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OIL SPILLAGE AND ITS DEVASTATING EFFECTS ON FISHING AND DRINKING WATER OF IKHORIGHO AND OTUMARA COMMUNITIES IN OIL PRODUCING AREA OF ONDO STATE, NIGERIA

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Abstract: The devastating effects of oil spillage on the fishing and drinking water of Ikhorigho and Otumara communities in oil producing area of Ondo State were investigated. Water samples were collected from fishing sites (FW) and some streams which serves as drinking water in both communities. The water samples from fishing sites (FW) and drinking water (DW) were taken from these communities because of numerous oil spillages recorded in the area. The samples were thoroughly mixed to have a composite sample. The water collected from both fishing and drinking water were analyzed to determine pH, electrical conductivity (EC), dissolved oxygen (DO), total dissolved solid (TDS), turbidity (T) and total hardness (TH) using the method of Ademoroti [19]. The results obtained showed that both the fishing and drinking water are highly polluted when compared with WHO [11] standard as the values for fishing water are pH 3.2; DO 3.8; EC 580; TDS 640; T 28 and WH 460 while that of drinking water are pH 3.6; DO3.1; EC540; TDS 680; T 32 and WH 490 respectively. Heavy metals contents in water samples were determined using Atomic Adsorption Spectrophotometer (AAS). The results showed that drinking water was polluted with all the tested metals while the fishing water accumulated most of the tested metals except Cu and Ni which were not detected. These metals may pass to humans’ body through food chain. Since Fe, Zn, Mn, Cd, Pb, Zn and Cr are known to be neurotoxic therefore the people drinking the water and eating the fish from the fishing water may be neurotoxicity.

Key words: Animals, Fishing Oil Spillage, Heavy Metals, People, Physico-chemical Properties, Water

1. Introduction

Oil spillage is the most universal problem associated with oil production in oil producing area of Ondo State. Despite the gross earnings and economic benefits derived from petroleum production in these areas, the indigenous people dwelling in the areas surrounding oil extraction are seriously suffered for water pollution. The prospecting and exploration of oil involves releasing of drilling mud and oils which seep into the streams, surface or underground water making them unfit for either fishing or drinking purpose [1]. The most obvious and visible sources of oil spillage in this environment are due to sabotage, corrosion of pipes and storage tanks; carelessness during oil production operations and oil tankers accidents. Most of the residents in Ikhorigho and Otumara communities fetch drinking water directly from stream and creeks that has been seriously polluted by oil spillage since no other options available to them. This is the major reason for the predominance of various diseases in the area because crude oil contains some thousands of different chemicals which are toxic and known to be carcinogenic with no determined safe threshold for human consumption [2]. Contaminants of aquatic ecosystems can be confirmed by determining levels of contaminants in water, sediment and organisms. Fish and other aquatic animals in this area acquire an objectionable oily odour (tailing) when expose to prolonged concentrations of oil and thereby loose their market values and inedible [3]. Birds (ducks, geese) are the most visible victims of the oil spill because of their like-hood exposure as they float on water surface with the oil and their feathers cannot repel water, thereby
causing them to lose body heat rapidly and drowning. When bird ingests oil that adheres to its body through the activity of preening that inhibits the movement of water and sodium across the gut wall, it caused the bird to be dehydrated or starved [4].

2. Materials and Methods

2.1 Sample Collection

The fishing and drinking water samples were taken at Ikorigho and Otumara communities because of numerous oil spillages recorded in the area. The samples were collected with plastic containers that had earlier been evacuated and fully sterilized. The samples were thoroughly mixed to have composite sample. The samples from fishing water were labelled as FW while those from drinking water were labelled as DW.

2.2 Laboratory Analysis

The composite samples were analyzed at Chemistry Laboratory of the Department of Industrial Chemistry of Federal University of Technology, Akure. The physiochemical properties of the water and their respective values obtained were recorded in Table 1: The pH values were measured by using a pH meter while the Electrical conductivity (EC) values were measured with a conductivity meter (Model DDS – 307). Dissolved oxygen (DO) was determined by iodometric test (Winklers method) procedure. Total dissolved solid (TDS) and Turbidity (T) were determined by using Hatch TDS meter and Hatch turbidity spectrophotometer respectively as described by APHA and Ademoroti [5,6]. Compleximetric titration method was employed in the determination of Total Hardness (TH). Heavy metals Fe, Pb, Cd, Cu, Zn, Se, Ni, Mn and Cr were determined at their respective wavelength and detection limit using the Bulk Scientific Atomic Absorption/Emission Spectrophotometer –200A and their respective values obtained were recorded in Table 2.

