Impact Of Industrial Effluents On Quality Of Segment Of Asa River Within An Industrial Estate In Ilorin, Nigeria

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ABSTRACT: The impact of industrial effluent on water quality criteria of a river within Asa Dam industrial estate, Ilorin was investigated. Physicochemical and bacteriological properties of samples of the river were examined to determine the quality and extent of pollution. The effluents were found to cause gross pollution of the river. Total hardness ranged between 51 and 175.5mg/l; while conductivity was between 65 and 318µs. Calcium and Magnesium ions varied between 33.7 and 102.3mg/l, and 3.5 and 57.1mg/l respectively. *E. coli* was found in the samples and the coliforms counts were high. The major sources of pollution were identified to be the direct runoff from the industries and refuse dumps within the estate. [New York Science Journal. 2008;1(1):17-21]. (ISSN: 1554-0200).

KEYWORDS: Pollutants, Surface water, Asa Dam, Nigeria.

Introduction

Industrialization is considered the cornerstone of development strategies due to its significant contribution to the economic growth and human welfare. It has become a yardstick for placing countries in the League of Nations and an index of its political stature (FEPA, 1991). Industrialization, like other human activities that impact on the environment, often results in pollution and degradation. It carries inevitable costs and problems in terms of pollution of the air, water resources and general degradation of the natural environment (Suflita *et al*., 1983; Thomas *et al*., 1992).

Worldwide water bodies are the primary means for disposal of waste, especially the effluents, from industries that are near them. These effluent from industries have a great deal of influence on the pollution of the water body, these effluent can alter the physical, chemical and biological nature of the receiving water body (Sangodoyin, 1991). The initial effect of waste is to degrade the physical quality of the water. Later biological degradation becomes evident in terms of number, variety and organization of the living organisms in the water (Gray, 1989). Often the water bodies readily assimilate waste materials they receive without significant deterioration of some quality criteria; the extent of this is referred to as its assimilative capacity (Fair *et al*., 1971). The input of waste into water bodies therefore does not always impact negatively on aquatic environment because of the self purification property of the water bodies.

Industries turn out wastes which are peculiar in terms of type, volume and frequency depending on the type of industry and population that uses the product (Odumosu, 1992). Industrial waste is the most common source of water pollution in the present day (Ogedengbe and Akinbile, 2004) and it increases yearly due to the fact that industries are increasing because most countries are getting industrialized. The extent of discharge of domestic and industrial waste is such that rivers receiving untreated effluent cannot give dilution necessary for their survival as good quality water sources. The transfer of unfavorable releases from industries is detrimental to human and animal health and safety (Sangodoyin, 1991). There is thus a challenge of providing water in adequate quantity and of required quality to minimize hazards to human health and conserve the water bodies and the environment.

Population explosion, uncontrolled urbanization and industrialization have caused a high rate of waste generation in Nigeria (Rosegrant, 2001). Akpata (1990) pointed out that aquatic pollution problem in Nigeria was increasing in scope and dimension. Olayemi (1994) identified that regular, unregulated indiscriminate dumping of waste into water bodies worsen aquatic pollution. This study is intended to assess the impact of industrial effluents on the surface water at Asa Dam industrial estate and its environs. It also identifies common pollutants in the water. The impact is assessed in term of its physicochemical and bacteriological quality.

Materials and Methods

Study Area

The study carried out within the industrial estate located in Ilorin, North Central Nigeria (8^o 28'N, 4^o 38'E to 8^o 31'N, 4^o 40'E). It houses the major industries in the town: Global soap and Detergent, Unifoam, 7^{up} Bottling Company, Tuyil pharmaceuticals and Nigeria Bottling Company. The study was on Asa River, the major water body in Ilorin, its course enters the southern end of the industrial estate from Asa Dam located south of the estate, and runs northwards through residential areas.

Sample Collection and Analysis

Duplicate grab samples of water were taken from five (5) points on the river: point of entry (PE), three different points on the river within the estate (L_1, L_2, L_3) and point of leaving (PL). Samples were collected using the conventional WHO (2004) methods. The pH of the samples was determined using a pH meter. The colour, turbidity, calcium ion, total hardness, chloride, dissolved oxygen were determined using standard methods. Bacterial count was determined using standard plate count (APHA, 1992). Bacterial isolates were characterized and identified using Cowan and Steel manual (Collines et al., 1989; Barrow and Feltham. 1995).

