EVALUATION OF INDUSTRIAL EQUIPMENT FOR WASTE AND POLLUTION CONTROL

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Abstract

Modern industries introduce some newly improved equipment to enhance the level of productivities and to increase their output to meet up the demand of the customer. In the process of doing that, most organizations do not consider the rate at which waste and pollution are been generated and ways of reducing generation of these waste and pollution. According to the case considered in this research work, evaluation of industrial equipment for waste and pollution control was undertaken so as to give insight on how these equipment generate waste and pollution. From the results obtained on selected manufacturing industries in Nigeria, hypotheses reveal great significant relationship in the evaluation of industrial equipment for waste and pollution control. Analysis of the result reveals that gender and marital status have significant effects on waste and pollution generation by industrial equipment. The maturity of age of the workers as well as their educational qualifications have significant effects, considering the hypothesis on statistical data generated from the questionnaire and other data collected.

Key Words: Equipment, Wastes, Pollution, Hypothesis.

1. Introduction

Industrial equipment are machine tools used in an industry to facilitate or enhance a continuous flow of production process. Modern industries generate different types of waste and pollution which endanger its working environment. These waste and pollution generated by the equipment cannot be totally eradicated but can only be reduced to nearest minimum. When a part has reached a specified dimension during the machining process, the monitoring equipment sends a command impulse to stop the machine. The adjustment devices check the parts immediately after machining and send a command impulse for the automatic correction of setting the mechanisms. The inter lock and safety devices send a command impulse to stop machining in case of a disruption of

setting or a broken tool. Wastes are unwanted or unusable materials. Waste is the substance which is discarded after use, or it is worthless, defective and of no use. Examples include municipal solid waste (house hold trash/refuse), hazardous waste, and waste water (such as sewage, which contain bodily wastes) feaces, urine, surface run off, radioactive waste and others. According to the Basel (2001) convention on the control of trans- boundary movements of hazardous wastes and their disposal of 1989, "wastes" are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.

Pollution is the process of making land water, air or other parts of the environment dirty and unsafe or unstable to use. There could be introduction of contaminants into the natural environment that causes changes. Pollution can take the form of chemical substances or energy such as noise, heat or light. Toxic pollution affects more than 200 million people worldwide. According to Pure Earth, a non-profit environmental organization in some of the world's worst polluted places, babies are born with birth defects, children have lost 30 to 40 IQ points and life expectancy may be as low as 45 years because of cancers and other diseases. Basel (2001)

The World Health Organization (WHO) estimates that about a quarter of the diseases facing mankind today are due to prolonged exposure to environment pollution. Most of these environment-related diseases are however not easily detected and may be acquired during childhood and manifested later in adulthood (Bell 2002). Industry plays an important role in the process of economic development in the world. It enhances the economics welfare of citizens and supplies the material goods they consume. The way in which society will develop in the future is largely dependent on how the growth is distributed. Industry is a major consumer of natural resources and a major contributor to the overall pollution load. Based on OECD (Organization for Economic Cooperation and Development) estimates, it accounts for about one-third of global energy consumption of their member states and for about 10percent of the total water withdrawal. The relative contribution to the total pollution is obliviously higher for industry-related pollutants. The individual sector generates both traditional pollutants (e.g., Organic substances, sulfur dioxide, particulates and nutrients) and newly-recognized pollutants (e.g., specific toxic substance). The industrial sector includes a number of diverse activities created by industry. Thus, industries have particular industrial responsibilities in terms of such factors as plant location and design, industrial pollution, vibration and noise controls, waste disposal, occupational health and

safety aspects, and long range planning. Generally, the pollutants from industries are divided into three categories namely gas, solid and water. There are also some other pollutant forms such as noise and odor. Therefore, there is need for government to enact and implement necessary industrial laws to control the issues of industrial pollution and waste. This can be done by putting necessary industrial pollution and wastes enforcement structure in place to curb the spate of industrial pollution and wastes in Nigeria (www.Projectclue.com and environmental science).