3. Results and Discussion

3.1 Result

Table 1 Physico-chemical Analysis of Water

<table>
<thead>
<tr>
<th>Water property</th>
<th>FW</th>
<th>DW</th>
<th>WHO STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>3.2</td>
<td>3.6</td>
<td>6.5-7.5</td>
</tr>
<tr>
<td>EC (µS/cm)</td>
<td>580</td>
<td>540</td>
<td>400</td>
</tr>
<tr>
<td>DO (mg/kg)</td>
<td>3.8</td>
<td>3.1</td>
<td>6.0</td>
</tr>
<tr>
<td>TDS (mg/kg)</td>
<td>640</td>
<td>680</td>
<td>500</td>
</tr>
<tr>
<td>WT (mg/kg)</td>
<td>28</td>
<td>32</td>
<td>5.0</td>
</tr>
<tr>
<td>TH (mg/kg)</td>
<td>460</td>
<td>490</td>
<td>&gt; 50.0</td>
</tr>
</tbody>
</table>

Table 2 Heavy Analysis

<table>
<thead>
<tr>
<th>Metal (mg/l)</th>
<th>FW Mean Value (FW)</th>
<th>WHO STD</th>
<th>DW Mean Value</th>
<th>(DW) WHO STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>1.68</td>
<td>1.37</td>
<td>0.20</td>
<td>0.30</td>
</tr>
<tr>
<td>Pb</td>
<td>0.38</td>
<td>0.20</td>
<td>0.25</td>
<td>0.01</td>
</tr>
<tr>
<td>Cd</td>
<td>0.16</td>
<td>0.14</td>
<td>0.02</td>
<td>0.005</td>
</tr>
<tr>
<td>Ni</td>
<td>nd</td>
<td>0.13</td>
<td>0.25</td>
<td>0.02</td>
</tr>
<tr>
<td>Cr</td>
<td>0.64</td>
<td>0.24</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>Zn</td>
<td>2.51</td>
<td>10.40</td>
<td>0.30</td>
<td>5.00</td>
</tr>
<tr>
<td>Cu</td>
<td>nd</td>
<td>2.31</td>
<td>0.50</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Fishing water - FW; Drinking water - DW; nd – not detected

3.2 Discussion

3.2.1 Physico-chemical Analysis

From Table 1, the pH of fishing water (FW) and drinking water (DW) are 3.2 and 3.6 respectively and they are acidic. This is because of the high level of organic carbon content and free carbon dioxide in the water as a result of oil spillage in the area. This had encouraged high levels of toxic metals such as Fe, Mn, Zn, Cd, and Pb. in the water [7]. In order to maintain a good fish population in fishing water, the pH must be kept in the range of 6.7-8.6 as only few fishes can survive outside this range [8]. This is one of the
reasons for the low population of fish in the study water. Electrical conductivity (EC) measures the exchangeable elements that presents in water body. The common quality measured in water in terms of electrical conductivity is salinity. The electrical conductivity of FW and DW were above WHO [8] standard of fishing and drinking water which is 400µs/cm. This is because the mineral salts in the spilled oil have dissolved into the water and increased the water salinity beyond acceptable level. This could explain the frequent report of high taste of water in the area [9]. Also, the high levels of salinity in the water have encouraged the production of salt which employs many people in the area and improve their economy. The dissolved oxygen (DO) in FW and DW were very low when compared with WHO [8] standard. This is an indication that both the FW and DW are not suitable for fishing and drinking. This is because under favourable environmental conditions, a minimum constant value of 6mg/l (DO) is satisfactory for sustenance of aquatic biota including fishes [8]. This is one of the reasons for rapid reduction in fish stock in the FW of the study area. The total dissolved solid (TDS) is very high in all the samples when compared with WHO [8] standard of 500mg/l. This is due to the dilution effect of oil spillage by rain. This is intolerable since water higher in TDS should be viewed as potentially toxic for human and aquatic lives [10]. The guide limit of water turbidity (WT) is 5NTU. The valves obtained in FW and DW were exceeded this guide limit because of the heavy presence of suspended colloidal particles from the oil spillage in the water [11]. It was observed that fish species abundant in the FW were conspicuously reduced in population due to their high turbid levels. Since the FW becomes perpetually turbid, light penetration is impaired and this prevents growth of algae, which is primary food for planktons on which fishes feed on. The pores of the gas exchange media in aquatic lives, like gills in fish become blocked by silts and suspended tiny particles which starve them of oxygen necessary for respiration [12]. It was clearly shown that both the fishing water and drinking water are very hard [8]. This is because hardness ions present in oil spillage have dissolved into the water bodies during the weathering process of the oil spilled [12]. The people depends on the drinking water sources may encounter problems with usage of this water most especially the laundering activities would cost more because of foaming-ability of washing agents caused by hardness ions in the water.

