IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 10, Issue 1 Ver. II (Jan. – Feb. 2018), PP 75-78
www.iosrjournals.org

Preliminary Investigation of Ph and D.C Conductivity Trend of Surface Water Sources in the Neighborhood of a Cement Factory in Gboko, Benue State – Nigeria.

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Abstract: *The effect of cement production on surface water bodies with the vicinity of Benue cement company Gboko now known as Dangote cement company Gboko was investigate using pH and d.c. conductivity of water samples in a radius of 5km in the direction of wind. The results of pH and d.c. conductivities were found to be in the following ranges; 7.2 - 7.7 and 49.85 - 185.35 µScm^{-1} in 2003; 7.9 - 8.6 and 26.00 - 456.00 µScm^{-1} in 2009; and 7.7 – 8.1 and 44.03 µScm^{-1} – 167.00 µScm^{-1} in 2017. The pH value ranges were found to fall within WHO recommended standar4ds of 7.0 - 9.2 while the upper limits of the d.c. conductivities ranges shows that the d.c. conductivities are below the WHO limit of 120-140 µScm^{-1} except in 2009 . Both results revealed that the variations in both parameters decreases with distance as one of moves away from factory. Since, the pH and d.c conductivity of waters is a measure of concentration of ionized chemicals in water (Hydrogen activity or purity of water). The chemical parameters of water should be assessed at regular intervals so that chemicals that are likely to emanate from the cement production processes will be controlled or avoided from finding its way into the surface water bodies in the vicinity the factory.*

Keywords: *Water quality, Environmental /health effects, pH, d.c Conductivity Portland Cement.*

Date of Submission: 12-02-2018 Date of acceptance: 26-02-2018

I. Introduction

Water in essential for all forms of life, its reliable and safe supply is a pre-requisite for a healthy community (Adeyemo, 2003). Any community without safe water supply is likely to suffer from water borne diseases. Water occupies oven 70% of the earth surface both the total percentage of water accessible to man is only 0.6% (Heinke, 1989; Oyenike, 2003, Krant and Kifferstein, 2008). Unfortunately, this 0.6% accessible water sources are open to pollution of all kinds such as run-off from municipal and urban settlements, industrial and Agricultural waste. All these contributed to degradation of water quality.Nigeria dependence on technology has increased tremendously after independence. This to some extent has improved the quality of life of her people. Alongside their development is the increased industrial pollution problem (Faboya,1997). According to World Bank report Published in 1993, there were about 300 industries in Nigeria. The number has increased greatly as large and small scale industries such as cement industries springs up yearly. The establishment and commissioning of Benue cement company Plc, Gboko 1979 and 1981 respectively has contributed immensely to the development of Benue state by providing cement for construction of houses, bridges and roads etc. It is a source of income to the state government as well as the federal government of Nigeria and has also provided employment opportunities for the teaming population of the immediate environment. However, the industrial pollution emanating from the companies seem to have negative impact on water quality in the company environment (Iyotyer, 1993). Hazardous wastes are generated by every industry; even those industries that themselves generate few hazardous wastes nonetheless use products from hazardous waste generating industries (Tajudeen and Okpuzor, 2011). Pollutants emitted into the environmental during cement production process are known to cause serious health and environmental problems (Meo, 2004; Mohammed and Sombo, 2008). Major Pollutants emitted from cement industry include SPM, SO_x, NO_x, CO_2 emissions and heavy metals like chromium, nickel, cobalt, lead and mercury (Baby et al., 2008). Other pollutants are oil spillages. This comes from primary and secondary crushes, mobile plant workshop and sites; soiled drum from tank sites, kiln sites etc. through leakage and spillage (Afolabi et al., 2012). Limestone excavation results in conversion of farmlands and settlements into quarry site and lakes in which water released from the limestone deposits is most times not developed into fish ponds or recreation centres, consequently resulting to breeding sports for pathogens such as mosquito, which causes malaria (Aribigbola et al., 2012). Research by Soleye (1968) on the effects of cement dust from Ewekoro cement works in Nigeria revealed that rivers and streams within the vicinity were polluted to the extent that villagers stopped using water from them; dug wells became unproductive and food crop production drastically reduced. At present, environmental pollution has become a serious problem to the inhabitants of Tse-kucha, Amua and Yandev settlement in Particular. According to Iortyer (1993) “the sitting of this multimillion naira company is more of a curse than blessing to these three rural communities. The owners, government and shareholders benefit from the economic gains while the inhabitants of the area reap social and environmental hazards caused by the company”.This research work seeks to determine the impact of the operation of Benue Cement Company (Dangote Cement Company) on water quality in its vicinity as well as the pollution trend so as to set up a monitoring program and proffer measures to eliminate/reduce water pollution that may arise from cement production. Material and MethodsSurface water samples were collected around Benue Cement factory site in a radius of 8km. The samples were thoroughly stirred for even distribution of solutes in the samples after which pH and d.c. conductivity measurements were made using digital Hanna water tester (Model; 730 Portugal); Suntex (Ts-2) water pH meter and Hach C0150 conductivity meter respectively.The meters were calibrated using standard buffer solutions with pH 7.0 and 4.0 After the calibration, the the water sample to be investigated was poured into the sample compartment of the Hanna water tester in pH mode. The pH values were displayed on the digital readout screen. After every reading, the meter was switched off and the same compartment was rinsed with de-ionized water. The same procedure was followed in the measurement of d.c. conductivity with the tester in the d.c conductivity mode.

