Analysis of Waste Gases at INTAFACT Beverages, Onitsha – Nigeria.

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***Abstract*—This study sets out to provide an insight into pollutants, solutions and the need to monitor our local industries with respect to environmental pollution control. An ITX Multi gas monitor (P/N 1810 - 4307) was used to monitor gases within the company. The parameters measured were suspended particulate matter, nitrogen dioxide, Sulphur dioxide, ammonia, carbon monoxide, chlorine, temperature, wind speed and direction. Based on the Limits set out by FMENV, WHO and ANSEPA, this study showed that most waste gases were within permissible limit except Sulphur (IV) oxide and carbon monoxide which have mean values of 0.16ppm and 10.26ppm. The permissible values of both gases are 0.01ppm and 10.00ppm respectively and more concentrated at the main gate / security post areas. These levels of pollutants call for serious environmental concern. Sulphur (IV) oxide corrodes metals, causes building materials and textiles to deteriorate and weaken. Carbon monoxide is a poisonous gas and deadly hence, the quality of air within those areas is poor and need to be regularly monitored to avert adverse health and environmental implications.**

***IndexTerms*—Pollution,Waste gas analysis,waste gases,Environmental pollution.**

I. INTRODUCTION

Pollution is the introduction by man of any impurity, substance or energy into the natural environment that can cause adverse change on ecological systems, damage to structure or amenity or interference with legitimate use of the environment. Pollution is not a new development or phenomenon but had been posing a devastating threat to mankind and its environment. There are numerous human activities, which result in the release of potential toxic substances into the atmosphere (Aas et al., 1999; Campbell et al., 1994).From human activities, the primary source of air pollutants in world presently is the emission of waste products from the exhaust of internal combustion engines and boilers and furnaces of industries, plants and homes (Park, 2005).

While developed countries in the world are faced with growing concern about global environmental issues, developing countries like Nigeria are experiencing complex, fast-growing and serious pollution problems of their own. The rising combination of industrialization, as well as urban developments which are executed by foreign companies from this developed countries operates with little regard for environment protection practice. Environmental pollution is not all about health issue in fact it is a wider societal issue because pollution has the potential to destroy structures, homes and communities.

Nigeria, like other developing countries suffers from a number of primary environmental problems mainly attributable to under-development and attendant poor living conditions. Added to this is the fact that numerous industries are fast springing up in different parts of the country. Consequently, failure to begin waging an early war against environmental degradation today is likely to affect output adversely and increase costs in the future. More so, Scientists have predicted that Nigeria may be seriously hit by the greenhouse effect as a result of large amount of greenhouse gasses emitted into the atmosphere, through automobile emissions, gas flaring and bush burning and industries (Gobo et al, 2012).

II. OVERVIEW OF THE INTAFACT BEVERAGES LTD.

INTAFACT Beverages Ltd *(a subsidiary of SABMiller Nigeria*), Onitsha is a major carbonated of alcoholic and non-alcoholic drinks bottling company in Nigeria. In the meantime, SABMiller has continued to invest hugely to compete favorably in the growing beer market. The world's second largest brewery contributed immensely to Nigerian Economy especially to Anambra State (Onitsha Brewery), owing to the success recorded by HERO Larger beer so far. The Onitsha brewery has annual production capacity of 700,000 hectolitres, and ongoing expansion programme in the company is expected to increase the figure to more than three folds.

The INTAFACT Beverages Ltd, Onitsha plant on which this evaluation was carried out was established in August 2012 and is sited on Niger bridge industrial layout Onitsha, Anambra state. The plant produces Hero lager beer, malt, Castle milk stout, yoghurt etc. The staff strength of the plant is 320 out of which 150 are directly involved in production activities. Others are managers, secretaries, caterers, security guards, administrative officer and technicians. It operates two (2) daily shifts of 10 hours each for 22 days per months.

