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Impact of Industrial Sanitation in the Prevention of Occupational Health Problems among Factory Workers in Niger Flour Mill Industry in Calabar Municipality in Cross River State, Nigeria

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Abstract
The study explored impact of industrial sanitation in the prevention of occupational health problems among factory workers in Niger Flour Mill Industry in Calabar Municipality in Cross River State, Nigeria. Three (3) hypotheses were formulated to direct the investigation. Two Hundred (200) respondents were drawn from the population of workers in various departments of the industry for the study. Data were collected from the sampled workers using well designed and validated structured questionnaire titled "Industrial sanitation and prevention of occupational health problem questionnaire (ISPOHPQ)" Data collected were subjected to statistical analysis using Chi-square (X^2) test statistics. Results obtained indicated a positive significant relationship between the industrial sanitation in terms of solid wastes, liquid wastes, and gaseous waste management and health of workers in the industry. It was concluded that proper industrial sanitation through sound solid wastes, liquid wastes, and gaseous waste management lead to improved health and well-being of workers, especially in Niger Flour Mill Industry. From this finding, it was recommended among others that the management of the industries should ensure that effective sanitation is put in place, especially in the area of solid, liquid, and gaseous wastes management so as to improve the health of workers in the industry.

Keywords: Industrial Sanitation, Solid Wastes Materials, Liquid Wastes, Gaseous Waste, Occupation, Health, Workers

Introduction

Sanitation is a very important index in the general health of any living person on earth. A good sanitation promotes a healthy environment and healthy wellbeing of any person and a poor sanitation affects the environment and the health of a person. Industries are business enterprises that are supposed to produced goods and services to the growth of man, but in this process hazardous wastes are generated, these have to be well managed with good sanitation practices and ethics to avoid injury to man; the workers and the environment as a whole (Peter, 2016) [12]. Calabar Municipality is a cosmopolitan city with industries such as Niger Flour Mills, Unicem Cement Industries, and many industries in the Export Processing Zone of Calabar. These industries produce waste in the course of their operation. The total work surrounding the environment has to be kept clean with good sanitation practices like proper administration and management of waste generated, be it the solid, gaseous and liquid form to avoid occupational health problem to the factory workers (Anderson, 2014).

All industrial establishments cannot do without surrounding and environment, without goods and services. Sanitation is designed, to protect public health from injury or damage. Industrial sanitation is the situation of maintaining clean environment in the process of operation of an industry to protect the health of the workers and the public from injury, The waste generated by industries as raw material waste is in the form of solid and gaseous state, gaseous form are the smoke-emission in the case of Niger Flour Mill, Calabar Municipality. Those that are toxic in nature has to be managed properly. The machine used in production also generates smoke and heat that are injurious to the health of the workers. All these constitute waste and are to be controlled sanitarily. World Health Organization (2011) asserted that the occupational health of a worker is based on a proper and sustainable sanitation practices and management in a working environment. A good sanitation practices and management in a work place promotes good health and efficiency of the workers and improved productivity.

Poor management of sanitation in a factory can result to various infections like cancer of the lungs, rashes in the body, weakness, burnt and heart failure (Turner, 2013) [16]. A good sanitation education is necessary in the protection and prevention of workplace diseases and hazard. In an industry such as Niger Flour Mill, they should follow the condition and set standard of safety first. Occupational health is very important to man, it goes with safety in a work place. It is the prevention among workers of health effects caused by their working conditions, promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation in the world and the protection of workers in their employment from risk resulting from factory adverse to good health. If this condition, a good health is obtained and achieved then there is job satisfaction input and output productivity, and safety (World Health Organization, 2010). In the light of these, the researcher intend to investigate how industrial sanitation impact positively. Or negatively in the prevention of occupational health problems among factory workers in Calabar Municipality using Niger Flour Mill as a case study.

Solid waste management and human health

Since prehistoric and historic eras, the human species has indisputable demonstrated the ability to influence significantly the biosphere, and as such as evolved from being just a member of certain ecosystems to that of a partner in all ecosystems. This has been enhanced by attributes considered as being specifically human such as the possession of a soul, use of tools, speech and construction of symbols which affords human a unique position among other organisms (Fellman and Gretics, 2015) [5].