2. Literature review

Throughout history, waste and pollution have been generated by humans and industrial equipment. In industries with low pollution density waste, pollution generation may have been negligible. In higher population areas even largely biodegradable waste, pollution had to be dealt with. Sometimes, industrial equipment generate a lot of waste and pollution during production process. The side effect have some impact on the working environment and to the general public when it is not properly disposed. Following the onset of industrialization and the sustained urban growth of large population centers in England, the buildup of waste and pollution in the industries and in the cities caused a rapid deterioration in levels of sanitation and the general quality of urban life. The streets became choked with filth due to lack of waste and pollutions clearance regulations. Calls for the establishment of a municipal authority for waste removal powers were mooted as early as 1751 by Corby Morris in London, who proposed that "as the preservation of the health of the people is of great importance, it is proposed that the cleaning of this city should be put under one uniform public management, and all the filth be conveyed by the Thames to proper distance in the country".

The first occurrence of organized solid waste management system appeared in London in the late 18th century. A waste collection and resource recovery system was established around the 'dust-yards'. Main constituent of municipal waste was the coal ash (‘dust’) which had a market value for brick-making and as a soil improver. Such profitability encouraged dust-contractors to recover effectively 100% of the residual wastes remaining after readily saleable items and materials had been removed by the informal sector in the streets ('rag-and-bone men'). Therefore, this was an early example of organized, municipal-wide solid waste management. The dust-yard system had been working successfully up to middle 1850s, when the market value of ‘dust’

collapsed. It was important in facilitating a relatively smooth transition to an institutionalized municipally-run solid waste management system in England.

In the mid-19th century, increasingly devastating cholera outbreaks and the emergence of a public health debated on consolidated legislation on the issue. Highly influential in this new focus was the report on the Sanitary Condition of the Laboring Population in 1842 of the social reformer, Edwin Chadwick, in which he argued for the importance of adequate waste removal and management facilities to improve the health and wellbeing of the city's population. Chadwick's proposals were based on the miasmatic theory of disease transmission which was proven to be false following the turn of the 1900s. The Nuisance Removal and Disease Prevention Act of 1846 began what was to be a steadily evolving process of the provision of regulated waste management in London. The Metropolitan Board of Works was the first city-wide authority that centralized sanitation regulation for the rapidly expanding city and the Public Health Act 1875 made it compulsory for every household to deposit their weekly waste in 'moveable receptacles' for disposal - the first concept for a dust-bin.

The dramatic increase in waste for disposal led to the creation of the first incineration plants, or as they were then called, 'destructors'. In 1874, the first incinerator was built in Nottingham by Manlove, Alliott & Co. Ltd. to the design of Albert Fryer. However, these were met with opposition on account of the large amounts of ash they produced and which wafted over the neighboring areas. Similar municipal systems of waste disposal sprung up at the turn of the 20th century in other large cities of Europe and North America. In 1895, New York City became the first U.S. city with public-sector garbage management.

Early garbage removal trucks were simply open bodied dump trucks pulled by a team of horses. They became motorized in the early part of the 20th century. The first close body trucks to eliminate odors with a dumping lever mechanism were introduced in the 1920s in Britain. These were soon equipped with 'hopper mechanisms' where the scooper was loaded at floor level and then hoisted mechanically to deposit the waste in the truck. The Garwood Load Packer was the first truck in 1938, to incorporate a hydraulic compactor. In the 19th century, in the United States, cities often became choked with horse manure. While the odor was tolerable to 19th century

sensitivities, walking through the streets without boots resulted in deplorable appearing footwear. In many cities, lacking trash collection, pigs and dogs ran loose, consuming the trash and excreting dung, which smelled offensively. Dead animals, particularly horses, were left lying in the streets, facilitating disease.

The philosophy behind environmental engineering is to prevent or minimize any negative impact resulting from human activities, low and non-waste technology from waste minimization, awareness campaign, environmentally and people oriented programmes are therefore the fundamental of environmental engineering. Manufacturing activities from production companies in pursuit of a better and effective production process with advance technology, have always had impacts on the working environment and the society in general. Most Nigerian production companies embark on purchasing advance technology innovation machines for their productions and services enhancement with no record of environmental implications which the equipment could cause. Consequently, this research is being conducted on the case studies in order to evaluate the manufacturing equipment and identify the associated wastes and pollutions generated.