Results

The pH varied between pH 6.8 and 7.4, the highest pH was recorded at point L_2 and the lowest at PL. Turbidity varied between 4.6 and 189 (NTU), the highest value was obtained at L_2 while the lowest was obtained at PL. The colour varied between 153 and 1913 (Pt – Co), the highest value was obtained at L_2 and the lowest at PE. The temperature ranged between 26- 29^OC. The total hardness varied between 27 and 176 mg/l, Calcium and Magnesium hardness range from 62 to 338mg/l and from 9 to 73 mg/l respectively. The conductivity ranged from 65 to 318 us, with the highest obtained at L_3 and the lowest at PE. Variations in the pH, colour, turbidity, temperature, hardness and conductivity of the Asa River are shown on Table 1.

The total solid content varied between 220 and 670 mg/l; the highest value was obtained at L2 and the lowest at PE. The total suspended solid and total dissolved solids ranged between 172 and 445 mg/l and 48 and 225 mg/l respectively. The dissolved oxygen content ranged from 7 to 8 mg/l. The variations in the total solids, total suspended solids and total dissolved solids as well as the dissolved oxygen content are shown in Figure 1. The total bacterial count ranged between 3.0×10^4 to 7.5×10^4 cfu/ml; the highest values was at L_3 and the lowest at L_1 (Figure 2). Twelve bacterial species were identified: *Bacillus subtilis, Citrobacter diversus, E. coli, Micrococcus albus, Micrococcus luteus, Proteus vulgaris, Pseudomonas aeruginosa, Serratia* sp, *Shigella* sp, *Staphylococcus aureus, Streptococcus bovis* and *Streptococcus faecalis*. Their distribution is shown on Table 2.

Table 1: Physicochemical Characteristics of Asa Stream within the Estate

Parameters measured	PE	L_1	L_2	L_3	PL
pH	7.1	7.3	7.4	7.2	6.8
Colour (Pt-Co)	153	211	1913	1740	182
Turbidity (N.T.U)	4.6	8	189	162	1.5
Temperature (^oC)	28	26	27	29	27
Total Hardness (mg/l)	27	51	99	176	51
Calcium Hardness (mg/l)	16	21	74	85	21
Magnesium Hardness (mg/l)	12	30	25	91	30
Calcium ion (mg/l)	62	84	294	338	84
Magnesium ion(mg/l)	9	24	20	73	24
Conductivity (us)	65	73	299	318	85
Chloride (mg/l)	2	2	69	107	12

PE= Point of Entrance to Asa Dam Industrial Estate. L_1= Stream Location One in the Industrial Estate.
L_2= Stream Location Two in the Industrial Estate. L_3= Stream Location Three in the Industrial Estate.
PL= Point of Leaving Asa Dam Industrial Estate.

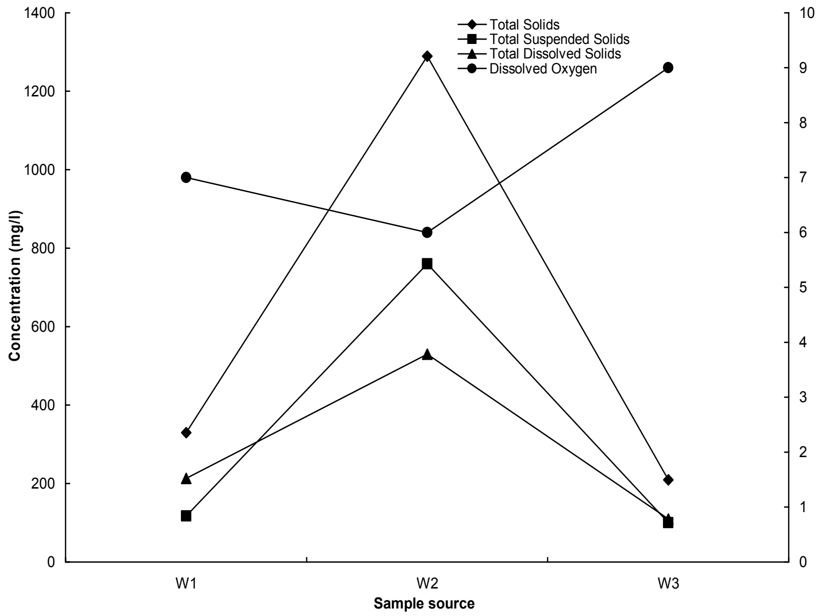

Figure 1. Variations in the total solids, total suspended solids, total dissolved solids as and dissolved oxygen content