The enhanced anatomical and mental features of humans have aided them to compete more successfully for their requirements than other organisms in the environments. They are this capable of exerting greater effect on the environment and its resources than other organisms in the ecosystem. Humans are numerically superiors among single species of large mammals. They occupy the highest trophic levels in the ecosystem and exploit all other trophic levels for their nutritive and other requirement. The exploitation lead to the generation of solid waste in all sphere of economic activities including the industries (Anderson and Burnham, 2012) [2]. Industrial waste matters refer to useless, unwanted or thrown away materials. It is often irritating to behold, sometimes stinking. It serves as the abode for the breeding of mosquitoes which in effect when it attacks man causes malaria to human health or human being. These waste materials are prevalent in Niger Flour Mill Industry in Calabar Municipality. Ehrlich (2002) [4] opined that dumped waste is prevalent in the tropical and coastal town industries, and the study area belongs to this zone.

Solid industrial wastes are domestic, commercial, industrial and agricultural wastes that are primarily toxic or non-toxic. Waste management is a serious issue to human health and factory workers. Virtually, everybody is guilty of releasing one form of waste or the other. Anderson and Burnham (2012) [2] observed that during the 1st century of the industrial revolution, the volume of waste produced in Nigeria was relatively small and could be handled by a concept of dilute and dispose. Factories were located near rivers because the water provided a number of benefits, including easy transport of materials by boat, sufficient water for processing and cooking and easy disposal of waste into river. With few factories and a spare population, this method seemed to remove the waste from the environment. Unfortunately, as industrial and urban areas expanded, the concept of dilute and dispose became inadequate and a new concept known as concentrate and contain became popular, it became apparent, however that concentrate and contain was and is not always achieved. Waste disposal sites are necessary if the society is to function smoothly, waste should not be dumped openly near the factory site to avoid the breeding of insects like mosquitoes, cockroaches, snakes, rats, lizards etc. Perhaps, the largest waste disposal site in the world is located on a 3,706 acre site on State Island, New York, United States of America.

National Blueprint on Municipal Solid Waste Management in Nigeria (2010) [8] see waste management as comprising of the collection, transport, storage, treatment, recovery and disposal of waste. Before the Nigeria Independence in 1960, and a few years after independence, what constituted waste was mostly biodegradable and did not require much effort to manage than to take it out of sight and disposed into forest and nature would decompose it. However, with the advent of modernization and increasing human population, socio-economic activities became more complex, so did the type of waste generated. To examine the problems of waste management, the colonial administration introduced bye-laws on waste management enforced by health inspectors. That effort appeared adequate for the period. Soon after independence, however, the volume and complexity of the wastes generated especially in the urban areas of Nigeria with many industries needs a more demanding system of legislation (Sridhar and Adeoye, 2013) [14]. Waste problems become more manifest during the boom of the 1970s when the economy of Nigeria witnessed an unprecedented growth occasioned by high levels of industrial activities. This period saw a number of policy statements used and draft legislation proposed but not promulgated into law (National Policy on the Environment, 2002) [9]. Sule (2012) carried out a study on waste in 1991 and observed that solid industrial waste management was a serious problem in urban centres of Nigeria. His analyses were that factory contributing to failure of waste management are social, cultural, economic and technological in nature. The solid industrial waste in Nigeria was generated at the rate of about 0.43kg per head per day. While open dumping is practiced all over Nigeria, attempts by the Federal Government to ensure other viable methods of hygienic disposal by the legislation and sustain the disposal, to prevent outbreak of malaria so it do not yield a hundred percent success.

Liquids waste disposal and the human health

Recycling of industrial wastes, be it solid, liquid or gaseous is regularly carried out by the multinational industries in the private or informal sector and was not brought into the mainstream of waste management. In the early 1970s, Lagos State of Nigeria acquired incinerators that were wrongly cited and never used because of the prohibitive cost. They were sold out almost three decades later. Composting which was mostly practiced at community or individual level was abandoned after crude oil discovery in the 1960s. Several studies carried out was for the adoption of sustainable processes to manage wastes instead of disposal to open dumped sites closed to factory premises. Recycling of liquid wastes in industries is sustainable in nature and brought about good health among factory workers (Igbinokpogie,

2010) [6].