3. Materials and method

Research is defined, according to the oxford advance learner's dictionary, to be a careful study or an investigation especially in order to discover new facts or information. Olaitan and Awoke(2014) defined research as the process of arriving at dependable solution to problem, through planned, systematic collection, analysis and interpretation of data. This idea is used to obtain information, data required for the study as well as the techniques employed for data analysis No work of this nature can be satisfactorily accomplished without the employment of one means or the other to get the information; for the research data are gathered in two ways which are the primary and secondary Primary source covers all data collection for the research in their original state. They include interview and questionnaire. Interview is a sort of face to face interactive session between two or more persons which are the interviewer and the interviewee. In this case, the interviewer is the researcher while the interviewee is the one who is been interviewed on a particular subject. Secondary Source covers all information or data collection

such as from engineering journal, environmental reports, magazine, textbooks etc. to support the primary data.

In this research work, the target population are from Nigeria Railway Corporation, International Tobacco Company and Princess Paint Nig Ltd in Lagos and Ilorin selected for the purpose of investigation. Our sample is a part or subset of the whole population selected for the purpose of making scientific statement on evaluating industrial equipment and waste it generates. Since the population of each organization is large, it was not easy to obtain data for the whole population. Therefore it was decided to select a sample from the population. The sample size selected for the respondent is sixty (60). Simple random sampling was used such that each and every professional member of the organizations has equal chance of being included in the sample. Simple random sampling was also used in selecting the engineering professional within the industry. Same sampling technique was used when carrying out the interview. This study is aimed to control waste and pollution generated by the industrial equipment's, as well as providing measures, suggesting practicable policy, to control such pollution and waste. Three organizations and some individuals who are engineering professionals from differs industries, were selected at random. The choice of these establishments as case studies was derived from the fact that the companies are highly organized government and private investment in Nigeria.

4. Analysis of results

The results of analysis of the data collected and interpretation of the findings are to be considered. Relevant data were collected from sixty (60) respondents respectively from various organizations. The data collected were analyzed using descriptive and inferential statistics. Null hypothesis was conducted at 0.05 alpha level of significance. The result is presented in three phases. The first phase provides the descriptive data of the respondents demographic using frequency count and simple percentage. The second phase presents the inferential statistics of t-test, Analysis of Variance (ANOVA) of the data collected from the questionnaires and the null hypothesis postulated at 0.05 alpha level of significance. The third phase presents the summary of the findings.

The demographic distribution of respondents by the variables such as gender, age, marital status and educational qualifications was analyzed using descriptive statistics of frequency count and

percentage. The four (4) null hypotheses formulated for this study were tested using statistical measure. All hypotheses were tested at 0.05 alpha-level of significance.

Hypothesis 1: Evaluation of industrial equipment for waste and pollution control based on gender

Table 1.0: Mean, standard deviation and t-value on evaluation of industrial equipment for waste and pollution control based on gender.

Gender	N	Mean	Standard deviation (SD)	DF	Calculated t-value	Critical t-value
Male	52	21.62	7.11	58	4.33	1.96
Female	8	32.75	3.54			
Total	60					

Significant p<0.05

The above table reveals that the calculated t-value of 4.32 is greater than the critical value 1.96 at 0.05alpha level of significance. Therefore the null hypotheses is rejected meaning that the evaluation of industrial equipment for waste and pollution control based on gender is significant. This also means that the population of the either male or the female increased or decreased) has effect on the rate of waste and pollution generation by industrial equipment since there is no agreement among them.

Hypothesis 2: Evaluation of industrial equipment for waste and pollution control based on age

Table 2.0: Analysis of variance (ANOVA) comparing respondent's scores on evaluation of industrial equipment for waste and pollution control based on age

Score	Sum of square	Df	Mean square	Cal.F-ratio	Sig
Between group	2015.49	2	100.75	38.04	3.00
Within group	1509.91	57	26.49		

Total	3525.40	59			

The above table reveals that the calculated F-ratio of 38.04 which is greater than the critical F-ratio of 3.00 at 0.05 alpha level of significance. Therefore the null hypotheses is rejected meaning that there is significant difference in the evaluation of industrial equipment for waste and pollution control based on age. This means that the age of the workers is significant to the rate of waste and pollution generated by industrial equipment. This is in line with the fact that if certain age grade of worker is employed into the industry it will control the rate of waste and pollution generation.

