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WATER QUALITY INDEX ESTIMATE FOR ISIODU RIVER WATER DURING DREDGING IN NIGER DELTA, NIGERIA

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ABSTRACT

Water quality index was estimated using the modified Brown *et al.*,(1972) equation for the Isiodu freshwater habitat during dredging processes. Ten parameters were analysed using recommended standard methods and the water quality index was calculated for each. These parameters include fecal coliform count, biochemical oxygen demand (BOD_5), dissolved oxygen (DO), hydrogen ion concentration (pH), temperature, total dissolved solids (TDS), phosphate, Turbidity, Nitrate and ammonia. The estimated water quality index for the studied parameters during the dry seasons of November and December are given respectively as, fecal coliform count (4.68, 7.47), BOD_5 (1.21, 1.29mg/L), DO (5.34, 5.37mg/L), pH (6.25, 623), temperature (5.81, 6.29^oC), TDS (104.36, 104.21mg/L), PO_4 (3.76, 3.78mg/L) Turbidity (132, 1.32 NTU), Nitrate (0.0023, 0.0024mg/L) and ammonia (1.23, 1.29mg/L). Similarly during the wet season of June and July, the water quality index are fecal coliform count (6.96, 7.57mg/L), BOD_5 (3.21, 3.17mg/L) DO (5.47, 5.36mg/L), pH (6.87, 6.86), temperature (13.20, 8.93^oC), TDS (71.02, 101.98mg/L), phosphate (3.37, 3.39mg/L), turbidity (1.57, 1.68 NTU), Nitrate (0.002, 0.002mg/L) and ammonia (0.83, 0.85mg/L) respectively. Most of the parameters were within recommended limits but care must be taken to avoid further accumulation leading to lethal effects on the plankton community.

KEYWORDS: Water quality Index, Isiodu River, freshwater, dredging, pollutants.

INTRODUCTION

Dredging is simply the removal of bed materials and associated vegetations from a river channel, (Iyama, 2005). According to Jones (1986), it is an underwater exaction to re-establish a channel to improve navigation or for commercial functions. There is also the deposition of dredged materials in uniform layers over wet land vegetation or open bay bottom (Turner and Streever, 2002).

According to Lewis *et al*., (2001), dredging may remove large amounts of sediments, change harbours' features and modify the structure and dynamics of the soft bottom community. Freshwater brings clay into saline areas, clay units aggregate into smaller clumps as the salinity approaches 14% (Mort, 2001). Due to the changes of abundant positive ions in marine waters to the surface charge of some of the positively charged particles, there is need for a good understanding of the chemistry of the freshwater since according to IMG-Golder (2004), the physical impacts of dredging are quite numerous. The water quality index according to Cude (2004) is a single number which expresses water quality by integrating measurements of eight carefully selected water quality parameters. According to Cookey (2001), about 67% of the Nigerian population depend on river sources that are not trusted to be potable. The demand for water according to Reddeppna (2001) will continue to increase due to certain economic activities and quest for better living standards. Egbo (2002) posits that pollutants strictly associated with only surface water and also can be found in groundwater. This is why it is very important to assess the water quality level of every water source including the Isiodu River so as to get the quality index. Hallock (2002) defined Water Quality Index as a unit less number ranging from 1-100. The higher the number, the better the water quality. Water quality index provides a more convenient way of summarizing complex quality and ease meaning to the user audience (Soffran et al., 2001). So many indices are available including the St. Laurent Quebec, Alberta and Canadian Council of Ministers of Environment indices (Wright and Wilson, 1995).

The Isiodu River is found in the Niger Delta area of Rivers State of Nigeria. It is located between longitude 6°00' and 6°52E and latitude 5°00' and 5°08'N. This area is a semi hot equatorial climate with a mean annual rainfall of about 2,405mm (Gobo, 1988). The major objective of this study is to determine the water quality index of the observed physico-chemical parameters during dredging activities since the Isiodu river is under intense dredging for its commercial use in road construction (The dualization of the East-West road by SETRACO Nig. Ltd).

