Impact of Waste Dump on the Sediment and Surface Water Quality of Otamiri River, Nigeria

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ABSTRACT: Some Physico-Chemical Parameters of surface water and heavy metal level in sediments of Otamiri River at dump site along Aba road were evaluated and correlated with that of control unit upstream. The annual means values showed that acidity(mg/l), alkalinity(mg/l), pH, Electrical conductivity(Scm⁻¹), BOD₅(mg/l), COD(mg/l), DO(mg/l), TSS(mg/l), Total Hardness(mg/l CaCO₃) are 2.00, 3.20, 6.45, 24.00, 11.30, 46.50, 8.45, 41.72, 12.85, 4.53 and 0.035 respectively for the dumpsite, while 4.05, 2.20, 6.31, 21.00, 15.63, 41.72, 12.85, 41.05, 9.06 and 0.035 respectively for the control. The annual values for the heavy metal (mg/kg) indicates that the dumpsite’s sediments are lower than that of control. This shows that organic matter present at benthic region must have adsorbed most of the heavy metals at the surface of benthic region downstream. ©JASEM

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MATERIALS AND METHODS

Study area: the study was conducted at the dumpsite near Aba road (7°2E,5°27N). Otamiri River originated from Egbu in Owerri north and flows through Nekede in Imo state and Ozuzu in Rivers state and finally joins Atlantic Ocean. The site for reservoir was chosen as Control because there was no waste dump in that area. Sampling and sample storage: for this study two sample stations were established. One at the dumpsite and the other at the control point upstream of the dumpsite, along the Otamiri river channel. Surface water was collected periodically during dry season (DS) and Rainy Season (RS), on each occasion samples were taken from triplicate spots at each station to form one composite sample and the mean values noted for the season. Water samples were collected at 30cm below surface using 1 litre polythene bottle with screw caps, sediment samples were dried at about 105°C in an oven to constant weight and ground to powder and sieved through 0.5mm sieve to remove coarse materials. One gram of each sample were digested using 1:5:1 mixture of perchloric acid, concentrated HNO₃ and H₂SO₄ in a fume chamber at 80°C until a colourless liquid was obtained each digested sediment was analyzed for the listed heavy metals that their respective resonance line using atomic absorption spectrophotometer, percentage total organic carbon (%TOC) was determined by walkey

Information on sediment water quality and pollution sources are important for implementing sustainable water use management strategies (Zhou et al., 2007: Sarkar et al., 2007).

Corresponding author E-mail: holygodson@yahoo.com
and black method, statistical analysis using student’s

t-test were applied to study seasonal variation of

Physico-chemical parameters and heavy metal with

Ms-Excel 2007 and Data analysis software. Some of

the result obtained is show below in table A and B.

RESULT AND DISCUSSION

The result in table 1 shows the level of heavy metal and

percentage total organic carbon in sediments of

otamiri at dumpsites and control point during dry and

rainy season.

The mean percentage total organic carbon on the

sediment at control point is %2.84 while its value at

dumpsite is %2.95. There was no significant

difference when student’s t-test were applied for

seasonal variation both at the dumpsite and control

points, however, the values during dry season are

slightly higher than the rainy season respectively.

Organic matters are reported to play significant role

as a controlling factor to the heavy metal distribution

in the surface of river sediments. These organic

matters might be associated with the trace metals by

adsorption to the particle surface and then combing

with the trace metals in the solution. Enhance metal-

particulate associations might also be attributed to the

metal-organic complexes that are able to adsorb to

the surfaces (Barry, 1982). The mean annual level of

heavy metals (mg/kg) i.e. Cd, Pb, Ni, Zn, Cu, Fe and

Cr at control point are 0.001, 0.49, 2.73, 6.91, 0.001,

256.35 and 0.001, respectively, while that of

dumpsite are 0.001, 0.175, 0.057, 0.053, 0.001, 25.88

and 0.001 respectively. The lower levels at dumpsite

is associated with the enhance adsorption of metals

into organic particulars at sub-sediment layer at the

river bed. From the result of students’ t-test obtained

there was no significant difference in the seasonal

variation of heavy metals in the sediment at dumpsite

and control points.

When the concentration of these heavy metals in the

sediments at dumpsite and at control points, are

compared to the Canadian, Dutch and German guild

lines, we found out that the levels in both sites are

below above (Canadian, Dutch and German)
guidelines, Iwuoha et al.,(2012). Waste dumping did

not affect the turbidity of surface water as then mean

annual values of both sites are the same, i.e.

0.035NTU the mean annual of COD and TSS is

higher at dumpsite. This is due to the increase in

oxygen needed to convert more suspended organic

solids to carbon IV oxide and water at dumpsite

relative to control points.

