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Impact of Drilling Wastes on Surface Water Acidity in South-South Nigeria

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Abstract:
This study examined the impact of drilling waste on surface water acidity in South-South Nigeria. The objective of the study was to determine the acidity of drilling wastes contaminated surface water in the region. Drilling waste contaminated surface waters in seven (7) different locations in South-South Nigeria were survey. Surface water samples from the selected locations were collected and analyzed for pH every month for a period of six (6) months (June to November 2017) using a graduated pH meter. Results revealed that the drilling fluid contaminated surface waters were slightly acidic, a situation which reduces the water quality significantly; the surface waters contaminated with drilling fluids contains metallic ions, hydrocarbons and related substances which are ever-present pollutants of the acidic water environment in differing concentrations; acidic surface waters have negative health consequences such as cancer, renal disorder, stroke and related health problems. Based on the study findings, the need for public sensitization on their right to safe environment and the establishment of an entirely independent agency that will ensure that community environmental resources are protected while oil and gas companies carry out their operations were recommended

Keywords: *Drilling, drilling waste, surface water, acidity, south-south Nigeria*

1. Introduction

Globally, petroleum ranks high as one of the natural resources that has contributed significantly to the economic development of most nations of the world, especially the oil and gas producing countries. In Nigeria, petroleum and related products occupies a focal position in the industrial and economic scheme of things as it contributes a great deal to the country's Gross Domestic Product (GDP). However, exploration of petroleum produces a considerable amount of drilling wastes. Drilling wastes are byproducts of oil and gas well exploration processes. Most drilling related activities exert adverse effects on the ecosystem and a large proportion of drilling wastes are associated with cuttings and related substances disposal. The forms of drilling wastes include produced water, oil and water-based waste, completion fluid, stimulation fluid, petroleum sludge among other drilling discharges (Drilling Lexicon, 2017).

Offshore oil and gas operations are usually associated with unwanted waste materials which could take the form of solid, liquid or gas. Nonetheless, of all drilling discharges, produced water constitutes a dominant part of oil and gas exploration waste. Produced waters are secondary products of oil and gas exploration and production activities which includes injection water, brine, formation water and related fluids. Minerals in form of dissolved ions such as chloride, magnesium, sodium, potassium and sulfate are major constitutes of produced water (Patin, 1999). Produced waters which are actually byproducts of drilling causes physical and chemical changes in surface water, a situation that could be harmful to aquatic organisms or make water less useful or unfit for use.

Another form of drilling waste is oil-based waste which includes lubricants, spacers, formation solids and oil-based muss all of which are composed of heavy metals, organics, aromatics and biocides which pose potential harmful effects when discharged into surface water (Onwukwe & Nwakandu, 2012).Surface waters are waters flowing freely on the surface of the earth and include rivers, streams, lakes among other flowing water sources. The composition of surface water can be altered by the discharge of waste materials such as drilling waste into it.

Closely connected to oil-based drilling wastes are the completion fluids which are liquids used in testing oil wells and minimizing damages associated with formation. Completion fluid which is a combination of formats, chlorides and bromides has high pH which could bring about chemical changes on surface water when discharged into the environment. Other drilling wastes such as stimulation fluid and petroleum sludge also have the potential to change the chemical composition of surface water. Stimulation fluids are water-based mediums prepared as a treatment fluid for oil and gas stimulation process. However, stimulation fluids which are sometimes discharged into surface water as drilling waste are highly acidic making aquatic subsistence and overall survival unfavourable (Slumberger, 2017). Petroleum sludgeis waste

produced from storage of oil and gas products, most times from crude oils. Oily sludge is harmful petroleum waste that could alter the chemical composition of surface water (Oil Filed Tekniks, 2017).

The huge amount of predictable hydrocarbon dispersed globally into the environment due to drilling waste discharges could change the usual state of the physical surroundings including surface water which could lead to issues that could be harmful to human health (Gazali, Alkali, Mohammed, Djauro, Muhammed & Kodomi, 2017). Drilling waste alters the pH of surface in such a way that they become acidic. However, the level of acidity varies depending on the characterization of drilling waste (Antai, Iwatt & Agbor, 2016). Drilling waste has the following constituent's levels of Pb, Cd, Zn, Ni, and Cr beyond permissible limits (Adewuyi, Etchie & Ademulegun, 2011; Abdus-Salam, Ademola & Bello, 2017). The release of drilling wastes into surface water exerts effects on water resources and enormous depletion of living organism in the habitat as surface waters contaminated with drilling wastes have varying degree of acidity (Ayotamuno, Akor & Igho, 2002). Pollution and breakdown of the environment associated with oil and gas operations have become a major issue of public concern globally. Nations including Nigeria are now paying more attention to measures that could help in minimizing as well as stopping contamination of the ambient environmental settings. Most times, petroleum pollutants such as drilling wastes are discharged into surface waters in South-South Nigeria, geopolitical zone that has a great wealth of oil and gas-related products (Kadafa et al., 2012). Key petroleum companies' activities occur in the South-South region of Nigeria, a regionmade up of six 960 oil producing states which includes Akwa Ibom Bayelsa, Cross Rivers, Delta, Edo and Rivers. However, despite the economic gains from oil and gas exploration in the South-South region in Nigeria, individuals, families and groups in the oil producing communities report evidence-based surface water pollution with oil and gas wastes, more particularly drilling wastes. A situation that could have inimical consequences on survival, sustenance and overall existence of the populace which is mainly rural. In the light of this study investigated the impact of drilling wastes on surface water acidity in South-South Nigeria with a view to ascertaining the pH of drilling waste contaminated surface waters in the region.