III. .RESEARCH PROBLEM

It is a fact that the activities of man can damage his environment even when he does not do that deliberately. The effect of pollution on public health and safety, effect on aquatic and other lives, damage to property and other economic losses pose a great problem to man. In Nigeria, the industrial sector has contributed immensely to this menace. However, INTAFACT Beverage Ltd, One of the major production company in Nigeria is studied to analyze the waste gas emitted.

IV. AIM AND OBJECTIVES

The aim of this study is to analyze waste gases at INTAFACT Beverages Ltd, Onitsha - Nigeria with respect to environmental permissible standard. The specific objectives of the work include;

- To verify the amount of waste gases emitted within different location in the industry.
- To analyze the data gotten using MATLAB Simulink software.
- To proffer viable and sustainable solutions that could check the impact of environmental pollution from pollution emitters.
- To recommend ideas that will help in monitoring our local production industries on compliance to world environmental permissible standards.

V. METHODOLOGY

Air quality measurements was made at three locations (production area, generators, main-gate/security post) within the study area using digital hand held meter and Ambient air quality measurements in the area were made three times during the day time, representing the moist weather and dry weather, on September 9th-12th, 2014 as shown in Table 4.1 to 4.5

Measurements were not made at night due to security reasons. At each station measurements were repeated. Five waste gases were monitored in the study area. These include: Carbon (II) Oxide (CO), Nitrogen (IV) Oxide (NO2), Sulphur (IV) Oxide (SO2), Ammonia (NH3), Chlorine (Cl), Suspended particular matter (TSP), and ambient temperature.

For air quality monitoring, the sampling equipment used is an industrial scientific corporation ITX Multi gas monitor (P/N 1810 – 4307). It is also portable hand held digital air meter that measures the air pollutants. It is also capable of monitoring and recording data for combustible, oxygen and up to four toxic gases simultaneously. Other features includes; operating temperature range of -20o to 50oC (-4^{o} to 122^{o}F), operating humidity range of 15 to 95% RH, typical, 0 to 99% intermittent, non-condensing.

VI. RESULTS AND ANALYSIS

The results of air quality samples collected from INTAFACT Beverages Onitsha and Mean Values of Waste Gases Concentration are presented in Table 4.1 – 4.18

Waste Gases Concentration

Table 1: Mean Values of Waste Gases Concentration

X_1 Location	X_2 Time	NO_2 (ppm)	SO_2 (ppm)	CO (ppm)	NH_3 (ppm)	Cl (ppm)	TSP (mg/m^3)
1	1	0.036	0.008	6.936	0.172	0.344	0.0674
0	1	0.036	0.014	9.164	0.150	0.268	0.0856
-1	1	0.038	0.014	9.874	0.128	0.228	0.0988
1	0	0.036	0.010	6.434	0.180	0.322	0.0740
0	0	0.036	0.010	8.416	0.140	0.248	0.1082
-1	0	0.038	0.018	8.522	0.152	0.192	0.1056
1	-1	0.040	0.012	6.566	0.204	0.290	0.0778
0	-1	0.036	0.014	8.664	0.160	0.252	0.0868
-1	-1	0.038	0.010	10.264	0.144	0.216	0.1154

Concentration of each gas using ANOVA

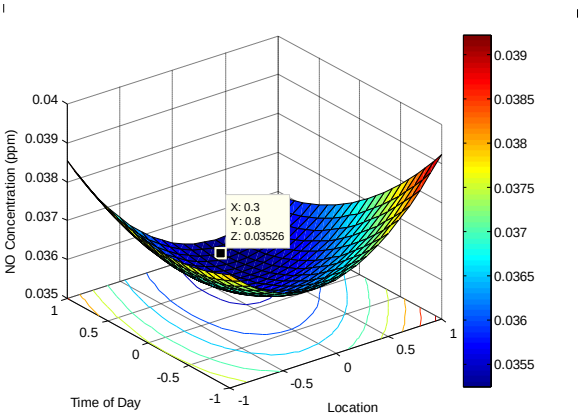

Figure 1: Surface plot of interaction of Time of Day and location on NO_2 concentration reading

