Thermal Gradient due to Gas Flared at Kokori/Erho-ike Flow Station, Delta State, Nigeria.

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ABSTRACT

The need for an improved standard of living has led to the exploration of man's environment. This has been possible through technological developments, which includes oil exploration, which in turn, leads to gas flaring. In the Niger Delta Region of Nigeria, the effects of gas flaring are obvious; some of them include acid rain, greenhouse effects, increased temperatures, low agricultural productivity, and changes in the aquatic ecosystem. There is therefore a need for more attention to be given to activities that will remedy the environmental problems caused in these areas.

Thermal gradients resulting from the gas flared at the Kokori/Erho-ike flow station is hereby reported. Surface temperature variations with distance from the flare point were investigated for the four cardinal directions. The results show a surface temperature elevation of about 1.4^0C above the mean normal daily temperature within a radius of 210m, hence, the thermal equilibrium has been altered. This increase in temperature has undesirable effects on man and his environment, especially on the socio-economic activities of the inhabitants. Consequently, residential buildings should be located at least 210 m away from the flare stark.

It is therefore necessary that government agencies empowered to monitor the environment such as the Federal Environmental Protection Agency (FEPA) should embark on adequate remediation activities in order to stop the environmental degradation before significant and permanent damage is caused.

(Keywords: temperature, distance, gas flare, environment, Kokori/Erho-ike)

INTRODUCTION

The history of natural gas production in Nigeria is dated back to 1950 when Shell D'archy and British Petroleum discovered the first oil in Oloibiri, presently Bayelsa State, of the Niger Delta Basin. Gas flaring began soon after in 1956. Today as petroleum exploration and exploitation intensify, gas flaring is now associated with every oil producing community in the Niger-Delta region (Chijoke, 2002). Within the oil producing communities, there have been environmental and social costs of oil exploration. Various ecological and human disasters, which have continuously occurred over the last three decades, implicate gas flaring by oil companies as a major contributor to environmental degradation and pollution of various magnitudes (Avwiri and Ebeniro, 1995; Avwiri and Ebeniro, 1996).

Agoawike (1995), in an article titled "Our Dying Environment" summarised that in oil producing areas from Warri in Delta State to Ogoni in Rivers State and Oguta in Imo State, the story is the same, farmlands are rendered useless, rivers depleted of aquatic life, and the air polluted by gas emissions. Ahiakwo (1990) opined that the oil industry in Nigeria is the foundation of under-development in Ogba-land where cases of atmospheric thermal and surface pollution abound.

Expert reports of oil exploration in Iko Community in Ikot Abasi Local Government Area of Akwa Ibom State reveals that gas flaring has caused most of the buildings in the community, especially those structures with corrugated iron sheet roofs, to experience massive damage resulting in frequent changes and leakages. Apart from the burning and "die-back" effect of gas flaring, which were visible in plantain and cocoyam leaves, the dry humid mornings in Ikot harbour photochemical smog in the lower atmosphere and this causes irritation of the eye and the body (Environmental Rights Action, 1981).

Current statistics indicates that Nigeria accounts for about 28% of the total amount of gas flared globally (Abiodun, 2004). In the past decades, efforts have been made in Nigeria to cut back on gas flaring and eventually end the practice altogether. A major event in this regard was the start of natural gas exports in 1999 from plants at Bonny Island in the Atlantic Coast. The NLNG Company, formed in the early 1990's, is a joint venture involving Nigeria, Shell, Total-Elf, and Agip (Integrated Regional Information Network (IRIN), 2001).

Exxon Mobil has its own natural gas liquids projects which the company says is now using 70 percent of the natural gas obtained in its oil fields. Chevron has its Escravos gas project, which was the first to begin gas exports in 1997 and is currently undergoing expansion. Most of the companies are also in the process of setting up power plants that utilize gas such as the Independent Power Plant in Kwale/Okpai gas plant. With these projects, both Nigerian Government and oil company officials expressed hope that gas flaring would end by 2009. But until this point, gas flaring has not been stopped.

FIELD PROCEDURE

Distances were measured from the flare point at intervals of 40 m apart in four different directions. These measurements were carried out using a measuring tape. The use of a metal tape was excluded in this research work because of errors which may arises from the expansion and contraction of the metal due to high temperature of the environment.

Temperature measurements were carried out at a constant height of 1.68m from the ground level and between 9.00h and 11.00h GMT to minimize the effect of vertical temperature gradient and for uniformity of weather conditions respectively. This was repeated for 28 stations at a constant spacing of 40m and the average reading was recorded along the four cardinal directions respectively. For safety reason, I was not allowed stand too close to the flare stack and take measurements at distances of between 0m to 39m, hence temperature readings began at the distance of 40m away from the flare stack. The result obtained is as shown in Table 1.

ANALYSIS AND DISCUSSION OF THE RESULTS

The graphs of the observed temperature versus distance away from the flare point along the four cardinal directions were plotted (Figure 1). The curves show a decrease in temperature with increasing distance away from the flare point. From the graph, surface temperature along the four cardinal directions normalized at 28.1^0 C within a distance of 210m away from the flare point. The mean daily temperature of the study area is 26.8^0C (FEPA, 1995).

Thermal air pollution occurs if the recorded air temperature of the place deviate from its normal ambient temperature (Columbia encyclopedia, 2004). The mean temperature of our planet is fixed by a steady balance between the energy received from the sun and the quantity of heat energy radiated back by the earth (Ademoroti, 1996). Disturbance in either incoming or outgoing energy would upset this balance and the average mean energy temperature of the earth's surface would drift to a different steady value. The radiation energy that sends heat back into space cannot travel freely through the air. The byproducts of gas flaring such as water vapor and CO_2 absorb some of the radiation. In this way, they act as a blanket around the earth, hindering the escape of heat from the atmosphere. As more CO_2 is produced due to gas flaring, the CO_2 causes hindrance to the escape of energy radiated from the earth surface and so the earth warms up the more leading to an increase in temperature. This increase in temperature has an undesirable effect on man and his environment (Avwiri and Ebeniro, 1995).

