

Effects of Gas Flaring On Surface and Ground Water in Irri Town and Environs, Niger-Delta, Nigeria

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Abstract: *Surface and ground water samples from gas flared area of Irri town and environs where gas flaring activities take place were analyzed for their heavy metals and trace element constituents and some physical characteristics. The results were evaluated with a view to determine and compare the quality and portability of the water from areas of high gas flaring activities with samples from areas of minimal gas flaring. The range of concentration of heavy metals were lead (0.181 – 0.245 mg/l), copper (0.000 to 0.007 mg/l) Zinc (0.001 to 0.19 gm/l), Nickel (0.1-0.13 mg/l), iron (0.02 – 1.42 mg/l) manganese (0.008 – 0.032 mg/l) cadmium (0.000). Some of these concentration levels are above World Health Organization (WHO) maximum permissible limits, the general results showed that water in the study area had acceptable quality for household utilization except the ones that contain excess lead and iron which may require treatment.*

Keywords: *WHO, Gas Flaring, Surface Water, Groundwater, Niger-Delta*

I. Introduction

The presence of unacceptable levels of foreign gaseous and particulate matters in the atmosphere is referred to as air pollution [18]. The deterioration of the environmental quality, which began when man first collected into villages and utilize fire has existed as a serious problem under the ever increasing impacts of exponentially increasing population and industrial society environmental contamination of air, water, soil and food has become a threat to continue existence of many plant and animal communities of ecosystem and ultimately threatens the very survival of the human race. Gas being flared into the atmosphere is one of such indiscriminate discharge. Petroleum industry operation is characterized by sets of hazards [3,4,5,14]. The nature and magnitude of these hazards are dependent on series of factors and varies significantly from one sector to another.

While it is true that Niger-Delta State of Nigeria suffers a great deal of immediate impact of gas flaring. It is now increasingly recognized that the contribution of the petroleum industry to the environment degradation goes beyond the immediate vicinity of the oil producing areas. The Nigeria Oil fields in the Niger – Delta Area produce about two millions barrels per day of oil and most of this oil comes from reservoir containing gas, which is produced with the oil [6,7,13]. This associated gas, a byproduct of the country's lifeline petroleum exploration activities is separated from the oil at the flow state and more than 95% of it flared. Currently a total sum of two billion standard cubic feet per day (SCF/day), which is estimated to be about a quarter of the world gas flared [14]. The impact of gas flared is of local and global concern. The main components of this flare include carbon (iv) oxide (CO₂), methane (CH₄), nitrous oxide (NO₂), water vapor and sulphur dioxide (SO₂). It is estimated that the Nigerian gas flared gas released 35 millions tons of carbon dioxide and 12 millions tons of methane in a year.

Since the discovery of oil in Nigeria, Niger- Delta region at Oloibiri of Bayelsa State in 1956, gas has been constantly flared. These result from the activities of the oil industries in the cause of the exploitation of crude oil or natural gas.

Gas flaring is therefore defined as the burning of natural gas and other petroleum hydrocarbons at flare site in the oil field and refineries during operations [9,20].

Gas Flaring In Nigeria

Our country is endowed with significant oil and even more gas reserves. Gas flaring in Nigeria is as old as oil production. The flaring has contributed more green house gases to the earth than all other source, yet it is not being used as a fuel. Nobody benefit from the energy it contains. Local people complain about the rearing noise and the intense heat from the flares. They live and work alongside the flares with no protection [19]. Generally, flaring was made illegal under regulations in 1984 and only allowed in specific circumstances on a field by field basis. Lately the deadline was moved from 2005 to 2010. Gas flares have potentially harmful effects on the health and livelihood of the communities in their vicinity as they release a variety of poisonous chemicals such as nitrogen dioxide, sulphur IV oxide, volatile organic compounds (benzene, hydrogen sulphide) and carcinogens. Human beings exposed to such chemicals can suffer from a variety of respiratory problems, aggregated asthma, dysentery, chronic bronchitis as well as breathing difficulties and pains [2,16,17,20].

II. Methodology And Sampling Techniques

Description of Study Area

Irri is situated in Isoko South Local Government Area of Delta State. Irri is one of the oil producing communities in Delta State with several oil wells. The people are mainly Isokos. They are industrious and hardworking. They indulge in farming, rubber tapping, petting trading etc. they are hospitable and receptive to all people.