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There are no serious industrial waste discharges around the study sites even though Wilbros Nig. Ltd. has its base upstream of the dredging area. Industrial discharge according to Akan *et al.,* (2007) is a major culprit in water pollution world wide.

MATERIALS AND METHODS

Six sample stations were selected for this study and labeled A, B, C, D, E and F respectively. Stations A and B are found upstream relative to the dredger position C, while D and E are downstream. Station F is the suction pump water. These stations were separated 100m apart from the dredger. The modified Brown et al., (1972) equation was then used to compute the predicted Water Quality Index (WQIp),

$$WQIp = \sum pi\ Wi + NG$$

Water samples were collected from these stations during dredging (i.e. A, B, C, D, E and F). The sampled water depth was about 5- 10cm below surface level. The sample containers were properly rinsed 2-3 times using the water samples, they are supposed to contain no impurities to avoid contamination. Dissolved oxygen was collected using DO bottles, BOD using 1-litre plastic containers. The containers were completely immersed in water and stoppered under water. The water samples were fixed and preserved on site. Winkler I and II were added for DO samples while BOD samples were kept on ice blocks for preservation before transporting to the laboratory for analysis.

Table 1: Summary of Parameters and Methods of Analysis

S/NO	PARAMETER	METHOD/MODEL INSTRUMENTATION
1.	Fecal colifiorm count	Most probable method (MPN)
2.	BOD^5 (mg/L)	Winkler method
3.	DO (mg/L)	Winkler method (modified oxygen depletion method, MOD).
4.	pH	691 pH meter (Type 1,69100) *insitu* measurement
5.	Temperature (^oC)	Mercury in-glass Thermometer (*insitu*)
6.	TDS	TDS meter (JENWAY Brand)
7.	Phosphate (mg/L)	Shimadzu uv-visible spectrophotometer, (type uv-160A, at 880nm)
8.	Turbidity	Spectrophotometer, type uv-160A, uv-visible
9.	Nitrate (mg/L)	Brucine method (spectrophotometer), spectonic 20 (B and L0 at 420nm.
10.	Ammonia (mg/L)	Titrimetric substitution method.

RESULTS AND DISCUSSION

Results of the physico-chemical parameters of the monitored dredging water of the Isiodu River are given in Table 2. Similarly, Table 3 shows the water quality index and the expected WQI.

Table 2: Summary Result of Water Samples from Isiodu River during Dredging in both seasons.

S/N	STATIONS	A		B		C		D		E		F	
	PARAMETER	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
1.	Fecal coliform count	4.30	UD	10.09	UD	7.67	UD	18.40	UD	7.95	UD	2.20	UD
2.	BOD_5 (mg/L)	1.14	2.08	1.14	2.66	1.15	3.79	1.39	4.03	1.63	3.88	1.22	2.13
3.	DO (mg/L)	5.40	3.41	5.43	4.93	5.24	5.78	5.58	6.08	5.15	5.66	5.34	4.34
4.	pH	6.29	6.34	6.34	6.58	6.24	6.40	6.35	6.67	6.25	6.35	5.97	6.52
5.	Temperature (^{0}C)	25.90	25.90	25.95	25.95	26.33	26.33	25.93	25.39	26.05	26.05	26.80	23.80
6.	TDS (mg/L)	86.00	85.33	109.30	116.13	85.30	72.67	173.30	103.33	92.00	109.33	10.67	98.00
7.	Phosphate (mg/L)	3.11	4.08	4.08	3.96	3.86	3.13	4.28	3.94	3.51	3.28	3.91	2.26
8.	Turbidity (NTU)	1.43	1.43	1.35	1.35	1.52	1.52	1.80	1.12	1.72	1.04	2.43	2.43
9.	Nitrate (mg/L)	0.0022	0.0033	0.0017	0.0017	0.004	0.0028	0.001	0.0019	0.008	0.0016	0.0015	0.0015
10.	Ammonia (mg/L)	1.45	0.72	1.23	1.11	1.53	1.00	1.43	0.61	0.88	0.77	1.18	0.89

