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SHORT COMMUNICATION

PETROLEUM HYDROCARBON LEVELS IN SEDIMENTS OF STREAMS AND RIVERS WITHIN IBADAN CITY, NIGERIA

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ABSTRACT. Bottom sediment samples were collected at several points along the course of eight different streams and rivers which flow through Ibadan city, Nigeria. These were analysed for their hydrocarbon oil contents. Petroleum hydrocarbon concentrations varied significantly along the course of any one stream, while the differences observed among the streams were found not to be significant. The Concentrations ranged widely between 20 mg/kg and 1000 mg/kg with a mean of 219±229 mg/kg. The levels were lower than those earlier found in contaminated sediments from petroleum production areas and in topsoil within Ibadan city, but slightly higher than levels found in sediment samples from control and remote areas.

INTRODUCTION

Petroleum hydrocarbon oils are of environmental interest because they are toxic to the human system, plants and animal resources [1-3]. Yet, they pervade the environment beyond the vicinities of petroleum exploration and production activities due to transportation, storage, disposal and other handling activities during which contamination of the environment sometimes occur [4,5]. Hence, urban centres remote from production activities are sometimes as much polluted with the hydrocarbons as are the surroundings of production areas. For example, topsoil from various parts of Ibadan, a city remote from the petroleum production zone of Nigeria, were examined and found to be contaminated to varying degrees with residual petroleum hydrocarbons derived from poor handling and disposal practices [6].

Water and sediment may also be contaminated with petroleum hydrocarbons in such urban centres. These reach the water bodies through sources such as spills from transportation trucks, runoff of leachate from automobile mechanic workshop surroundings which are usually heavily contaminated, direct dumping of hydrocarbon-bearing waste into streams and rivers, and direct discharge of oily effluent from factories. Once a water body is contaminated with hydrocarbon oil, the oil readily becomes incorporated into the sediments where it accumulates and is more persistent [7-9]. Assessing aquatic sediment is often an effective way of detecting the contamination of a water body [10,11].

Ibadan city is one of the largest in sub-Saharan Africa. Numerous studies of the Ibadan environment have been carried out, including the screening of petroleum hydrocarbon levels in topsoil [6]. The present study investigates petroleum hydrocarbon levels in the sediments of the several streams and rivers which flow through the city and serve as receptacle for the disposal of variety of wastes. Such data are currently not available. The results of this study provides this useful information to complement the array of data now available on different aspects of the environment of Ibadan city.

EXPERIMENTAL

Sediments were obtained in May-July 1994 from several different points along the course of eight different stream/river networks (Kudeti, Oluyoro, Ogunpa, Gege, Ona, Orogun, Agoro and Temidire) which criss-cross Ibadan city metropolis. The lithology of the sediments varied at different points, and ranged from coarse sand to fine clay. Sediments were collected with a metal grab from the generally shallow water bodies and placed in aluminium foil wrappers. They were later air-dried and sieved.

Total hydrocarbon oil was determined by the method of the Intergovernmental Oceanographic Commission (IOC) [12]. 100 g of sediment was refluxed with 100 mL of methanol containing about 3.0 g of KOH for about 2.5 h. The reflux mixture was filtered, and the filtrate extracted with two 25 mL portions of redistilled hexane. The combined extract was evaporated to about 1.0 mL and then subjected to clean-up in a short silica column eluted with n-hexane. The eluate was subsequently evaporated to isolate the hydrocarbon oil which was then weighed. A recovery test of the procedure was carried out by spiking five analysed sediment samples with varying amounts of fresh automobile engine lubricating oil, and then repeating the analysis. An average recovery of 87.2±4.7% (mean ± s.d.) was obtained.

RESULTS AND DISCUSSION

The mean and range of the total hydrocarbon oil concentrations in the sediments are given in Table 1. Significant variation was observed in the concentrations at different points of any given stream course, with coefficients of variation ranging from 23% to 132%. The pattern of variations could not be correlated with any specific factors. Analysis of variance (ANOVA) of all the individual concentrations at all points shows that the apparent differences observed among the streams are not significant. The overall mean concentration for all the streams was thus calculated to be 219±229 mg/kg (mean ± s.d.) with a wide range of 20-1000 mg/kg, indicating an erratic contamination pattern.

Table 1. Concentrations of total hydrocarbon oil in the sediments.

River/stream	No. of samples	Mean ± S.D. (mg/kg)	Range (mg/kg)	Coefficient of variation (%)
Kudeti	4	155±159	40-390	103
Oluyoro	4	170±80	60-260	47.1
Ogunpa	7	310±410	20-1000	132
Gege	4	520±250	150-690	48.1
Ona	7	97±71	30-230	35.2
Orogun	4	130±60	60-200	46.2
Agoro	3	130±30	100-160	23.1
Temidire	4	240±60	180-320	25.0

The average levels obtained in the sediments are slightly lower than those which have been obtained in topsoil at various locations within the city [6]. Topsoil mean values ranged between 355-1950 mg/kg around the most polluted areas. Polluted sediments from rivers in the oil-producing regions of Nigeria contained levels as high as 100-3000 mg/kg [13]. The levels in sediments obtained in this study are however still higher than those obtained in

sediments of streams and rivers around some remote unpolluted sites in Nigeria where average levels ranged between 1.0 mg/kg to 10 mg/kg [13]. Gearing *et al.* [14] found similarly low levels in the unpolluted sediments of the Gulf of Mexico shelf. Thus, even though the levels obtained in the sediments in this study appear relatively low they still represent a slight elevation beyond what is the background levels usually found in unpolluted sediments.

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