The study area lies within the Niger Delta sedimentary basin which is characterized by both Marine and mixed continental quaternary sediments that are composed of abandoned beach ridges and mangrove swamps [2]. The area is bounded by latitude 5° 28' 0" North and longitude 6° 12' 0" East in this pattern, world >Africa > Nigeria > Delta > Isoko South > Irri geographical co-ordinate. The area experience wet and dry season which are typical seasons in Nigeria [14,15].

Data Collection

Samples of water were collected from around and within the flare site in the month of June 2012. Rainwater (directly from the sky), borehole water and surface water from a stagnant pool. Also samples of rain water, borehole and surface water were collected from irri environ where no gas flaring activities is evident. The samples were collected in clean plastic bottles and taken to the laboratory for analysis. To ensure that no foreign substance was introduced into the sample, the plastic containers were washed with the samples before final collection. Sample were analyzed after 48 hours of collection. Results were compared with the World Health Organization limit values.

Sampling Techniques

This is the method for the rapid determination of Pb, Cu, Zn, Ni, Cd, Fe and Mn in water samples using AA. This method is suitable for both dissolved and total metals in water and wastewater samples.

Principle

The sample was first aspirated into the flame or electrothermal device where it was vaporized and atomized, radiation of the proper wavelength was then passed through the vapour containing the ground state atoms of the metal where absorption occurs. The magnitude of the AAS absorption signal was directly proportional to the concentration of the analyze metal in the sample solution.

Apparatus and Reagents

The apparatus and reagents used include: Unicam 929 AA Spectrometer,(AAS) 100mg/l stock standard solution of Pb, Cu, Zn, Ni, Cd, Fe and Mn Conc HNO₃ Hot Plate, Volumetric flask, Distill water, Beaker.

Procedures

Sample preparation for turbid and waste water A representative portion of the well mixed sample (100ml) was transferred into a beaker and 5ml of conc. HNO₃ was then added. The solution was evaporated to near dryness on a hot plate, making sure that the sample does not boil. A gentle refluxing action of the solution was set by increasing the temperature of the hot plate. Heating was continued with addition of acid as necessary until digestion was completed (light coloured residue was obtained).

The beaker was allowed to cool and another 5ml of Conc. HNO₃ was added. The beaker was covered with a watch glass and returned to the hot plate.

1.2ml Conc. HNO₃ was then added to dissolve the residue. The residue was washed with distilled water and filtered to remove silicate and other insoluble material. The volume of the solution was adjusted to 100ml in a volumetric flask. A reagent blank determination was carried out, samples and reagent blank was analyzed for total heavy metals with the flame AAS.

Sample Preparation for Surface Ground Water Samples

Samples were not pretreated in any way they were analyzed directly using the AA.

Calibration and Analysis

Single elemental working standard solutions were prepared by dilution of 1000mg/l stock solutions of the individual elements (Pb, Fe, Cu, Zn, Ni, Cd and Mn).

A minimum of five standard working solution were prepared daily from the stock solution. The solutions ranged between 0.1mg/l to 10.0mg/l. External calibration was used by running de-ionized Water and a suite of calibration curve were then generated for each metal.

The extraction solution and blank were then run on the AA to obtain the absorbance values.

Concentrations of the metals in the water sample were then calculated from the equation of the calibration curve. The concentration level of the constituents were compared with the WHO [24] recommended standards.

Calculations

$$\text{Conc. Of Element } x \text{ (mg/l)} = A-B$$

Where, A = Conc. Of Element x (mg/l), B = conc. of blank (mg/l)

III. Result And Discussion

Result

The analytical results obtained in the research work and the World Health Organization WHO [23,24] stands for portable rain, surface and borehole water are presented in the tables below:

Table1: Sample Site 1-Physiochemical parameters results Obtained from Gas Flaring site

Parameter	Surface water	Rain water	Borehole water	WHO Standard maximum limit
PH	6.76	6.80	6.47	6.5 – 8.5
Alkalinity(mg/l)	16.00	20.00	14.00	500
Conductivity (mg/l)	7.00	22.20	60.00	-
Colour (Hu)	11.00	14.00	10.00	15.0 – 85.0
Hardness (mg/l)	24.20	17.70	18.45	500
Temperature (°c)	30.90	30.10	29.60	-
TDS (mg/l)	6.75	15.24	19.34	1000.0
Turbidity (NTU)	5.00	5.10	5.20	25

Table2: Sample Site 2-Physiochemical parameters results Obtained from Irri Environs with Minimal Gas Flaring Activities