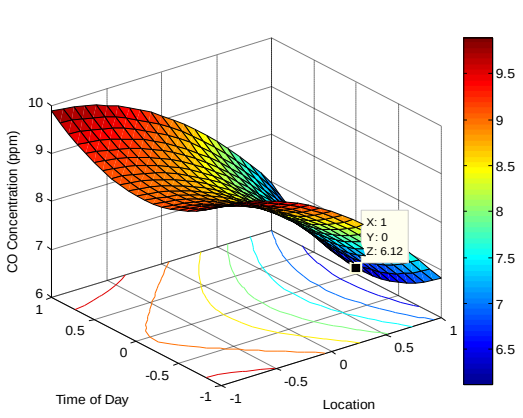

Figure 2: Surface plot of interaction of Time of Day and location on CO concentration reading

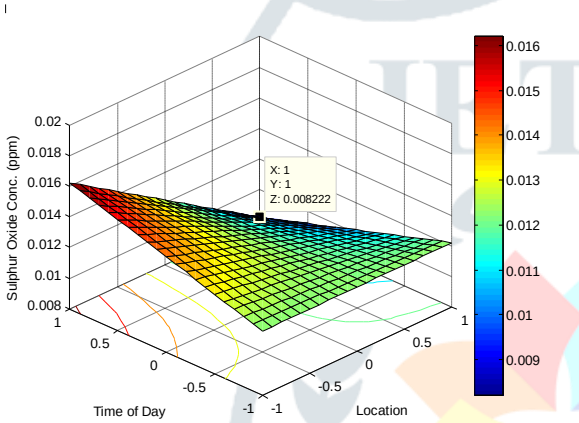

Figure 3: Surface plot of interaction of Time of Day and location on SO_2 concentration reading

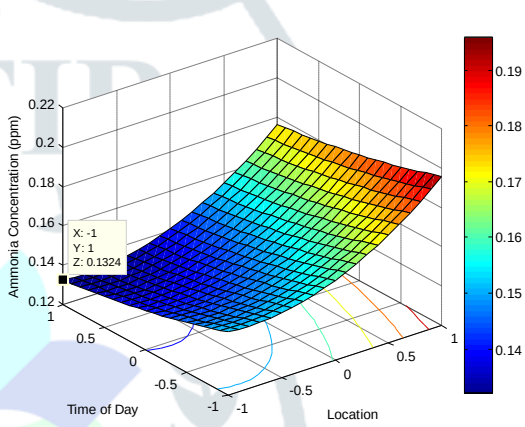

Figure 4: Surface plot of interaction of Time of Day and location on NH3 concentration reading

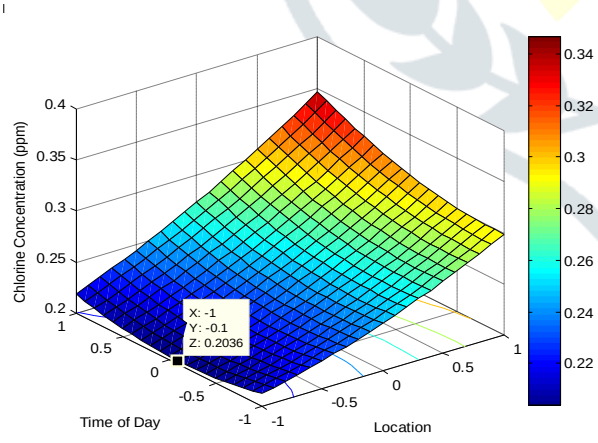

Figure 5: Surface plot of interaction of Time of Day and location on Cl concentration Reading