In the last two decades, there was renewed interest in converting liquid wastes to good drinking water instead of disposing them indiscriminately to cause hazard to human health especially factory workers in the industries that produces this waste. Several studies were carried out at household level, community level and by 1995, the interest had spread to the national level with the successful build of a demonstration organo-mineral fertilizer plant of Ibadan. This was initiated by the sustainable Ibadan project with technical advice from the University of Ibadan (Sridhar, 2010). Studies carried out have shown that factory workers who ignore safety procedure in their working environment are more likely to risk and hazard than those who work according to safety rules. The rules are to use safety equipment which can help. To prevent hazard that emanate from industrial waste (Anderson and Burnham, 2012) [2].

World Health Organization (2010) calls on the employers of labour in industries to provide safety standard and enforce it in the work place. Workers should be given environmental health education and awareness. Occupational health is aimed at identifying and protecting workers from hazard that may occur at the place of work, offer adequate advice and rehabilitation services from workers who are injured and those with psychological problems and to ensure that workers get maximum, physical and mental adjustment to the work they carry out and for which they are suited (Scotney, 2014) [13]. There are different categories of occupational health hazards. These are physical, chemical, biological, mechanical, economical and psychological factors. Occupational disease can be prevented because they are caused by environmental agents which can controlled, this is the reason occupational health laws are formulated, implemented and enforced (National Blueprint on Municipal Solid Waste Management in Nigeria, 2010) [8].

Studies have shown that a prolong exposure to machine loud noise can lead to hearing damage. Machines in Niger Flour Mills Industry are heavy machines with high noise hazard. Apart from risk of noise, liquid waste produced by the machines can cause loss of vision, dizziness, paralysis, aseptic-necrosis of the bone and death. It can also cause prickly heat, depletion due to excess unit loss of sweat, heat exhaustion, and vascular abnormalities (Arufor, 2010) [3]. Poisonous gases effluent in industries in the form of ammonia, carbon dioxide, carbon monoxide, hydrogen sulphide, chlorine oxides etc. are risk to factory workers in Flour Mill Industry and this include irritation of the skin, mucous membrane of the eyes, corneal ulceration and blindness etc. All factory workers have to undergo periodic medical examination (Igbinokpogie, 2010) [6].

Discharge of gaseous effluents and human health

Poor industrial sanitation is as a result of insensitivity of industries especially in developing and third world nations. Sanitation is the science and act of a factory maintaining a high level of cleanliness in the general operation of a factory to the health of the workers, the surrounding and the environment as a whole (Scotney, 2014) [13]. Industries in the world over, generate a lot of wastes in the course of their operation. Niger Flour Mill is not an exception. Niger Flour Mill generates wastes and disposed them in the open dump site. Sanitation generally in the study industry do not meet the standard stipulated by the World Health Organization (2010), asserts that factory premises must be kept clean at all time. Solid, liquid and gaseous wastes must be managed according to international standard-mandate. Waste bin should be provided and placed in strategic locations in factories for workers to dumped paper and non-heavy waste into them.

Studies carried out by Lucas (2008) [7] observed that there is the prevalence of poor industrial sanitation among industries especially in developing and third world countries in a study to assess the level of sanitation management in six industries within South-South geo-political zone of Nigeria which Niger Flour Mill belongs. Poor industrial sanitation causes a lot of occupational health problems to the workers in factories in the case of Niger Flour Mill as a flour manufacturing company, the gaseous wastes generated if not well managed causes cancer of the lungs, heart failure, rashes, outbreak of epidemic like malaria and many other diseases associated with it (World Health Organization, 2010).The concepts of occupational health as defined by World Health Organization (2010) are the placing and maintenance of the workers in an occupational environment adopted to his physiological equipment; the promotion and maintenance of highest degree of physical, mental and social wellbeing of workers in all occupations, and the protections of workers in the employment from risk adverse to health. The concepts of health promotion are related to individual lifestyle and those of physical activities and the social relationship in the work places. An unprompted work condition calls for tiredness of workers, therefore improvement in work relationship, proper planning and a prompted social condition is desirable in attaining the objective of occupational health (Scotney, 2014) [13].