N/B: All parameters are measured in mg/1 except temperature (^{0}C), Turbidity (NTU) and fecal coliform count in (MPN).
UD = Undetected

Table 3: Summary of the Water Quality Index during Dredging for Isiodu River

S/N	Parameter	S=d Value	Expected WQI	Mean WQI		WQIp (N=1)	
				Dry	Wet	Dry	Wet
1.	Fecal coliform count	<10	1.0000	5.3495	2.2279	0.14	0.73
2.	BOD^5 (mg/L)	10	1.0000	0.0136	0.2147	0.13	0.32
3.	DO (mg/L)	10	1.0000	0.0863	0.4776	0.54	0.54
4.	pH	7-8.5	1.0000	0.2393	0.4191	0.65	0.69
5.	Temperature (^{0}C)	24.28	1.0000	1.4388	4.0696	0.75	1.11
6.	TDS (mg/L)	500	1.0000	4.1265	2.5358	10.84	8.65
7.	Phosphate (mg/L)	10	1.0000	0.0944	0.1182	0.14	0.16
8.	Turbidity (NTU)	5	1.0000	0.0944	0.1182	0.14	0.16
9.	Nitrate (mg/L)	10	1.0000	0.000	.0000	0.002	0.002
10.	Ammonia (mg/L)	10	1.0000	0.0202	0.0077	0.13	0.08

From the WQIp calculated for both dry and wet season of each parameter, only TDS exceeded 100. The higher the WQIp value the better that parameter in terms of water quality (Hallock, 2002). The water quality measure in this study obeys the table below.

Table 4: Nature of WQIp Interpretation

Mean WQIp	Nature
Below 1	Safe
Above 1	Unsafe

TDS was 10.84mg/L during the dry season and 8.65mg/L during the wet season. This is an indication that there was high concentration of dissolved solid in the Isiodu River which was corroborated by Ikpe (1999) and Iyama (2005) on the Orashi River and Imonite Creeks respectively. The WQIp observed for BOD5, DO, turbidity, nitrate and ammonia is an indication of potential decrease in pollution due to these parameters. The WQIp for the nutrient parameters are quite low but of high pollution potential due to the anthropogenic inputs from the natives and other natural means. This is in agreement with the high level of measurements recorded for nutrient parameters by Manila and Tamuno-Adoki (2007) and Emovin et al., (2006) in the Woji creek water also found in the Niger Delta.

Fecal coliform count had a higher WQIp during the dry season (1.1423) compared to the wet season (0.7275). This shows that more fecal wastes were in circulation during the wet season. This may be resulting from the washing down of fecal waste and domestic waste down the river and circulated by the dredging process. There was a slight negligible change in pH during the dredging process (0.3878 changes in the WQIp). This may result from the slight acidification throughout the season which was in conflict with that recorded by Muri and Branceiji (2003) on three Slovenian lakes of slight basicity. The acidic nature of the river water may be due the absence of any alkaline metal in the environment thereby reducing the potentials of solubilization of CO_2 from the atmosphere.

CONCLUSION

The result of this study shows that the Isiodu river water is not polluted due to the dredging process from both seasons. The high WQIp for TDS was an indication of the pH changes which occurred from higher values in the wet seasons. The acidic nature of the river was an indication of the nature of soil (rock) and activities prevalent in this area. Dredging activity may affect the distribution of the fecal coliform count in the stations studied during the dredging process. The developed mean water quality index could be used for stream monitoring for dredging of any stream and also predict the nature of the stream water quality in future years (N = years). From the water quality index, the Isiodu River water may not be considered polluted, but care must be taken to avoid deposition of industrial wastes which may remain in bottom sediments and hence brought to the surface water by dredging. This may also increase the present concentrations and pollution potential of the Isiodu River Water.

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