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Assessment of the Impact of Gas Flaring on the pH, Cd, Pb, Cu, Zn, Fe and Mn Concentrations in the Rainwaters of Jeddo Community, Delta State, Nigeria

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ABSTRACT: *This paper is focused on the possible impact of gas flaring on the pH, Cd, Pb, Cu, Zn, Fe, and Mn concentrations in the rainwaters of Jeddo community, Delta State, Nigeria. The Rainwater samples were collected from two locations in the community. The samples were then taken to the laboratory for analyses. The result for the pH for both samples of Rainwater 1 (R_1) and Rainwater 2 (R_2) (which are 6.20 and 6.00 respectively) showed that their pH did not comply with the acceptable limits of World Health Organization (WHO, 2003), National Environmental Standards and Regulations Enforcement Agency (NESREA, 2011), Department of Petroleum Resources (DPR, 2002) and Nigerian Standard for Drinking Water Quality (NSDQW, 2007). The result also showed that Cd, Pb and Mn all complied with WHO (2003), NESREA (2011), DPR (2002) and NSDQW (2007) domestic/recreational water quality limits; while the values of Cu, Zn and Fe metals generally did not comply with the safety standards.*

KEYWORDS: gas flaring, metals, rainwater, pH, Cd, Pb, Cu, Zn, Fe, and Mn

INTRODUCTION

Gas flaring is a universal technique for disposing incendiary, lethal or corrosive fumes, found in oil producing sites and refineries, to compounds that are less reactive [Deetz and Vogel, 2017]. It is the method of burning-off related gas from wells, hydrocarbon processing plants or refineries, so as to dispose of or to release pressure [Emam, 2015]. It is also when surplus hydrocarbons in oil and gas manufacturing are collected from the flow site/station and burnt un-empirically [Atuma and Ojeh, 2013]. It is the quick oxidation of natural gas with the discharge of gaseous particulate and high temperature into the atmosphere [Giwa et al., 2019]; and it takes place in the course of processing and producing crude oil [Ojijiagwo et al., 2016]

Five nations have the maximum flaring volumes in billion cubic meters (bcm) which are as follows: Russia (35), Nigeria (15), Iran (10), Iraq (10) and USA (5) [Deetz and Vogel, 2017]

The discovery of crude oil and natural gas in large quantity, in Nigeria, shifted the backbone of the Nigeria's economy from agriculture to these natural resources [Seiyaboh and Izah, 2017]; and Niger Delta, located in the southern area of the southern region of Nigeria [Adewale and Mustapha, 2015], is where gas flaring is widespread [Seiyaboh and Izah, 2017].

During gas flaring toxic chemicals are released into the environment. Examples of such chemicals are NO_2, SO_2, Volatile Organic Compounds (VOCs) like C_6H_6, $C_6H_5CH_3$, $(CH_3)_2C_6H_4$, H_2S, polyaromatic hydrocarbons, dioxins, benzapyrene and particulates [Seiyaboh and Izah, 2017]; and the composition and quantity of natural gas flared determines the amount and type of pollutants emitted [Giwa et al., 2019]. Also gas flaring radiates heat and causes thermal conduction into the environment; and also, bring about noise pollution [Ibitoye, 2014].

Even though developed nations have employed the use of modern technology to now process the natural gas for commercial advantage or to re-introduce it into reservoirs (instead of flaring the gas, as they did before), nonetheless, Nigeria amongst numerous sub-Saharan African countries, still utilize gas flaring technique to remove associated gas during operations in the oil sector. Unfortunately, due to the composition of the natural gas, 'flaring' of associated gas results in the release of emissions rich in carbon oxides, nitrogen oxides, sulphur oxides and soot [Akpojivi and Akumagba, 2005]

This study therefore seeks to assess the impact of gas flaring on the pH, Cd, Pb, Cu, Zn, Fe, and Mn concentrations in the rainwaters of Jeddo community, Delta State, Nigeria

METHODOLOGY

Collection and Preservation of the water Samples

The rain water samples were collected in Jeddo town in Delta State of Nigeria. 1 Litre each of the rain water samples were collected, on the 2^{nd} and 16^{th} of June, 2020, in a well labelled 1 Litre containers, respectively. The samples were then preserved by refrigeration. This is to keep the samples as cool as possible, so as to avoid possible volatilization or biodegradation of the samples before their analyses [APHA, 2018].

MATERIALS

pH meter, Glass electrode, Reference electrode, Beakers, Stirrers, Flow chamber, Atomic Absorption Spectrophotometer (AAS)

Method of the Water Samples Analysis

pH Analysis

After standardizing the instrument with pH buffer 2 and 3, equilibrium between electrodes and sample was established by stirring sample to ensure homogeneity. The sampled was stirred gently to minimize CO_2 entrainment. The electrode was blot dried and immersed in a fresh sample, and the pH was read [APHA, 2017].