3.2.2 Heavy Metal Analysis

Table 2 shows the concentration of the heavy metals in FW and DW. Fe concentration was 1.68mg/l in FW and 1.37mg/l in DW. These values are very high when compared with WHO [13] standard for fishing and drinking water. This is because the free iron presence in the spilled oil had reacted with water to produce complex radicals. Therefore, the people drinking this water source and eating the fish may suffer for hemochromatosis [14]. Such people can be treated using a specific chelating agent called deferoxamine to bind and expel excess iron from the body [15]. Pb has a concentration of 0.38mg/l in FW and 0.20mg/l in DW. These values are above the WHO standard set for fishing and drinking water. This could be responsible for the recurrent report of toxic biochemical effects of lead in the area, which includes renal dysfunction, poor development and intelligence quotient in children, muscular weakness, fatigue, which are more pronounced in the fingers, wrist, toes and forearm; clumsiness, ataxia, headache, insomnia, irritability and so on [16].

The concentration of cadmium was 0.16mg/l in FW and 0.14mg/l in DW. These values were above the WHO [13] standard set for fishing and drinking water. The source of Cadmium into the water was through the oil spillage. Cadmium is highly toxic, accumulating in the body and eventually causing effects such as tabular dysfunction, disturbances, in calcium homeostatic and metabolism [WHO, 2008]. It is capable of inducing renal, hepatic and testicular injury [17]. Ni and Cu were not detected in the FW but were found in the DW. It means that the fish in FW is likely to free from toxic effect of Ni and Cu but the DW is
highly polluted with Ni and Cu. The values of Ni and Cu in DW is exceeded the permissible limit of WHO [13] standard. The people drinking this water may be suffered for cancers, anemia, liver and kidney damage, lung embolism, respiratory failure, birth defects, asthma and chronic bronchitis [5,18]. The values of Cr in FW and DW were above the desirable levels of WHO standard. The severe effect of Cr toxicity manifests in the form of birth defects, infertility and tumor formation. Most chromium compounds are carcinogenic, long exposure may cause kidney, liver and nerve tissue damage [19]. FW and DW were polluted with respect to Zn when compared with the WHO standards of 3.0 mg/L and 5.0mg/l respectively. Zn is a neurotoxin which caused eminent health problems such as stomach cramps, skin irritations, vomiting, nausea and anemia [20].

4. Conclusion

When the results obtained from both the fishing and drinking water are compared with WHO standard, the results showed that the drinking water was polluted with all the tested metals while the fishing water accumulated most of the tested metals. These metals may pass to human’s body through food chain. Since Fe, Zn, Cd, Pb, Zn and Cr are known to be neurotoxic therefore the people drinking the water and eating the fish from the fishing water may be neurotoxicity. The recurrent pollution of this water by oil spillage has also caused reduction in aquatic lives. Therefore, there is need for urgent monitoring of oil spillage in the area before it out of control. The Oil companies, Federal, State and Local government should use modern methods to reclaim the polluted drinking water sources and fishing sites that have been polluted by oil spillage. Finally, Oil spill committee should be established with the participation of recognized leaders in Ilaje community to educate their people about the need to stop pipeline vandalism. This may involve making people realized that oil spills do more damage to the environment that it does to the operation of the oil companies.

References


Bibliography
Engr. S.A. Agbulajobi holds B.Eng., (Hons) and M.Eng. (Surface Mining Option) in Mining Engineering from Federal University of Technology, School of Engineering and Engineering, Technology, Akure in 1994 and 2013 respectively. He is a Member of Nigeria Society of Mining Engineers (MNSME), Member Nigeria Mining and Geosciences Society (MNMGS), Council for Regulation of Engineering in Nigeria (COREN), Council of Nigerian Mining Engineers and Geoscientists (COMEG) and Nigerian Association of Hydrogeologists (NAH). He has published in reputable Journals in Nigeria and outside Nigeria in the area of Safety & Environment, Surface Mining and Drilling Engineering. Finally, he is presently lecturing in the Department of Mineral Resources Engineering, Kwara State Polytechnic, Ilorin, Nigeria. He is happily married with children.