat" maintains a constant inner body temperature by pumping more blood to the skin and by increasing sweat production. In this way, the body increases the rate of heat loss to balance the heat burden created by the environment. In a very hot environment, the rate of "heat gain" exceeds the rate of "heat loss" and the body temperature begins to rise. A rise in the body temperature results in heat illnesses (Taiwo, 2006).

How does the body control heat gain and heat loss?

The main source of heat gain is the body's own internal heat. Called metabolic heat, it is generated within the body by the biochemical processes that keep us alive and by the energy we use in physical activity. The body exchanges heat with its surroundings mainly through radiation, convection, and evaporation of sweat.

Radiation is the process by which the body gains heat from surrounding hot objects, such as hot metal, furnaces or steam pipes, and loses heat to cold objects, such as chilled metallic surfaces, without contact with them. No radiant heat gain or loss occurs when the temperature of surrounding objects is the same as the skin temperature (about 35°C).

Convection is the process by which the body exchanges heat with the surrounding air. The body gains heat from hot air and loses heat to cold air which comes in contact with the skin. Convective heat exchange increases with increasing air speed and increased differences between air and skin temperature.

Evaporation of sweat from the skin cools the body. Evaporation proceeds more quickly and the cooling effect is more pronounced with high wind speeds and low relative humidity. In hot and humid workplaces, the cooling of the body due to sweat evaporation is limited by the capacity of the ambient air to accept additional moisture. In hot and dry workplaces, the cooling due to sweat evaporation is limited by the amount of sweat produced by the body.

The body also exchanges small amounts of heat by conduction and breathing. By conduction, the body gains or loses heat when it comes into direct contact with hot or cold objects. Breathing exchanges heat because the respiratory system warms the inhaled air. When exhaled, this warmed air carries away some of the body's heat. However, the amount of heat exchanged through conduction and breathing is normally small enough to be ignored in assessing the heat load on the body.

What are the effects of hot environments on the body?

When the air temperature or humidity rises above the optimal ranges for comfort, problems can arise. The first effects are subjective in nature - they relate to how you feel. Exposure to more heat stress can cause physical problems which impair workers' efficiency and may cause adverse health effects. Some of the problems and their symptoms experienced in the temperature range between a comfortable zone (20C - 27°C) and the highest tolerable limits (for most people)

In moderately hot environments, the body "goes to work" to get rid of excess heat so it can maintain its normal body temperature. The heart rate increases to pump more blood through outer body parts and skin so that excess heat is lost to the environment, and sweating occurs. These changes impose additional demands on the body. Changes in blood flow and excessive sweating reduce a person's ability to do physical and mental work. Manual work produces additional metabolic heat and adds to the body heat burden. When the environmental temperature rises above 30°C, it may interfere with the performance of mental tasks.

Heat can also lead to accidents resulting from the slipperiness of sweaty palms and to accidental contact with hot surfaces. As a worker moves from a cold to a hot environment, fogging of eye glasses can briefly obscure vision, presenting a safety hazard.

Several studies comparing the heat tolerances of men and women have concluded that women are generally less heat tolerant than men. While this difference seems to diminish when such comparisons take into account cardiovascular fitness, body size and acclimatization, women have a lower sweat rate than men of equal fitness, size and acclimatization. Laboratory experiments have shown that women may be more tolerant of heat under humid conditions, but slightly less tolerant than men under dry conditions (Hartley, 1994).

What are the illnesses caused by heat exposure?

The risk of heat-related illness varies from person to person. A person" general health also influences how well the person adapts to heat (and cold). Those with extra weight often have trouble in hot situations as the body has difficulty maintaining a good heat balance Age (particularly for people about 45 years and older), poor general health, and a low level of fitness will make people more susceptible to feeling the extremes of heat.

Medical conditions can also increase how susceptible the body is: People with heart disease, high blood pressure, respiratory disease and uncontrolled diabetes may need 'to take special precautions. In addition, people with skin diseases and rashes may be more susceptible to heat. Substances both prescription or otherwise — can also have an impact on how people react to heat (Luigi, 1983).

Heat exposure causes the following illnesses:

Heat edema is swelling which generally occurs among people who are not acclimatized t working in hot conditions. Swelling is often most noticeable in the ankles. Recovery occurs after a day or two in a cool environment.

Heat rashes are tiny red spots on the skin which cause a prickling sensation during heat exposure. The spots are the result of inflammation caused when the ducts of sweat glands become plugged.

Heat cramps are sharp pains in the muscles that may occur alone or be combined with one of the other heat stress disorders. The cause is salt imbalance resulting from the failure to replace salt lost with sweat. Cramps most often occur when people drink large amounts of water without sufficient salt (electrolyte) replacement (Jeanne, 1998).

