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Distribution of Heavy Metals in the Sediments of Lagos Lagoon

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The concentrations of cadmium, lead, nickel, chromium, copper, zinc, iron, manganese, cobalt and mercury in the sediments of the Lagos lagoon were determined by atomic absorption spectrophotometry in the year 1998. The respective ranges of the concentrations of the metals were Cd:0.13-8.60, Pb:4.10-295. 70, Ni: 11.60-149.40, Cr:23.30-167.20, Cu:4.80-102.70, Zn:27.30-323.70, Fe:10579.80-85548.00, Mn:276.00-748.00, Co:6.40-41.50 and Hg:0.04-0.53mg kg^{-1} dry weight. The data showed considerable variation in the values from one sampling station to the other. Highest values of metals were obtained at sampling station 3(Iddo).

Key words: Sediments, Heavy metal pollution, Lagoon industries, Metal accumulation.

Introduction

The Nigerian coast is about 800 kilometers in length from Lagos in the west to Calabar in the east. The coastal belt has estuaries and lagoons as a transition zone between it and the numerious rivers and creeks flowing southwards into the Atlantic Ocean. Numerous settlements and some major cities eg. Lagos, Port Harcourt, Warri and Calabar are located near the estuaries and lagoons. There are a variety of industrial establishments producing different industrial wastes and effluents. Industries in Lagos alone account for more than 40% of all the industries in Nigeria. The proliferation of urban settlements and slumbs in the city of Lagos has also increased generation of domestic effluents which eventually find their way into the Lagos lagoon. The lagoon receives a complex mixture of domestic and industrial wastes and has served as the ultimate sink for the disposal of domestic sewage since the latter part of the 19th century (Aina 1991; Aina and Adadipe 1993).

Environmental Pollution is one of the major problems of a developing nation which is increasing mainly due to increase in population, urbanization and industrialization (Mcllanby 1980).

Industrial wastes contain heavy metals, solvents, cyanides, minerals and organic acids, fats, oil, bleaching agents, sulphides, ammonia, etc. many of which are known to be toxic (Kenneth 1985)

Nigeria has established industries like petroleum refinery, soaps and detergents, food and beverages, breweries, textiles and building materials, iron and steel, plastic, clay and ceramics photographic, printing and building, wood and leather working, metal working, chemical industries. All these industries produce various waste which contain harmful concentrations of trace metals finally being discharged into the environment (FEPA 1982). Waste is a nuisance which must be disposed off by all means, however, improper disposal of industrial waste could produce harmful effects on human health.

A knowledge of the distribution of trace metals in water and sediments plays a key role in detecting the sources of pollution in aquatic system (Forstner and Wittan 1981). The suspended particles carried by various industrial effluents and domestic sewage are ultimately deposited as sediments containing measurable concentration of Pb, Zn, Cd, Cr, Cu, Ni, Co, Mn and Fe etc. (Duarfrige and Winwright 1981; Forstner and Wittman 1981).

The present study was undertaken to investigate the impact of domestic and industrial discharge of waste on the levels of cadmium, lead, nickel, chromium, copper, zinc, iron, manganese, cobalt and mercury metals in the sediments of Lagos lagoon and to compare the distribution of metals in top and bottom sediments.

Study area. Lagos is almost surrounded with water. It is heavily populated and highly industrialized. For the purpose of this study, three major areas viz. Iddo, Yaba and Ikorodu, that are industrialized and heavily populated were chosen and used as sampling sites in the Lagos lagoon (Fig 1).

Materials and Methods

The top layer of uncontaminated samples were collected from the hauls at each station and were put in a labelled polythene containers. The samples were air dired at 105 °C for 36 h and were ground into a homogenous mixture using mortar and pestle. 5g of each sample, was digested using nitric acid (15 cm^3), perchloric acid (2cm^3) and hydrogen fluoride (15cm^3)

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on a hot plate for 3h. On cooling, the digests was filtered and made up to 100.00 ml with deionize water and analysed for heavy metals using perkin Elmer Spectrophotometer model 3110.

Results and Discussion

Tables 1 and 2 represent analytical results from top and bottom sediments collected from each of the three stations.

The highest concentration of metals with few exceptions were obtained in sample station 3 (Iddo) in both top and bottom sediments. Generally there was greater concentration of all metals in the bottom sediments than in the top sediments. Bioavailability and bioaccumulation of cadmium depends largely on the concentration of Cd leached from sediments to water which in turn, depends on organic carbon and ion-exchange capacity of the sediment (Mclecse 1980). Cadmium levels found in the top sediments of Lagos lagoon (Yaba: 0.13 mg kg^{-1}, Ikorodu: 0.40mg kg^{-1} and Iddo: 0.77 mg kg^{-1} were lower than those of bottom sediments (Yaba: 8.60 mg kg^{-1}, Ikorodu: N.D and Iddo: 2.70 mg kg^{-1}). The concentration of Cd for the top sediments from Iddo was higher than that from yaba and Ikorodu. In the bottom sediments, the accumulation of Cd at Yaba was about 3 times higher than that of Iddo. The levels of Cd in both top and bottom sediments were too high and could leach into water. The level exceeded 0.3 $\mu g\ g^{-1}$ as reported by Rankama and Shama (1960). This high level of cadmium is attributed to over population and industries located around stations 1, 2 and 3. The highest level of lead (Pb) was obtained at Iddo for bottom and top sediments. The presence of high levels of pb in Lagos lagoon may be attributed to various paint industries. . The concentration of Pb in top and bottom sediments from Iddo, Ikorodu and Yaba exceeded the mean world sea sediment level of 20.00 $\mu g\ g^{-1}$ except those top sediment of Yaba and Ikorodu of the (Rankama and Sahama 1960). The highest concentration of nickel was found in Iddo (station 3) in bottom sediment; the levels of Ni were high to pose danger. The chromium accumulation at station 3 (Iddo) showed the highest sediment pollution. The high Cr levels obtained at station 1and 2