II. Results and Discussion

Table 1: pH and d.c conductivity measurements in 1999 (27.0 ± 0.5^0C)

Location	Code	Conductivity (μScm^{-1})	pH
Tse-Kucha	A_0	160.20 ± 0.26	8.9 ± 0.3
Amual (Power Station)	B_0	154.70 ± 0.34	8.2 ± 0.1
Amua Estate	C_0	63.40 ± 0.18	8.1 ± 0.6
Amua Settlement	D_0	43.70 ± 0.32	8.0 ± 0.3
Tyeku	E_0	40.20 ± 0.47	7.8 ± 0.4

Table 2: pH and d.c conductivity measurements in 2003 (27.0 ± 0.5^0C)

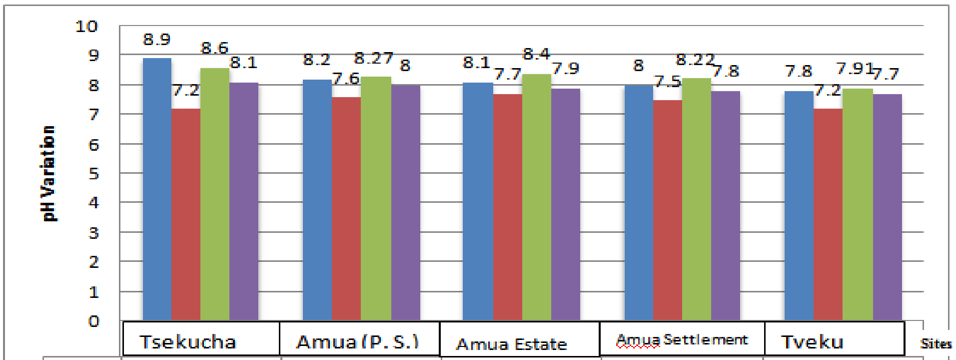
Location	Code	pH	Conductivity (μScm^{-1})
Tse-Kucha	A_1	7.2	132.35 ±
Amual (Power Station)	B_1	7.6	185.30 ±
Amua Estate	C_1	7.7	60.41 ±
Amua Settlement	D_1	7.5	49.85 ±
Tyeku	E_1	7.2	87.65 ±

Table 3: pH and d.c conductivity measurements, 2009 (27.0 ± 0.05^0C)

Location	Code	pH	Conductivity (μScm^{-1})
Tse-Kucha	A_2	8.60 ± 0.46	456.00 ±0.46
Amual (Power Station)	B_2	8.27 ± 0.23	314.00 ± 0.23
Amua Estate	C_2	8.40 ± 0.52	26.00 ± 0.52
Amua Settlement	D_2	8.22 ± 0.19	35.40 ± 0.19
Tyeku	E_2	7.91 ± 0.28	83.00 ± 0.28

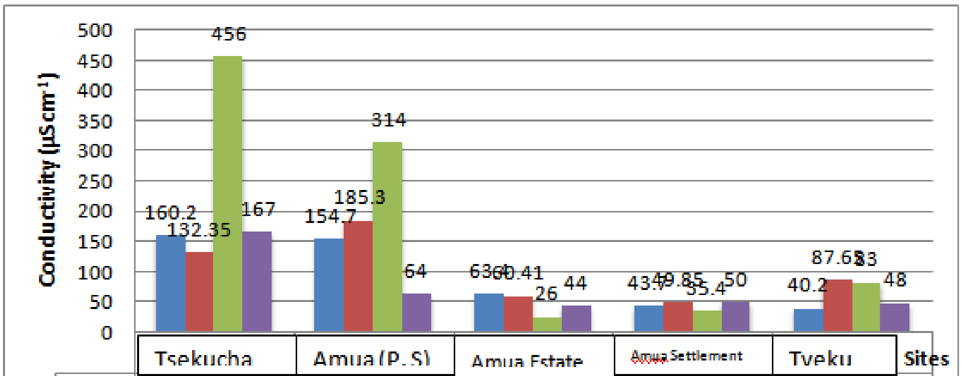
Table 4: pH and d.c conductivity measurements, 2009 (27.0 ± 0.05^0C)