Preventive health involves education and counselling service, screening immunization and other intervention measures on the health of workers. Health education creates awareness in workers with respect to work related hazard, precautionary methods and safety measures in the work environment aimed at protecting the individual in the process of his work and preventing, controlling accident in the work place. Awareness therefore guides against industrial accident. Prevention of accident is a part of good management which both management and workers should join hands to achieve the task of protecting workers. Occupational health will continue to fight a losing battle if the protection of workers with appropriate measures is neglected (Arufor, 2010) [3]. Protective measures should be adopted to prevent infection resulting from poor sanitation in a factory. Protective equipment should be used in a work place. Many industries ignore sanitation standard thus causing hazard like heart failure, cancer of the lungs, body rashes, epidemic from mosquitoes attack and other illness (World Health Organization, 2010).

Studies has shown that a prolong exposure to machine loud noise can lead to hearing damage. Machines in Niger Flour Mills Industry are heavy machines with high noise especially the manufacturing machines and this lead to risk of noise hazard. Apart from risk of noise, liquid waste produced by the machines can cause loss of vision, dizziness, paralysis, aseptic necrosis of the bone and death. Poisonous gases effluent in industries in the form of ammonia, carbon dioxide, carbon monoxide, hydrogen sulphide, chlorine oxides etc. are risk to factory workers. The efforts include irritation of the skin, mucous membrane of the eyes, corneal ulceration and blindness etc. Factory workers have to undergo periodic medical examination

(Igbinokpogie, 2010) [6]. Table 1 and 2respectively show the impact of occupational health problems on human and classification of various types of occupational hazard.

Methodology

This study was conducted in Niger Flour Mill Industry in Calabar Municipality in Cross River State, Nigeria. Calabar Metropolis being the seat of Cross River State capital houses many industries notable among which is Niger Flour Mill Industry. Calabar Municipality is located in mangrove ecological zone of the state at the edge of the Bight of Bonny. Workers of Niger Flour Mill Industry constitute the population of the study. The sample of 200 workers drawn from various departments of the industry was used for the study. This was drawn using systematic sampling technique taking into consideration all variables of interest in the factory.

A 20 items structured questionnaire titled "Industrial sanitation and prevention of occupational health problem questionnaire (ISPOHPQ)" was designed and used for collecting data from the sampled factory workers. The questionnaire had 2 sections A and B. Section A was made up of 6 demographic variables while section B consisted of 14 items of closed-ended types that measured the three main variables used in the study, which included solid wastes, liquid wastes, and gaseous waste management and health of workers.

A pilot test was carried out using 25 workers, who were not part of the study's sample, to establish the reliability of the instrument. Cronbach Alpha reliability statistics was used to establish reliability estimate and the result ranged from 0.72 to 0.85 figures which adjudged satisfactory and confirmed that the instrument was reliable in realizing the study's objectives. Data collection was done through direct administration of the instrument personally by the researcher with the aid of research two assistants recruited for the study. This measure yielded 100% percent returns rate. Chi-square statistics was used for the analysis of data collected for the study.

Analysis of Results

Hypothesis One: There is no significant relationship between solid waste management and the health of workers in Niger Flour Mill Industry, Calabar. The independent variable in this hypothesis is solid waste management while the dependent variable is health of workers. The hypothesis was tested using Chi-square statistics since the variables were measured on a discrete scale. The result is shown Table 1.

Table 1: Shows the relationship between solid waste management and workers' health

Solid Waste Management Practice	Health of Workers		Total	X^2tab	X^2cal
	Not affected	Affected			
Good	62(31)	18(9)	80		
Poor	28(14)	92(46)	120	3.841	56.9
Total	90 (45)	110 (55)	200		

$$X^2 = \frac{(OF - EF}{EF})$$

Table 1 showed data analysis on the hypothesis which holds that there is no significant relationship between solid waste management and the health of workers in Niger Flour Mill Industry, Calabar. Two hundred (200) respondents were studied out of which 80(40%) have adopted good solid waste management practices while 120(60%) do not. Of the 80(40%) who adopted good solid waste management practices, majority of them 62(31%) reported that their health status was not affected with only 18(9%) who reported that their health status was negatively affected.