Heavy Metals (VARIAN 220 FS) Analyses

The concentration of the following heavy metals: **Cadmium (Cd), Lead (Pb), Copper (Cu), Zinc (Zn), Iron (Fe) and Manganese (Mn)** were determined by Flame Atomic Absorption Spectrophotometry (F**AAS**) Varian-220 FS, analysis for the metals of interest was by direct aspiration into the AAS. The concentration of each metal was determined by spraying the

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extracts into the flame, light rays from a hollow cathode lamp is shone through the flame which triggers the atoms of the elements being determined to absorb radiation from the lamp. The absorption is proportional to the concentration of each element in each sample, which was then detected [APHA, 2017].

RESULTS FINDINGS

Table 1: pH and Heavy metals in R_1 and R_2

Parameters	R_1	R_2	WHO Limits 2003	NESREA Limits 2011	DPR Limits 2002	NSDQW Limits 2007
pH	6.20	6.00	NS	6.5-8.5	6.5-9.2	6.5-8.5
Cd (mg/L)	<0.001	<0.001	0.003	0.005	NS	0.003
Pb (mg/L)	<0.001	<0.001	0.01	0.01	NS	0.01
Cu (mg/L)	<0.001	0.020	2.00	0.001	1.5	1.00
Zn (mg/L)	0.035	0.041	NS	0.01	15.0	3.00
Fe (mg/L)	0.611	0.507	NS	NS	1.0	0.3
Mn (mg/L)	<0.001	<0.001	0.4	NS	0.5	0.2

R_1: Rainwater 1; R_2: Rainwater 2; NS: Not Supplied; Cd: Cadmium; Pb: Lead; Cu: Copper; Zn: Zinc; Fe: Iron; Mn: Manganese;

DISCUSSION

The pH level of the R_1 and R_2 (which are 6.20 and 6.00 respectively) did not comply with the National Environmental Standards and Regulations Enforcement Agency (NESREA, 2011), Department of Petroleum Resources (DPR, 2002) and Nigerian Standard for Drinking Water Quality (NSDQW, 2007) limits, which showed that the R_1 and R_2 are more acidic than the acceptable limits; because a pH with a value that is less than 7 is said to be acidic while that with a value more than 7 is said to be basic [Obi et al., 2016]. Because the R_1 and R_2 both have low pH value, they will result to acid rain; and from the study conducted by Obi et al. (2016) on environmental influence of gas flaring on the value of soil pH in some communities in Niger Delta of Nigeria, acid rain is brought about by the release of SO_2 and NO_2, which reacts with molecules of H_2O in the air.

Cd for the R_1 and R_2 samples, have values that are less than the acceptable limit of World Health organization (WHO, 2003), NESREA (2011), and NSDQW (2007). This then means that the presence of Cd in the rain water samples have no impact on the rainwater samples, and as a result will not have impact on the environment.

Pb in the two samples have values less than 0.001 mg/L, respectively; which are less than the acceptable limit of Pb from WHO (2003), NESREA (2011) and NSDQW (2007) limits. This shows that the gas flaring activity has no impact on the concentration of Pb in the rain water sample in the Jeddo community.

The amount of Cu in R_1 is less than the limit of Cu from WHO (2003), NESREA (2011), DPR (2002) and NSDQW (2007) standards, while the R_2 exceeded the limit of Cu from NESREA (2011) standard, and therefore failed to comply with the NESREA limit. This then implies that

Cu has significant value in R_2 samples, which in turn will lead to a detrimental impact on the environment.

The values of Zn in the R_1 and R_2 samples complied with the DPR (2002) and NSDQW (2007) standards, but went above the NESREA (2011) limit. This goes to show that Zn has significant value in the R_1 and R_2 samples, which in turn can pose a possible danger to the environment.

The content of Fe in the two samples complied with the DPR (2002) limits, but went above the NSDQW (2007) limit. This shows that the quantity of Fe in the two samples has significant values in the samples, and potentially dangerous to the environments.

Mn values for the two samples all complied with the WHO, DPR and NSDQW limits. This means that the quantity of Mn in the samples will be harmless in the environment.

CONCLUSION

The results showed that rain water from the Jeddo community was affected by the emission from the gas flaring in the community: with the pH of the Rainwater samples being acidic; with the concentrations of Cu (for R_2) and Zn (for R_1 and R_2) above the NESREA (2011) limit; and the Fe concentrations for the R_1 and R_2 above the NSDQW (2007) limits. Therefore is recommended that inhabitants of Jeddo community should be discouraged on using the rainwater for domestic purposes. Also the government of Delta State should demand for a comprehensive Environmental Impact Assessment (EIA) from the Stakeholders of Gas Flaring Industries before issuing them a license for Gas Flaring. Also the Nigerian government should look at providing an improved method of Gas Flaring, which will reduce the emission to the atmosphere.

FUTURE RESEARCH

Further studies should be made on the impact of gas flaring in air, soil and vegetation.

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