Heat exhaustion is caused by loss of body water and salt through excessive sweating. Signs and symptoms of heat exhaustion include: heavy sweating, weakness, dizziness, visual disturbances, intense thirst, nausea, headache, vomiting, diarrhea, muscle cramps, breathlessness, palpitations, tingling and numbness of the hands and feet. Recovery occurs after resting in a cool area and consuming cool salted drinks.

Heat syncope is heat-induced giddiness and fainting induced by temporarily insufficient flow of blood to the brain while a person is standing. It occurs mostly among unacclimatized people. It is caused by the Loss of body fluids through sweating, and by lowered blood pressure due to pooling of blood in the legs. Recovery is rapid after rest in a cool area.

Heat stroke and hyperpyrexia (elevated body temperature) are the most serious types of heat illnesses. Signs of heat stroke include body temperature often greater than 41℃, and complete or partial loss of consciousness. The signs of heat hyperpyrexia are similar except that the skin remains moist. Sweating is not a good symptom of heat stress as there are two types of heat stroke - “classical” where there is little or no sweating (usually occurs in children, persons who are chronically ill, and the elderly), and “exertional” where body tempera hire rises because of strenuous exercise or work and sweating is usually present.

Heat stroke and heat hyperpyrexia require immediate first aid and medical attention. Delayed treatment may result in damage to the brain, kidneys and heart. Treatment may involve removal of the victim’s clothing and spraying the body with cold water. Fanning increases evaporation and further cools the body. Immersing the victim in cold water more efficiently cools the body but it can result in harmful overcooling which can interfere with vital brain functions so it must only he done under close medical supervision (Jeanne, 1998).

What are the illnesses caused by long-term (chronic) heat exposure?

Certain kidney, liver, heart digestive system, central nervous system and skin illnesses are thought by some researchers to be linked to long-term heat exposure. However, the evidence supporting these associations is not conclusive. Chronic heat exhaustion, sleep disturbances and susceptibility to minor injuries and sicknesses have all been attributed to the possible effects of prolonged exposure to heat. The lens of the eye is particularly vulnerable to radiation produced by red-hot metallic objects (infrared radiation) because it has no heat sensors and lacks blood vessels to carry heat away. Glass blowers and furnace-men have developed cataracts after many years of exposure to radiation from hot objects. Foundry workers, blacksmiths and oven operators are also exposed to possibly eye-damaging infrared radiation (Jeanne, 1998).

A possible link between heat exposure and reproductive problems has been suggested. Data from laboratory experiments on animals have shown that heat stress may adversely affect the reproductive function of males and females. Exposure of males resulted hi reduced rate of conception. Exposure of females caused disruption of the reproductive cycle until they became acclimatized to heat. When animals are simultaneously exposed to heat and toxic chemicals, the influence of heat exposure seems to accelerate the chemical reactivity. In men, repeatedly raising testicular temperature 3 to 5℃ decreases sperm counts. There is no conclusive evidence of reduced fertility among heat-exposed women. There are no adequate data from which conclusions can be drawn regarding the reproductive effects of occupational heat exposure at currently accepted exposure limits.

Laboratory study of warm-blooded animals has shown that exposure of the pregnant females to hyperthermia may result in a high incidence of embryo deaths and malformations of the head and the central nervous system (CNS). There is no conclusive evidence of teratogenic effects of hyperthermia in humans. The NIOSH criteria document (1986) recommends that a pregnant worker’s body temperature should not exceed 39- 39.5℃ during the first trimester of pregnancy (Jeanne, 1998).

MATERIAL AND METHODOLOGY

MATERIAL

This work is an experimental research with survey on hazards associated with engineering construction work. The instruments used to acquire the relevant data collection for this study include: Gravimetric suspended particulate matter sampler, Sound level meter, Mercury in glass thermometer and Measuring tape.

Description of Gravimetric Suspended Particulate Matter Sampler

The MRE 113A gravimetric suspended particulate matter sampler is a sell-powered portable instrument for sampling of suspended particulate matter (SPM), where a rechargeable 7.5V, 9OmA battery drives, a governed motor and a pump to draw 2.5 1/rn in of SPM laden air through a horizontal elutriator. The coarse particles in the suspended particulate matter laden air settle down by gravity in the elutriator while the harmful fine particles size in the respirable size range are collected in a filter 55mm in diameter glass fiber or a membrane filters in a light aluminum holder are used for sampling.

The amount of air in litres sucked during sampling is recorded on a counter. The counter is resettable to zero by the knurled knob through the door of the instrument case. The pump is diaphragm type and is fitted with two flap vales and a flow smoothened at the outlet A flow meter is connected to the output side of the pump. The counter and the flow meter are readable through small windows fitted in the side of the instrument. The window of the instrument has three horizontal lines engraved, the middle line representing the correct flow rate of 2.51/min.