On the other hand, out of the 120(60%) who adopted poor solid waste management practices, majority of them 92(46%) reported that their health status was negatively affected with only 28(14%) who reported that their health status was not affected. The statistical test of the hypothesis showed that X^2_{cal} = 56.9> X^2_{tab} at α, 0.05 = 3.841. We therefore reject null (H_o) and conclude that there is a significant relationship between solid waste management practices and the health of workers in Niger Flour Mill Industry. The positive relationship means that as solid waste management practices improve, the health status of workers also improves and vice versa.

Hypothesis Two: There is no significant relationship between the proper disposal of liquid waste and the health of the workers in Niger Flour Mill Industry, Calabar. The independent variable in this hypothesis is liquid waste Management disposal while the dependent variable is health of workers. The hypothesis was tested using Chi-square statistics since the variables were measured on a discrete scale. The result is shown Table 2.

Table 2: Shows the relationship between liquid waste Management disposal and the health of factory workers

Liquid Waste Management Practice	Health of Workers		Total	X^2tab	X^2cal
	Not affected	Affected			
Good	64(32)	20(10)	84		
Poor	26(13)	90(45)	116	3.841	56.9
Total	90 (45)	110 (55)	200		

Table 2 showed data analysis on the hypothesis which holds that there is no significant relationship between disposal of liquid waste and the health of workers in Niger Flour Mill Industry, Calabar. Two hundred (200) respondents were studied out of which 84(42%) adopted good liquid waste management practices while 116(58%) do not. Of the 84(42%) who adopted good liquid waste management practices, majority of them 64(321%) reported that their health status was not affected with only 20(10%) who reported that their health status was negatively affected.

On the other hand, out of the 116(58%) who adopted poor liquid waste management practices, majority of them 90(45%) reported that their health status was negatively affected with only 26(13%) who reported that their health status was not affected. The statistical test of the hypothesis showed that X^2_{cal} = 56.9> X^2_{tab} at α, 0.05 = 3.841. We therefore reject null (H_o) and conclude that there is a significant relationship between liquid waste management practices and the health of workers in Niger Flour Mill Industry. The positive relationship means that as liquid waste management practices improve, the health status of workers also improve and vice versa.

Hypothesis three: There is no significant relationship between discharge of gaseous effluents and the health of workers in Niger Flour Mill Industry, Calabar. The independent variable in this hypothesis is discharge of gaseous effluents while the dependent variable is health of

workers. The hypothesis was tested using Chi-square statistics since the variables were measured on a discrete scale. The result is shown Table 3.

Table 3: Shows the relationship between discharge of gaseous effluents and the health of factory workers

Discharge of Gaseous Effluents	Health of Workers			X^2tab	X^2cal
	Not affected	Affected	Total		
Good	70(35)	22(11)	92		
Poor	(20)	88(44)	108	3.841	66.5
Total	90	110	200		

Table 3 showed data analysis on the hypothesis which holds that there is no significant relationship between discharge of gaseous effluents and the health of workers in Niger Flour Mill Industry, Calabar. Two hundred (200) respondents were studied out of which 92(46%) adopted good discharge of gaseous effluents while 108(54%) adopted poor gaseous effluents discharge practices. Of the 92(46%) who adopted good gaseous effluents discharge practices, majority of them 70(35%) reported that their health status was not affected with only 22(11%) who reported that their health status was negatively affected.

On the other hand, out of the 108(54%) who adopted poor gaseous effluents discharge practices, majority of them 88(44%) reported that their health status was negatively affected with only 20(10%) who reported otherwise. The statistical test of the hypothesis showed that X^2_{cal} = 66.5> X^2_{tab} at α, 0.05 = 3.841. We therefore reject null (H_o) and conclude that there is a significant relationship between gaseous effluents discharge practices and the health of workers in Niger Flour Mill Industry. The positive relationship means that as gaseous effluents discharge practices improve, the health status of workers also improve and vice versa.