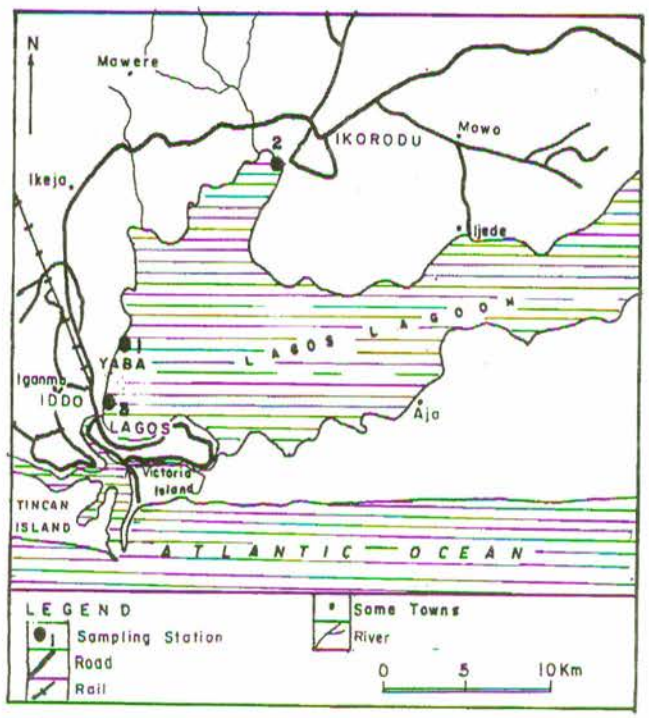

Fig 1. Map of Lagos showing sampling stations.

Table 1

Mean concentrations of heavy metals (mg kg^{-1} dry weight) in top sediments of Lagos lagoon.

Parameter	Station 1 (Yaba)	Station 2 (Ikorodu)	Station 3 (Iddo)
Cadmium	0.13	0.40	0.77
Lead	11.90	4.10	57.00
Nickel	24.10	11.60	70.00
Chromium	40.90	23.30	110.80
Copper	7.30	4.80	91.20
Zinc	76.40	27.30	223.10
Iron	10579.80	1614.20	11722.70
Manganese	275.00	510.00	489.00
Cobalt	6.40	18.30	35.50
Mercury	N.D	N.D	N.D

N.D, Not detectable

Table 2

Mean concentrations of heavy metals (mg kg^{-1} dry weight) in bottom sediments of Lagos lagoon.

Parameter	Station 1 (Yaba)	Station 2 (Ikorodu)	Station 3 (Iddo)
Cadmium	8.60	N.D	2.70
Lead	259.80	128.50	295.40
Nickel	75.00	56.30	149.40
Chromium	33.20	57.30	167.20
Copper	9.00	19.10	102.70
Zinc	44.30	50.70	323.70
Iron	85548.00	13624.00	53094.00
Manganese	604.50	513.10	749.00
Cobalt	41.50	13.60	40.70
Mercury	0.05	0.04	0.53

N.D, Not detectable

exceeded 0.15 mg kg^{-1} dry weight as recommended by WHO base limit for occupation at exposure to heavy metals (Waidichuk 1986) copper levels in top and bottom sediments were highest at station 3 (Iddo). The high accumulation of iron in all the sediment samples was unexpected. At although iron is not known as a toxic metal but high concentration may lead to rusting and corrosion of industrial and domestic materials. The uptake of manganese metal was high for sediments analysed from all the stations. Cobalt levels of accumulation in Yaba 41.50 mg kg^{-1} and Iddo 40.70 mg kg^{-1} were approximately equal and were higher than that of Ikorodu 1360 mg kg^{-1}. These values were high as against 0.2 mg kg^{-1} permissible health base limit for occupational exposure. Accumulation level of mercury was highest in sampling stations 1 and 2, which were high as against 0.03-02 $\mu g\ g^{-1}$ dry weight suggested background level of fresh water top sediments.

Conclusion

The results of the present study indicate that there is considerably high metal concentration in the sediments of the Lagos lagoon. The activities of industries and urbanization have increased the rate of heavy metal pollution in the territorial waters. All hands must be on deck to plan and execute the measures for controlling heavy metal pollution in the natural resources of Nigeria.

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