Location	Code	pH	Conductivity (μScm^{-1})
Tse-Kucha	A_2	8.1	167.0 ±
Amual (Power Station)	B_2	8.0	64.0 ±
Amua Estate	C_2	7.9	44.0 ±
Amua Settlement	D_2	7.8	50.0 ±
Tyeku	E_2	7.7	48.0 ±



	Tsekucha	Amua (P. S.)	Amua Estate	Amua Settlement	Tveku
1999	8.9	8.2	8.1	8	7.8
2003	7.2	7.6	7.7	7.5	7.2
2009	8.6	8.27	8.4	8.22	7.91
2017	8.1	8	7.9	7.8	7.7

Fig1: variation of pH with sites during wet season



	Tsekucha	Amua (P. S)	Amua Estate	Amua Settlement	Tveku
1999	160.2	154.7	63.4	43.7	40.2
2003	132.35	185.3	60.41	49.85	87.65
2009	456	314	26	35.4	83
2017	167	64	44	50	48

Fig2: variation of conductivity with sites during wet season

The results of this work revealed that surface water sources in the vicinity of the cement factory have pH and d.c. conductivity ranges of 72.-7.7 and 87.65 -132.35µScm^{-1}; 7.91-8.6 and 26.0 – 456.0µScm^{-1} and 7.7-8.1 and 44.0-167.0µScm^{-1} in 2003, 2009 and 2017 wet seasons respectively. Generally, the d.c conductivity values decreased further from the factory. The closest sampling points, TseKucha and Amua Power Stem recorded the highest pH value while the fastest sample points Amua Estate, Amua settlement and Tyeku recorded the lowest values for the Period investigated. The d.c. conductivity of water depends largely on the quality of dissolved salts present in water. These dissolved inorganic solids include chloride, nitrates, sulphates and phosphate ions, sodium, magnesium, calcium iron and aluminum cations (Tebbuth, 1990). Introduction of Impurities (e.g. electrolytes) raises the conductivity of water. Even the smallest ionic impurities leads to a large increase in electrical conductivity of water (Vogel,1989). Industrial discharge can contribute ions to receiving waters or may contain substances that are poor conductors (organic compounds) thereby changing the conductivity of the receiving water (Stoddard et al., 1999). This implies that d.c. conductivity can be used to detect pollution sources. Although the value of d.c. conductivity for the sampling sites are within WHO (1984) safety limit of 120 -140µScm^{-1} except that of Tse –Kucha and Amua power station (in 2017) whose values are higher than the maximum range (140µScm^{-1}) as shown in fig I. This suggests that traces of chemical wastes from the factory finds its way into the nearby surface water sources. Water borne diseases are likely to be a challenge to this host community since both human and their animal drink from these sources. Measurement of pH of water is vital to water quality assessment, since most aquatic organism live within very narrow pH limit (Ency. Americana, 1981) Fresh water sources with ph below 5.0 or above 9.5 may not be able to sustain plant and animals species. The pH value of surface water sources in the vicinity was observed to be fairly constant (i.e. basic in nature) and within the WHO (1984) of 6.5 - 8.5. It also decreases as one move further from the factory. Oral interview with the villagers during pre-luminary survey in 2003 revealed that Ngo stream in Tse-Kucha is polluted to a level that fishes caught from the stream are not fit for consumption since they had oily flavor; their tomatoes and pepper nurseries often die-off when irrigated with water from the stream; skin etching after bath prevented the community from using the stream water.

III. Conclusion

Result of this work revealed that surface water sources within the cement factory are were safe except in the year 2009 and the pollution pattern decreased with increase in distances from the factory. This suggests that untreated wasted from the company may have found its way into the surface water sources within the factory.

Recommendations

From the results of the investigation, the following:

(i) Electrostatic precipitator should be installed so as to control dust emitted into the environment.

(ii) Chemical waste should be treated before disposal.

(iii) Air and water quality monitory programs should be established in the host community.

(iv) Organizations charged with the responsibility of preserving our environment should be encouraged to discharge their duties diligently so as to avoid further degradation of surface water sources.

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IOSR Journal of Applied Physics (IOSR-JAP) is UGC approved Journal with Sl. No. 5010, Journal no. 49054.

Sombo T " Preliminary Investigation of Ph And D.C Conductivity Trend of Surface Water Sources In The Neighborhood of A Cement Factory In Gboko, Benue State – Nigeria..” IOSR Journal of Applied Physics (IOSR-JAP) , vol. 10, no. 1, 2018, pp. 75-78.