Description of Sound Level Meter

The sound level meter has been designed for quick noise surveys and sound level checks. Despite its excellent features, it is very easy to use. It measures and displays sound pressure levels on its decibel (dB) from 30 to 130dB. The user selectable features include Frequency Weighting (‘A’ and ‘C’), Response Time (Fast and slow), Max Hold, and Max/Mm recording. Other meter’s description include: Microphone, LCD Display, On- Off Button, A/C Weighting, Range Selector Button, Windscreen, Calibration Adjustment, AC analog Output Jack.

Description of Mercury in Glass Theremometer

The mercury in glass thermometer consists of a glass tube with a small but uniform bore, a reservoir or bulb at the bottom, and a sealed end at the top. The bulb and part of the tube are filled with mercury. The mercury in glass thermometer is easy to make, easy to read, cheap, reliable, convenient and it requires little or no maintenance.

METHODOLOGY

In order to acquire comprehensive information, instruments that capable of taking direct reading of occupational hazards and secondary source of information were used for this research work. In the determination of the hazards (noise, suspended particulate matter and heat), Sound level meter, Gravimetric SPM sampler and Mercury in glass thermometer were used to determine the noise level, respectively in three (3) areas (Asphalt Plant Section, Concrete Section and Workshop Section).

Mode of Operation! Application of Sound Level Meter

The Extech 407730 Digital Sound level meter was used for this research work. The batteries were properly inserted after fixing the microphone head.

The sampling instrument was then placed in the location where the noise, level is to be determined (i.e. a distance of 10 meters) at a height, approximately equal to the hearing level of the workers and switched on with “A” weighting selected and the “S” button pressed to select the slow response in order to monitor a sound source that has a consistent noises level or to average quickly changing levels and the reading displayed on’ the meter were recorded in decibel. The same method was used when the distance was increased and also at the other sections.

Mode of Operation/Application of Gravimetric Suspended Particulate Matter Sampler

The MRE 113A Gravimetric SPM sampler was used for this research work. A clean filter paper was selected and mounted in the filter holder. The assembly was then weighed in an accurate balance having a sensitivity of 0.1mg. It was inserted in the sampler and tightened in position.

The battery was charged fully by the charger provided. The charged battery was inserted in the instrument and the counter was set to zero, The sampling instrument was then placed in the location where the breathable 5PM concentration is to be determined (i.e. a distance of 10 meters0 at a height approximately equal to the breathing level of the workers and switched on for 10 mins. A lower rate of sampling indicates overloading o the filter paper with 5PM or discharged battery.

After the sampling was over, the volume of air sampled was noted and the SPM-laden filter paper was removed from the Instrument along with it (older and weighed. The difference in weight in mg. divided by the volume of t3h air sampled in m gives the SPM concentration in mg/m^3.

The same method was applicable to the increase in distance and at the other sections.

Mode of Operation/Application of Mercury in Glass Thermometer

The mercury in glass thermometer was hand-held very close to the work zone for five minutes duration at a specific distance (I.e. 10m, 20m, 30m, and 40m). The temperature were taken and recorded.

Table 1. Results of Noise Exposure Level from Asphalt Plant Section, Concrete Section and Workshop Section to Workers.

Section	Hazards	Distance from the noise source (m)	Noise level obtained (dBA)	Average Noise Level obtained (dBA)	Work Duration (in hrs)	FEPA/OSHA permissible Exposure limit (dBA)
		10	78.4			
Asphalt	Noise	20	64.2			
Plant		30	52.0	60.75	8	80 – 90
		40	48.4			
Concrete	Noise	10	95.0			
		20	88.4			
		30	74.5	78.98	8	80 – 90
		40	58.0			
Work-shop	Noise	10	68.4			
		20	70.0	60.75	8	80 – 90
		30	56.2			
		40	48.4			

Table 2. Results of Suspended Particulate Matters Exposure Level from Asphalt Plant Section, Concrete Section, and Workshop Section to Workers.

Section	Hazards	Distance from the SPM source (m) in 10mins	SPM level obtained (μg/m^3)	Average SPM Level obtained in (μg/m^3)	Work Duration (in hrs)	FEPA/OSHA permissible Exposure limit (μg/m^3)
		10	184.0			
Asphalt Plant	SPM	20	104.0			
		30	74.5	105.66	8	150 – 230
		40	60.2			
Concrete	SPM	10	340			
		20	234			
		30	208	239.25	8	150 – 230
		40	174			
Workshop	SPM	10	74.6			
		20	50.4	50.95	8	150 – 230
		30	45.6			
		40	33.0			

The same method was applicable to other sections.

RESULTS

Three sections (Asphalt plant, Concrete and Workshop) of the Construction Company were assessed and the hazards evaluated include, Noise, Suspended particulate matters and Heat. The data obtained from the research work were tabulated in table1- 3 respectively.