Discussion of results

Hypothesis 1: There is no significant relationship between solid waste management and the health of workers in Niger Flour Mill Industry, Calabar. The finding in respect to the above hypothesis showed that there exist significant positive relationship between industrial sanitation in terms of solid waste management and the health of workers in Niger Flour Mill Industry, Calabar. The statistical test of the hypothesis showed that the calculated chi-square is greater than the table chi-square (X^2_{cal} = 56.9> X^2_{tab} at α, 0.05 = 3.841) hence the conclusion that proper industrial sanitation, especially good solid waste management practices enhanced workers health in the industry. Proper solid waste management in industries does not only improve the aesthetics of the workplace but also reduced risk of accidents and diseases thereby improving workers health. The finding is in line with Ehrlich (2002) [4] who observed that waste matter or substance is useless, unwanted or thrown away materials are often irritating and stinking as well as provide abode for the breeding of mosquitoes and other vermin which affect human health and well-being.

Hypothesis 2: There is no significant relationship between the proper disposal of liquid waste and the health of the workers in Niger Flour Mill Industry, Calabar. The finding in respect to the above hypothesis showed that there exist significant positive relationship between industrial sanitation in terms of liquid waste management and the health of workers in Niger Flour Mill Industry, Calabar. The statistical test of the hypothesis showed that the calculated chi-square is greater than the table chi-square (X^2_{cal} = 56.9> X^2_{tab} at α, 0.05 = 3.841) hence the conclusion that proper industrial sanitation, especially good liquid waste disposal practices enhanced workers health in the industry. Proper liquid waste management in industries does not only improve the hygiene of the workplace but also reduced risk of diseases thereby improving workers health. The finding of this hypothesis is in line with Igbinokpogie (2010) [6] whose study affirmed that adoption of sustainable processes in the management of liquid waste enhanced diseases prevention and control. It was further asserted that recycling of industrial liquid waste lead to sustainable work environment and brought about good health among factory workers.

Hypothesis 3: There is no significant relationship between discharge of gaseous effluents and the health of workers in Niger Flour Mill Industry, Calabar. The finding in respect to the above hypothesis showed that there exist significant positive relationship between industrial sanitation in terms of discharge of gaseous effluents and the health of workers in Niger Flour Mill Industry, Calabar. The statistical test of the hypothesis showed that the calculated chi-square is greater than the table chi-square (X^2_{cal} = 66.5> X^2_{tab} at α, 0.05 = 3.841) hence the conclusion that proper industrial sanitation, especially good discharge of gaseous effluents enhanced workers health in the industry. Proper gaseous effluents management in industries does not only improve the hygiene of the workplace but also reduced risk of diseases thereby improving workers health. It was discovered that the attitude of maintaining good sanitation practice by the factory workers were low and poor due to lack of environmental health education among workers coupled with poor supervision and enforcement of sanitation laws by management and regulatory agencies. The finding of this hypothesis is in line with Lucas (2008) [7] who observed that indiscriminate discharge of gaseous effluents in industries especially in the developing and third world countries like Nigeria lead to serious health consequences on workers.

Conclusion

From the result of findings, it is concluded that good sanitation play an important role to the life of factory workers. Conclusively, good sanitation is the key to the good health of any human being and as such all industries should thrive to maintain good sanitation ethics for clean and safe environment for the overall improve health status of workers. Government and her accredited agencies should enforce sanitation and health laws in all industries operating in Nigeria for interest of public safety and health.

Recommendations

After a careful observation, the researcher makes the following recommendations:

1. Environmental health education should be given to factory workers by the government regulatory agencies and Non-Governmental Organizations to improve their knowledge based on industrial sanitation.
2. Adequate protective devices should be provided and the management should ensure that the workers use them.
3. Medical services should be provided and made easily

accessible to all employees to prevent deterioration of health condition in the event of sickness and accident emergency.
4. There should be good medical examination on workers and it should be carried out during employment (pre-medical examination), when changing from one job to another (pre-placement) and at regular intervals (periodic medical examination).
5. Safety education programmes should be made as a compulsory aspect of workers, health services and workers who do not participate should be punished.

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