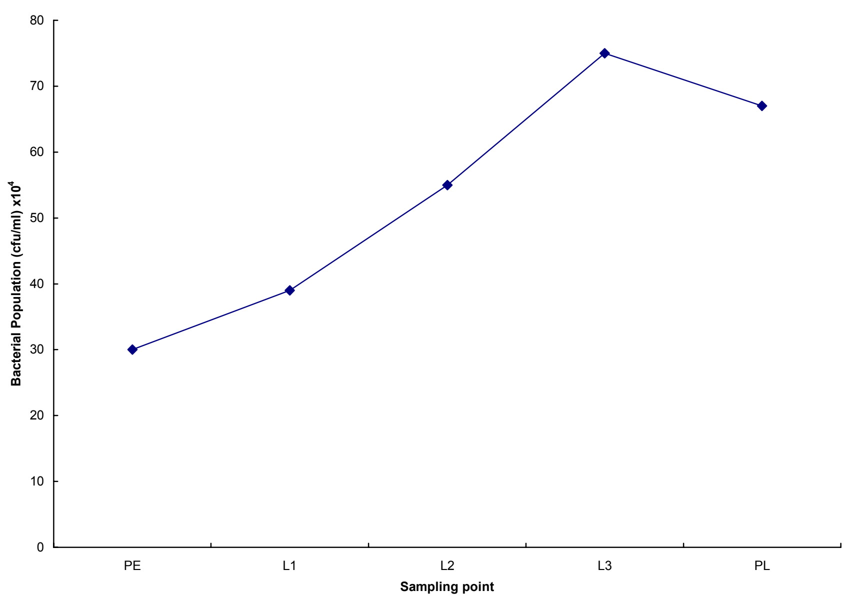

Figure 2. Variation in Bacterial Population in Asa River within the industrial Estate

Table 2: Identity and Distribution of bacteria isolated from Asa Stream within the Industrial Estate

Organisms	PE	L_1	L_2	L_3	PL
Bacillus subtilis	+	+	+	+	+
Citrobacter diversus	+	+	+	+	+
E. coli	+	+	+	+	+
Micrococcus albus	+	-	-	+	+
Micrococcus luteus	+	-	+	+	+
Proteus vulgaris	+	+	+	+	+
Pseudomonas aeruginosa	+	+	+	+	+
Serratia sp	+	-	+	+	+
Shigella sp	+	-	+	+	+
Staphylococcus aureus	+	+	+	+	+
Streptococcus bovis	+	-	-	+	+
Streptococcus faecalis	+	-	+	+	+

PE= Point of Entrance to Asa Dam Industrial Estate. L_1= Stream Location One in the Industrial Estate.
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PL= Point of Leaving Asa Dam Industrial Estate.

DISCUSSION

The higher concentrations of most of the measured parameters at points within the estate over values at the point of entry to the various points within the estate are suggestive of input of materials within the estate. The turbidity is directly related to the amount of materials present in the water, this is observed to be highest at the point within the estate after input of wastes from the industries. This is further buttressed by the higher concentrations of total solids, total dissolved solids and total suspended solids, which signify input of materials. Increased concentration of the measured parameters is probably due to the effect of the pollutants released by the industries into the water body.

The divalent metallic cations: Calcium and Magnesium contribute to the total hardness of the water (51 to 176mg/l). The water is hard and is thus largely unsuitable for direct use by communities that use it for laundry work and bathing. Turbidity of the water increased greatly from 4.6 N.T.U at the point of entry to 189 N.T.U for the water sample L_2 within the estate; this indicates an increase in the concentration of suspended matters in the water sample. The subsequent reduction to 1.5N.T.U at the point of leaving is indicative of self purification by the river (Gray 1989).

The river showed high bacterial count as is characteristic of water body receiving organic pollutant (Olayemi, 1994). The presence of *E.coli* is a definite indication of faecal contamination (WHO, 2004). The presence of the organism shows that the river can not be used directly as source of drinking water; it ranks among water that requires auxiliary treatment. In addition some of the organisms encountered in the water are potential pathogens contrary to the WHO (2004) recommendation that drinking water should be free of pathogens.

The presence of some of the organisms suggests that materials were being added to the water from other sources apart from the effluent. This is likely to be the refuse dumps within the estate. The dumps are exposed and hence can be washed into the river during rains or material be carried from it to the water during heavy winds. Summarily, water from Asa River requires elaborate treatment before it could be suitable for domestic purposes.

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