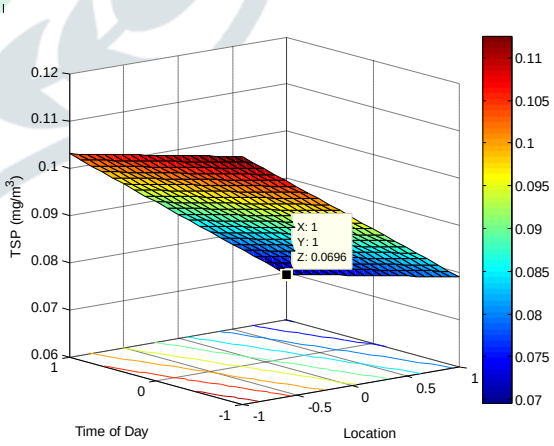

Figure 6: Surface plot of interaction of Time of Day and location on TSP concentration reading.

From the graphs above, Fig. 1 shows that the minimum value is for: x_1= 0.3 (0 to the nearest whole number) and x_2=0.8 (1 to the nearest whole number). Equivalent values: x_1 (Location) = Generator Area, x_2 (Time of Day) = 9.30am. While in Fig. 2; The Response surface model statistics show that a pure quadratic model; (y=a_1+a_2 x_1+a_3 x_2+a_4 x_1^2+a_5 x_2^2) gave the best fit to the CO concentration data as a function of location (x_1) and Time of Day (x_2). The model explains 95% of the observed variability in the experimental data with the constant term and location (x1) being significant at 95% confidence while the quadratic term of Time of day (x_2) is significant at 90% confidence. The model is adequate based on the f-statistics.The ANOVA table shows that location (x_1) is the only significant variable, which corroborates with the surface plot that indicates stronger color variation

along the location (x_1) axis than along the Time of Day (x_2) axis.The model predicts the minimum mean CO concentration at the production area (x_1=1) and at time of 12.30pm (x_2=0). In Fig. 3; SO_2 is more concentrated towards the Main Gate/Security Post mostly in the morning hours with values of 0.016ppm while it is less concentrated (0.01ppm) at production area. Fig. 4 shows that NH_3 is less concentrated (0.13ppm) towards the Main Gate/Security and tend to increase more towards production area though the highest value is 0.19ppm. It poses no environmental threat. Furthermore, Fig. 5 shows that Cl is less concentrated (0.20ppm) towards the Main Gate/Security and tends to increase more towards production area though the highest value is 0.34ppm. Finally, Fig. 6 shows that TSP is more concentrated (0.105mg/m3) at the Main Gate/Security towards evening time and less concentrated towards production area with concentration value of 0.07ppm.

Analysis of Air Assessment

The mean results of air pollutants at INTAFACT Beverages, Onitsha was presented in Tables 1. The Total Suspended Particulates (TSP) concentration varies significantly at locations where it was measured. The mean TSP concentration varied from 0.098mg/m3 in the morning to 0.105mg/m3 in the afternoon and 0.115mg/m3 in the evening at Security post/main gate. The of TSP concentration slightly exceeded the permissible limit of 100mg/m3 at generator area in afternoon and thus increases more at main-gate/security post, therefore do pose serious environmental problems. This was as a result of fumes from generators as well as smokes from vehicles at security post/main gate. Most waste gases at INTAFACT Beverages Onitsha were within permissible limit but carbon monoxide is closely within permissible value and Sulphur dioxide which have mean values of 0.016ppm. The permissible values of both gases are 10.0ppm and 0.01ppm respectively and more concentrated at both production and generator areas. These levels of these waste gases do not call for serious environmental concern. Carbon monoxide concentration is as a result of combustion of carbon-containing fuels from the heavy duty generator, heavy motor vehicles etc. Sulphur dioxide (SO_2) is, primarily found in the combustion products of oil and coal, as fruit preserving agent, food preservative or additive.

Again, the differences in ambient temperature at the stations was due to differences in the time of the day measurement was made. Furthermore, the concentrations of pollutants in the dry weather were found to be higher than the concentrations in the rainy weather. This could be attributed to rainfall during the rainy season. The results obtained in this study are in line with the report by (Alaoga and Deferaka, 2002). That the month of June (rainy season) recorded a monthly mean of 80% and the month of January (dry season) recorded below 65%. This is in agreement with the fact that pollutant dispersion is highest in the dry season and lowest in the rainy season (Bhatia, 2002).