This increase in oxygen demand reflects also the

depletion of dissolved oxygen at dumpsite relative to

the values as the control points, please see Table 2.

The higher value of \( \text{BOD}_5 \) at control points as

against the value at dumpsite suggest that the

chemical environment at dumpsite is not favorable to

microbial activity. Acidity and total hardness at

control points have values that are twice that of the

dumpsite, while alkalinity, pH, and Electrical

conductivity values are higher at dumpsites.

Application of student test shows no significant

difference in the seasonal variation of Physico-

chemical parameter at both sites.

Conclusion And Recommendation: From the results

and discussion so far one can see that increased

percentage total organic carbon at the refuse sight

only helped to absorb some of the heavy metals by

enhance metal-Particulate association, thereby

helping the sediment to be cleaner with respect to

heavy metals. Poor waste management in otamiri

dumpsite like refuse burning etc, contributes to

alteration of some important physico-chemical

parameters that are essential for the good health of

aquatic organism and air pollution. Ibe, (1999).

Refuse burning also increase the levels of phosphate

and nitrate stream of dumpsite even though the

impact alteration of physicochemical parameter is not

significantly different and values are still below

acceptable levels by World health organization

(WHO) it is necessary that better and more efficient

waste management is put in place to avoid the

accumulated damage in the near future.

Acknowledgement: The authors are grateful to the

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during the research. We are also grateful to the

laboratory technologist in plant science and biology

university of Port Harcourt for assisting us in

carrying out preliminary analysis

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Table 1. Heavy metal levels in sediments of Otamiri at Dumpsite and control points during dry and raining season

<table>
<thead>
<tr>
<th>Heavy Metal mg/Kg</th>
<th>Dumpsite Annual</th>
<th>Control site Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ds</td>
<td>Rs</td>
</tr>
<tr>
<td>Cd</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Pb</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>Ni</td>
<td>0.06</td>
<td>0.053</td>
</tr>
<tr>
<td>Zn</td>
<td>0.57</td>
<td>0.48</td>
</tr>
<tr>
<td>Cu</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Fe</td>
<td>32.14</td>
<td>19.61</td>
</tr>
<tr>
<td>Cr</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>%TOC</td>
<td>3.01</td>
<td>2.98</td>
</tr>
</tbody>
</table>

Table 2. Some physico chemical parameter of Otamiri surface water at dumpsite and (control) during dry and raining season

<table>
<thead>
<tr>
<th>Physico-chemical parameters</th>
<th>Dumpsite Ds</th>
<th>Rs</th>
<th>Annual average</th>
<th>Control Ds</th>
<th>Rs</th>
<th>Annual average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity(mg/l)</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>4.00</td>
<td>4.10</td>
<td>4.05</td>
</tr>
<tr>
<td>Alkalinity(mg/l)</td>
<td>3.30</td>
<td>3.10</td>
<td>3.20</td>
<td>2.00</td>
<td>2.40</td>
<td>2.20</td>
</tr>
<tr>
<td>pH</td>
<td>6.10</td>
<td>6.80</td>
<td>6.45</td>
<td>6.22</td>
<td>6.40</td>
<td>6.31</td>
</tr>
<tr>
<td>E/conductivity(Scm-1)</td>
<td>24.00</td>
<td>24.00</td>
<td>24.00</td>
<td>20</td>
<td>22.00</td>
<td>21.00</td>
</tr>
<tr>
<td>BODs (mg/l)</td>
<td>9.60</td>
<td>13.80</td>
<td>11.30</td>
<td>12.8</td>
<td>18.45</td>
<td>15.63</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>40</td>
<td>53</td>
<td>46.50</td>
<td>39.6</td>
<td>43.83</td>
<td>41.72</td>
</tr>
<tr>
<td>DO(mg/l)</td>
<td>5.60</td>
<td>11.30</td>
<td>8.45</td>
<td>9.60</td>
<td>16.10</td>
<td>12.85</td>
</tr>
<tr>
<td>TSS(mg/l)</td>
<td>80</td>
<td>81.70</td>
<td>80.85</td>
<td>40</td>
<td>42.10</td>
<td>41.05</td>
</tr>
<tr>
<td>Total hardness (mg/l CaCO3)</td>
<td>4.0</td>
<td>5.05</td>
<td>4.53</td>
<td>8.0</td>
<td>10.12</td>
<td>9.06</td>
</tr>
<tr>
<td>Turbidity(NTU)</td>
<td>0.003</td>
<td>0.04</td>
<td>0.035</td>
<td>0.03</td>
<td>0.04</td>
<td>0.035</td>
</tr>
</tbody>
</table>

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