In table 1, The concrete section has the highest average noise level of 78.9SdBA, while asphalt plant and workshop sections have the least values of 60.75dBA each which is below the FEPA/OSHA standard of 80-90 dBA for 8 hours work per day. The distance from the source of noise is inversely proportional to the noise exposure level.

Table 2, shows that the concrete section recorded the highest average SPM level of 239.25μg/m^3, which fell below the FEPA/OSHA standard of 230 for 8 hours work per day, while the workshop section has the lowest value of 50.95μg/m^3.. The value of the exposure level decreases as the distance from the sources of SPM increases.

The Asphalt plant section recorded the highest average heat exposure level of 35.38℃, which is fell within FEPA/OSHA standard of 38℃ for 8 hours work per day in table 3, while the concrete section has the lowest value of 32.25℃. The value of the heat exposure level decreases as the distance from the sources of heat increases.

DISCUSSION OF RESULTS

From table I. Three (3) sections were considered (Asphalt plant, Concrete, and workshop sections), the noise exposure levels were compared. At 10 away from the

Table 3. Results of Heat Exposure Level from Asphalt Plant Section, Concrete Section and Workshop Section to Workers.

Section	**Hazards**	**Distance from the heat source (m) in 5mins**	**Heat level obtained (^{0}C)**	**Average Heat Level obtained (^{0}C)**	Work Duration (in hrs)	**FEPA/OSHA Permissible Exposure Limit (^{0}C)**
Asphalt Plant	Heat Radiation	10	39.1			
		20	37.5	35.38	8	38
		30	34.1			
		40	30.8			
Concrete	Heat radiation	10	36.6			
		20	34.3	32.25	8	38
		30	32.8			
		40	29.4			
Workshop	Heat Radiation	10	36.7			
		20	35.0	34.33	8	38
		30	33.6			
		40	31.9			

noise source, employees working at the concrete section were exposed to 95dBA, which is above the FEPA/OSHA standard of 9OdBA 8 hours work per day. Among these three sections, the concrete section has the highest average noise exposure level of 78.98dBA; this is followed by Asphalt plant and workshop sections having the same average noise exposure of 60.75dBA each. It was observed that there was relationship between distance of a noise exposure, which shown that the farther the distance from the source of noise, the less the effect of exposure.

Table 2, indicates that at 10m and 20m away from the SPM source, employees working at the concrete section were exposed to 340µg/m^3 and 234µg/m^3 SPM respectively, which fell below FEPA/OSHA permissible exposure limit for 8 hours work per day. The concrete section has the highest average suspended particulate matter exposure level of 239.25µg/m^3 which also fell below OSHA/FEPA standard of 230µg/m$^{3.}$ This followed by Asphalt plant section with 105.66µg/m^{3,} while the workshop section recorded the lowest of 6O.95µg/m$^{3.}$ This implies that concrete section's workers are more exposed to suspended particulate matter than workers at the asphalt plant and workshop sections. It was observed that the distance from the SPM source is inversely proportional to the SPM exposure level.

From table 3, Asphalt plant workers working at 10m away from the heat source recorded heat exposure level of 39°C which is above the OSHA/FEPA standard of 38°C of 8 hours work per day. The average heat exposure level that workers at the asphalt plant were exposed to was 35.38°C, this is closely followed by workshop section with 34.33°C while the concrete section recorded 32.25°C. *Among the three sections considered, it was concluded that workers at the concrete section are more exposed to noise hazards of 78.98dBA and suspended particulate matter of 239.5µg/m^3. Compared to workers at the asphalt plant and workshop sections. While, workers at the asphalt plant are more exposed to heat radiation of 35.38°C compared to workers at the concrete and workshop sections. Recommendations were made to improve on safety and health issues in other to reduce the level of exposure of the workers to these hazards.*

CONCLUSION

Undoubtedly, workers working in the asphalt plant were exposed to occupational health hazards from the results available, ie.at the concrete section they are more prone to noise hazards and suspended particulate matters compare to workers at the Asphalt plant and workshop sections, even though the average noise exposure level fell below the FEPA/OSHA permissible exposure limit of 9OdBA in 8 hours work per day. While that of suspended particulate matters was fell below the permissible exposure limit of 230µg/m^3 8 hours work per day.

Asphalt plant workers are more prone to heat hazards compare to workers at the concrete and workshop section and this is closely followed by workers at the workshop sections, though the average level of exposure to these hazard still fell below the OSHA/FEPA standard of 9OdBA 8 hours' work per day. However, it was deduced that the management of the company is effective in the area of Noise and Heat hazards. The health effect on workers in both Asphalt plant and workshop sections is low compare to concrete section.

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