Hypothesis 3: Evaluation of industrial equipment for waste and pollution control based on marital status

Table 3.0: Analysis of variance (ANOVA) comparing respondent's scores on evaluation of industrial equipment for waste and pollution control based on marital status

Score	**Sum of square**	**Df**	**Mean square**	**Cal.F-ratio**	**Sig**
Between group	1691.895	2	845.947	26.299	3.00
Within group	1833.505	57	32.167		
Total	3525.400	59			

The above table reveals that the calculated F-ratio of 26.299 which is greater than the critical F-ratio of 3.00 at 0.05 alpha level of significance. Therefore the null hypotheses is rejected meaning that there is significant difference in the evaluation of industrial equipment for waste and pollution control based on marital status. This means that the the marital status of the workers is significant considering the rate of waste and pollution generated by industrial equipment in line with fact that if certain marital status of worker is employed into the industry, it will control the rate of waste and pollution generation.

Hypothesis 4: Evaluation of industrial equipment for waste and pollution control based on highest qualification

Table 4.0: Analysis of variance (ANOVA) comparing respondent's scores on evaluation of industrial equipment for waste and pollution control based on highest qualification

Score	Sum of square	Df	Mean square	Cal.F-ratio	Sig
Between group	2587.662	3	862.554	51.510	3.00
Within group	937.738	56	16.745		
Total	3525.400	59			

The above table reveals that the calculated F-ratio of 51.510 which is greater than the critical F-ratio of 3.00 at 0.05 alpha level of significant. Therefore the null hypotheses is rejected meaning that there is significant difference in the evaluation of industrial equipment for waste and pollution control based on highest qualification. This means that the highest qualification of the workers is significant considering the rate of waste and pollution generated by industrial equipment in line with fact that if certain highest qualifications of worker are employed into the industry, it will control the rate of waste and pollution generation.

5. Conclusion

Control of industrial pollution and wastes due to various environmental hazards is an important topic for industrial engineers enabling them to recognize and understand in order to protect human, machinery and the ecosystem from harm or damage at local, regional or global scales. For example, to deal with pollution on equipment in the industries, risk and exposure assessment help engineers in choosing an optimal solution to either treat of hazard (e.g., to remove the contaminants from the equipment) or reduce the exposure (from the source of intake to the equipment). It was discovered from the analysis that evaluation of industrial equipment for waste and pollution control based on age, gender, marital status and highest qualification has significant difference, meaning that age,

gender, marital status and highest qualification of the workers are significant to the rate of wastes and pollution generation by industrial equipment. Consequently, Nigerian industries should take adequate consideration in terms of recruitment of workers with respect to their ages, gender, marital status as well as required qualifications according to their professional qualification and experiences.

Based on our findings, the following recommendations are made:

- Government should introduce strict policies thereby empowering agencies to affect the policies.
- Advertisement/enlightenment programme, seminars and workshops should be made to conducted to change the individuals and organization perception.
- Sensors and monitoring devices should be placed in and outside of the equipment or machinery.
- Retrofitting of existing industries and power plants is also worthwhile so as to meet the new age technology and standards.
- Technology to reduce all forms of waste and pollution at the source should be established and should be used in all new industrial development.
- Concerted actions are needed to safely manage the use of waste generated by industrial equipment and to develop monitoring and regulating guidelines.
- The principles and practices of sustainable development, coupled with local research, will help contain or eliminate risk and hazard resulting from industrial waste and pollution.
- Regular visit of Environmental Impact Assessor should be undertaken to check the industries before and after installation.
- The interior of the equipment should be cleansed to avoid pollution of clean water coming from the inlet to the equipment.
- Authorities need to develop partnership with other sectors to identify and implement priority interventions.

- Greater international collaboration involving governmental and non – governmental organization can guide this highly interdisciplinary and intersectional area of waste and pollution control in industries.
- Further effort should be carried out by researchers to control the rate at which industrial equipment generate waste and pollution.

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