VII. CONCLUSION

This evaluation has assessed the INTAFACT Beverages, Onitsha Plant operational processes in terms of raw materials utilization, air, safety and healthcare services, the impacts of the plant's process on the environment and it was gathered that;

- For the Noxious gases (NO_2, SO_2, CO, NH3, and Cl) and Total particulates; some of the gases and particulates were in trace quantities which were within set limits in some locations and also exceeded the set limit in other locations. Any of these noxious gas and Total particulates which exceeded the permissible limit poses environmental concern.

VIII. RECOMMENDATION

Most developing countries are aware of the impact of sound environmental management in the process of national economic development and in the case of Nigeria, a wide array of policies and institutions have been put in place over the years to tackle the problem of environmental pollution. Such polices includes;

- Section 17 of FMENV regulation S. I. 9 states "An industry which is likely to release gases, particulate, liquids or solid untreated discharges shall install into its system appropriate abatement equipment in such manner as may be determined by the Agency". The plant is yet to install full appropriate abatement equipment (Effluent Treatment Plant) for its effluent.

- Section 1 (1) of FMENV Regulations S. I. 8 of 1991, which states that "every industry shall install anti-pollution equipment for the detoxification of the effluent and chemical discharges emanating from the industry". The Intafact Beverage Onitsha plant had put in place oil separators in the drain to remove oil from their effluent, but they are yet to have facility for the detoxification of its liquid effluent.

IX. ACKNOWLEDGMENT

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REFERENCES

[1] Aas, W., Hjellbrekke, A.G, Semb, A. and Scaug, J. (1999). Data quality 1997, Quality assurance and field comparisons. Lillestrom Chemical Coordinating center, Norwegian Institute for Air Research, EMEP/CCC6 / 99.

[2] Achi, P.B.U. (1991). "Management of Industrial Waste in Nigeria Environment Protection Engineering" No.3-4 Vol. 17 CRACON, 1991.

[3] Achi, P.B.U. (2000). "An update on the Nigerian Environment" Quality, Reliability and Maintenance (QRM) 2000. St Edmund Hall, University of Oxford, March 2000.

[4] Achi, P.B.U. (2000). "Maintenance of Nigerian Environment" QRM 2000 St. Edmund Hall, Oxford.

[5] European Commission News. (2005). Modeling and Mapping of urban noise pollution with sound plan.

[6] FAO (1990). Global forest land-use change by Food and Agriculture Organization of United Nation.

[7] FEPA (1999). National Master Plan for Public Awareness on Environment and Natural Resources conservation in Nigeria, FEPA, Garki, Abuja.

[8] FGN (1988): Federal Environmental Protection Agency Decree 58, 1988, Federal Ministry of Information and Culture, Lagos, Nigeria.

[9] Hongmao, T. and Dhari, A.A. (2001). Textbook: Introduction to air pollution and Air Quality Management.

[10] Ideriah, T.J.K., Braide, S.A., Fekarurhobo, G. and Oruambo, I. (2001). Determination of suspended particulate matter in South-Eastern Nigeria. Ghana Journal of Science.

[11] Ideriah, T.J.K., Warmate, A.G., and Alabraba, M.A. (2008). Effect of Naked Lamp on levels of Air pollutants in Port Harcourt, Nigeria. Research Journal of Applied Sciences 3(1): 77-80.

[12] Karl, T.R, Melillo J.M, and Peterson T.C. (2009). Global climate change Impacts in the United States New York; Cambridge University press;

[13] Kreith, F. (1994). "Handbook of solid waste management." McGraw- Hill Inc. New York.

[14] National Environmental Protection (Effluent Limitation Regulation (1991). National Environment Protection (Pollution Abatement in Industries and facilities generating waste regulation (1991)).