Parameter	Surface water	Rain water	Borehole water	WHO Standard maximum limit
PH	6.40	5.50	6.45	6.5 – 8.5
Alkalinity(mg/l)	7.00	10.40	6.00	500
Conductivity (mg/l)	17.00	20.00	18.40	-
Colour (Hu)	34.00	31.00	29.50	15.0 – 85.0
Hardness (mg/l)	35.50	37.00	34.40	500
Temperature (°c)	30.00	29.00	30.10	-
TDS (mg/l)	78.10	6.20	7.80	1000.0
Turbidity (NTU)	5.00	4.60	5.00	25

Table3: Sample Site1- results obtained around the flare site

S/N	Standard methods	1	2	3	Mean	(mg/l) WHO limits (2007)
Sample I.D		Surface (mg/l)	Rain (mg/l)	Borehole (mg/l)		
Pd	ASTMD3559 – 96	0.195	0.245	0.181	0.207	0.05
Cu	ASTMDI688 – 95	0.007	0.007	ND	0.007	1.5
Zn	ASTMDI691 – 95	0.002	0.019	0.001	0.0073	5
Ni	ASTMDI1886 –94	0.07	0.1	0.13	0.1	N/A
Fe	ASTMDI068 – 95	0.08	0.02	1.42	0.507	1.0
Mn	ASTMD858 – 95	0.029	0.008	0.032	0.023	0.5
Cd	ASTMD355795	ND	ND	ND	ND	0.005

N/A = Not Available, ND = Not Detected

Note: The results obtained complied with WHO limit except those highlighted on bold.

Table 4: Sample Site 2 - Results Obtained from Irri Environs with Minimal Gas Flaring Activities

S/N	Standard methods	1	2	3	Mean	(mg/l) WHO limits (2007)
Sample I.D		Surface (mg/l)	Rain (mg/l)	Tap (mg/l)		
Pd	ASTMD3559 – 96	0.005	0.004	0.001	0.003	0.05
Cu	ASTMDI688 – 95	0.006	0.007	ND	0.004	1.0
Zn	ASTMDI691 – 95	0.002	0.018	0.001	0.007	5
Ni	ASTMDI1886 –94	0.08	0.1	0.14	0.107	N/A
Fe	ASTMDI068 – 95	0.08	0.02	0.22	0.107	0.3
Mn	ASTMD858 – 95	0.029	0.008	0.032	0.023	0.5
Cd	ASTMD355795	ND	ND	ND	ND	0.005

N/A = Not Available, ND = Not Detected

IV. Discussion

WHO [23,24] set the maximum permissible limits of heavy metals in our waters as follow: lead (0.05mg l^{-1}), copper (1.0mg l^{-1}), zinc (5.0mg l^{-1}), iron (0.3mg l^{-1}) manganese (0.1mg l^{-1}) cadmium (0.005mg l^{-1}) with the exception of lead and iron, all the water samples analyzed in this project were fully within these limits and therefore posed no danger to consumers as these specific heavy metals are concerned. For lead the surface, Rain and Tap water samples did not meet the WHO guideline value.

Conclusion and Recommendations

From the study, it is seem that gas flaring has untold effect on the environment especially in the study area which ranges from its effect on the waters to its effect in the atmosphere. For instance, high lead and iron content of the substance, high lead and iron content of the waters has been raced to gas flaring in the study area. Based on the results from the research work:

- It will be advantageous to utilize this gas alternatively either by expressing it to generate revenue or for other domestic uses to improve the standard of living in this our blessed country Nigeria. By so doing gas is seen as another service of fuel as this will go a long way to save our environment from pollution. This will also help to reduce its effect on human and animal beings.
- The promulgation of the associated gas re-injection of Nigeria which requires companies to stop flaring. This represents a regulative responses to the degradation of environment and the Niger-Delta which the study area is conduced as being caused by gas flaring the amendment of the said decree in 1955 by fixing a rate of 2 kobo as penalty for each thousand cubic of gas flared in a gross manifestation of the fact that environments have been ineffective legislation and enforcement of a more reasonable amount of N10, 000 penalty for each thousand cubic feet of gas flared as this will go a long way to reduce the rate of gas flaring.
- The government and companies should provide relief assistance to the communities involved in the study area as regards to provision of potable water treatment plants to enable them reduce the effects on their waters. Compensation and huge attention in terms of medical care should be paid to the host communities.

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