2. Materials and Method

Drilling waste contaminated surface waters in seven (7) different locations in South-South Nigeria were survey. Surface samples from the selected locations were collected and analyzed forpH every month for a period of six (6) months (June to November 2017) using a graduated pH meter and the study findings were presented in tables to allow for clarity and better understanding.

3. Results and Discussion

3.1. Results

Sws	Ph (June)	Ph (July)	WHO Standard For Treated Water
1	5.8	6.2	7-8
2	4.6	6.8	
3	6.2	5.3	
4	6.4	4.6	
5	4.8	6.8	
6	5.6	6.5	
7	6.1	6.6	
Mean	5.6	6.1	

Table 1: Ph of Analyzed Surface Waters in South- South Nigeria for June and July 2017

Table 1 shows the pH of analyzed surface waters in South-South Nigeria for June and July, 2017. The pH values of 5.6 and 6.1 indicate that the seven (7) selected drilling fluid contaminated surface waters were slightly acidic.

SWs	pH (August)	pH (September)	WHO Standard for Treated Water
1	5.6	6.3	7-8
2	4.8	6.6	
3	6.1	5.0	
4	6.6	4.8	
5	4.8	6.6	
6	5.4	6.4	
7	6.1	6.8	
Mean	5.6	6.0	

Table 2: Ph of Analyzed Surface Waters in South- South Nigeria for August and September 2017

Table 2 shows the pH of analyzed surface waters in South-South Nigeria for August and September, 2017. The pH values of 5.6 and 6.0 indicate that the seven (7) selected drilling fluid contaminated surface waters were slightly acidic.

SWs	pH (August)	pH (September)	WHO Standard for Treated Water
1	5.4	6.4	7-8
2	4.6	6.8	
3	6.3	5.1	
4	6.6	4.8	
5	4.8	6.8	
6	5.4	6.4	
7	6.3	6.6	
Mean	5.6	6.1	

Table 3: pH of Analyzed Surface Waters in South- South Nigeria for October and November 2017

Table 3 shows the pH of analyzed surface waters in South-South Nigeria for October and November, 2017. The pH values of 5.6 and 6.1 reveals that the seven (7) selected drilling fluid contaminated surface waters were slightly acidic.

4. Discussion

The study findings revealed that drilling wastes contaminated surface waters in South-South Nigeria are slightly acidic. This means that drilling wastes contaminated surface water has a significant level of hydrogen ions. The results of this study are consistent with the report of Swingle (2000) that organic wastes such as drilling wastes make surface water acidic. The findings of a study conducted by Antai et al (2016) that drilling waste polluted water contains acidic constituents. Antai et al (2016) further stated that the acidic constituent of drilling waste contaminated surface water emanates from the use of pollutants of hydrocarbons in the environment. The submission of Uzoekwe and Oghosanine (2011) that oil and gas exploration waste water emitted into surface waters, makes the water environment slightly acidic. Thus, drilling waste contaminated surface water poses considerable challenge for survival of the populace, as such waters are unfit for domestic and related use. Metallic ions including lead, zinc, copper and manganese seeps easily into acidic surface waters. This elevated levels of metallic ions in acidic surface water contaminated by drilling waste places consumers of such water at risk for health disorders such as renal impairment, cancers, hypertension, cerebrovascular disease and transient loss of memory. According to Water for Life USA (2017), the harmful effects of acidic water on health is associated with the fact that it brings about oxidation of body cells resulting is stress to the various systems of the body. Culligan Water (2017) reports that there is a high concentration of copper, zinc, iron and manganese in acidic surface water which brings about water hardness and staining of household items when used for domestic purposes. Individuals, families and groups who consume acidic surface waters experiences health challenges which manifests as stomach upset, liver pathology, nausea, vomiting and disorders of the nervous system among other problems (Culligan Water, 2017). The acidification of surface water by drilling wastes discharge has potential and actual inimical consequences on the health, survival and overall well being of the society.

5. Conclusions

Breakdown of the ecosystem has become a major issue, one that has become a distressing on a global scale. The problem of environmental contamination especially pollution of surface waters with byproducts of oil and gas operations is a highly reported problem in South-South Nigeria. This reported trend has pushed government and international agencies to regulate the activities of petroleum companies as regards environmental protection, communities especially the oil producing area exerts unswerving effects on the water environments. Drilling waste contaminated surface waters in South-South are slightly acidic. The adverse impacts of drilling waste disposal into surface water are associated with the fact that drilling waste contains metallic ions, hydrocarbons and related substances which are ever-present pollutants of the environment in differing concentrations. Nations including Nigeria are therefore paying attention to the formulation and implementation of policies that will help ensure sustained scrutiny and assessment of oil and gas companies' operations especially on issues of compliance to environmental protection standards. The need for public sensitization on their right to safe environment and the establishment of an entirely independent agency that will ensure that community environmental resources are protected while oil and gas companies carry out their operations are hereby recommended

6. Acknowledgement

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7. Abbreviations

pH: Potential for Hydrogen
Pb: Lead
Cd: Cadmium
Zn: Zinc
Ni: Nickel
Cr: Chromium

8. References

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