Meanwhile, within kokori/Erho-Ike gas plant the temperature normalized at 28.1^0C.The study revealed that, the surface temperature has increased by 1.4^0C when compared with the mean normal daily temperature (26.8^0C). Hence the thermal equilibrium has been altered. This increase in temperature has enormous influence on the socio-economic lives and activities of the inhabitants.

Furthermore, observation within the area revealed that the cassava, plantain, palm trees, yam and other crops that were cultivated within the flare area had stunted growth and red leafs. While the inhabitants of Kokori/Erho-ike, who are mainly farmers migrate to other towns such as Onumane for settlement.

Table 1: Distance Temperature Variation at Kokori/Erho-ike Flow Station in the North, South, East, and West Directions.

S/N	Distance (Xm)	North (⁰C)	East (⁰C)	West (⁰C)	South (⁰C)
1.	40	50.1	52.0	42.1	45.1
2.	80	47.2	49.9	42.9	40.5
3.	120	43.3	43.0	39.7	38.3
4.	160	39.2	41.0	38.3	38.3
5.	200	31.1	31.0	31.0	31.0
6.	240	29.9	31.2	30.1	29.7
7.	260	29.7	30.2	31.4	29.7
8.	300	30.4	31.1	30.0	28.7
9.	340	30.9	31.9	30.0	28.7
10.	380	31.0	31.9	30.0	28.6
11.	420	30.8	32.0	30.0	28.8
12.	460	30.8	31.0	30.1	29.6
13.	500	29.8	33.1	30.1	29.6
14.	540	30.1	31.8	29.9	29.8
15.	580	32.2	31.9	30.0	29.3
16.	620	31.0	32.0	30.9	30.4
17.	660	30.4	30.7	31.9	28.1
18.	700	30.0	30.8	31.3	28.1
19.	740	30.1	30.2	31.4	27.0
20.	780	30.5	30.0	29.1	27.0
21.	840	30.4	30.1	29.1	27.1
22.	880	30.4	30.0	28.6	27.0
23.	920	30.7	29.7	27.4	26.7
24.	940	30.6	29.1	27.2	26.7
25.	1000	30.5	29.0	27.2	26.4
26.	1040	30.5	29.0	27.2	26.4
27.	1080	30.5	29.0	27.2	26.4
28.	1120	30.5	29.0	27.2	26.4

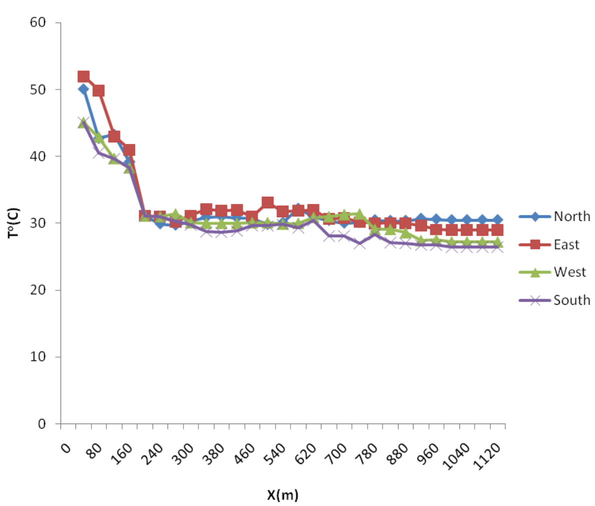

Figure 1: Characteristic Curves for Variation of Temperature (T) with Distance (X) for North, South, East, and West of the Flare stack.

CONCLUSION

Based on the deductions from the graph of distance/temperature at the Kokori/Erho-ike gas plant, the study revealed that, the surface temperature increased by 1.4^{0}C when compared with the mean normal daily temperature. Hence the thermal equilibrium has been altered. This increase in temperature has enormous influence on the socio-economic lives and activities of the inhabitants.

It is safe to conclude that gas flaring not only produces excessive heat which alters the temperature of the environment , but also causes gaseous pollutants to be present in the environment which may have adverse effects on the inhabitants including flora and fauna.

The temperature of the environment returns to normal at about 210m away from the flare stack. Residential buildings should therefore be located within this range of distance.

SUMMARY

As much as the Nigeria oil industry has affected the country positively, by fashioning a remarkable economic landscape and contributing to foreign exchange earnings, it also has a negative impact on the socio-economic life of the inhabitants and the environment of the host communities.

The cassava, plantain, palm trees, yam and other crops that were grown within the flare area were yellowish in color with stunted growth. Also observed in Kokori/Erho-ike was the migration of the inhabitants, who are mainly farmers, to other towns such as Onumane for settlement. This was attributed to he gas being flared, which raises the temperature above normal and also causes light pollution within the gas flare environment.

RECOMMENDATIONS

In view of the gas flaring situation at the Kokori/Erho-ike gas plant with respect to the negative impacts (socio-economic) on the environment, the following are recommended:

1. Gas should not be flared but harnessed with the aid of a gas turbine for electricity generation

2. With reference to Kokori/Erho-ike gas plant, residential areas should be situated at a minimum of 210m away from the flare point

3. Water analysis should be carried out on the area to ascertain the potability of the water

4. Chemical analysis of the roofing sheets should be carried out within and away from the area to determine the extent of corrosion.

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