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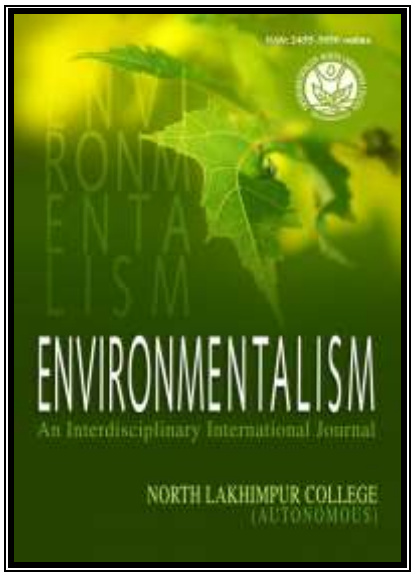

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EXTENT OF TOTAL PETROLEUM HYDROCARBON POLLUTION IN LENTIC WATER BODIES NEAR BONGAIGAON REFINERY AND PETROCHEMICAL COMPLEX, ASSAM, INDIA

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Abstract

The aim of the present investigation was to study whether lentic water bodies near oil installations get contaminated with TPH over the years. In the present study three water bodies were selected which were located at sufficient distance from the effluent discharge point so that the extent of TPH contamination in lentic water body away from the source could be detected. Water bodies for collection of samples were selected where oil film could be seen. S_3 is closest to effluent discharge point whereas S_1 and S_2 are 1.38 and 2.14km away from S_3 respectively. High concentration levels of hydrocarbons present in contaminated sites could pose a health risk to humans, plants and animal lives. TPH concentration in water in three lentic water bodies were below detection limit. The low concentration of ∑TPH in water may be due to low aqueous solubility, volatilization, and affinity of these compounds to the organic matter In the present study sites (S1, S2 and S3) concentration of TPH in sediments ranged from 3000 to 17000 mg/kg which was higher than the specified value. Though TPH concentration in surface water was below detectable level, in sediment much higher level was detected (3000 -17000 mg/kg).

Keywords: TPH, lentic water body, pollution, refinery sites

1 Introduction

The petroleum refining industries are one of the major sources of total petroleum hydrocarbon pollution (TPH) in lentic water bodies. TPH is defined as the measurable amount of petroleum-based hydrocarbon in environmental media (Research Triangle Institute 1999; Gustafson 1997). Carcinogenic hydrocarbons such as polycyclic aromatic hydrocarbons (PAHs) and toxic elements are associated with hydrocarbon formation, refining, processing , transportation , and usage and can degrade environments or leach into surface and ground waters (Adebiyi and

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Afedia 2011). Waste waters released by oil-processing and petrochemical enterprises are characterized by high amounts of oil products, polycyclic and aromatic hydrocarbons, phenols, metal derivatives, surface-active substances, sulfides, naphthylenic acids and other chemicals (Suleimanov 1995). In India, the effluent discharge from petroleum oil refining is regulated under the provisions of the Environment (Protection) Act, 1986 as amended by the Ministry of Environment and Forests, Government of India (MoEF 2008). Aquatic ecosystems act as a major sink for pollutants. Sublethal concentrations of petroleum can disrupt many of the physiological and behavioral processes of a variety of aquatic organisms (Connell *et al.* 1981). High–molecular weight (>C16) hydrocarbons (HMWHs) are common pollutants in sediments of freshwater systems, particularly urban water bodies. The aquatic macroinvertebrates in the field-based experiments were affected by HMWHs as low as 840 mg/kg (Pettigrove and Hoffmann 2005). Following release to the environment, refined and residual petroleum products may accumulate in soils and sediments where they undergo several dispersal and weathering processes that affect the composition and toxicity of the hydrocarbon mixtures (Neff *et al.* 1994). In the present study TPH concentration in water and sediment in three lentic water bodies near Bongaigaon Refinery, Assam were analysed in the month of January 2015 in order to record whether these water bodies are affected.

2 Materials and methods

2.1 Description of the study area

The sampling sites (S1, S2 and S3) are lentic water bodies which are located near to Bongaigaon Refinery Ltd, Assam. S3 is near to the effluent discharge point. S1 is 1.38 km away whereas S2 is 2.14 km away from S3.

2.2 TPH analysis in water and sediment

Extraction of TPH from water samples was done following the EPA method 3510C. It is based on separatory funnel liquid-liquid extraction method. Water samples were extracted three times with 20 ml of n-hexane in a separating funnel. The water extracts were dried by anhydrous sodium sulphate, and the extracts were concentrated by rotary evaporation. In sediment, analysis of TPH was performed by a modified EPA SW-846 Method 8270B, (USEPA 1994) utilizing an automated accelerated solvent extractor (Dionex ASE-200) with 100% dichloromethane. The extracted TPH was collected and immediately concentrated to a volume of 1 ml.

3 Results and discussion

The aim of the present investigation was to study whether lentic water bodies near oil installations get contaminated with TPH over the years. In the present study three water bodies were selected which were located at sufficient distance from the effluent discharge point so that the extent of TPH contamination in lentic water body away from the source could be detected. Water bodies for collection of samples were selected where oil film could be seen. S_3 is closest to effluent discharge point whereas S_1 and S_2 are 1.38 and 2.14km away from S_3 respectively.

High concentration levels of hydrocarbons present in contaminated sites could pose a health risk to humans, plants and animal lives. TPH concentration in water in three lentic water bodies were below detection limit. The low concentration of ∑TPH in water may be due to low aqueous solubility, volatilization, and affinity of these compounds to the organic matter (Malik *et al.* 2011). Once entered into a water environment, part of the lower molecular weight fraction of the petroleum hydrocarbon compounds is removed by evaporation. The other part of it gets dispersed in the water phase and poses risks to ecosystems and human health through trophic transfer (Hentati

et al. 2013). Petroleum hydrocarbons as contaminants in water environment are toxic components, relatively soluble in water and stable to chemical and biological interactions (Al-Imarah *et al.* 2007).

Sediments have been extensively used to assess the pollution of water bodies and to reflect the sources and history of pollution, because of the general importance of the sediment phase in the fate and transport of contaminants (Gomez- Gutierrez *et al.* 2007). Due to high chemical stability and hydrophobicity, hydrocarbons tend to be adsorbed by suspended particulate matter and deposited in sediments, which can be accumulated at higher levels compared with an adjacent water column, primarily under anoxic conditions (Readman et *al.* 2002).

Sediment quality guideline value of TPH for all sediments as per Simpson et al. (2013) is 280 mg TPH/kg (dry weight). In the present study sites (S1, S2 and S3) concentration of TPH in sediments ranged from 3000 to 17000 mg/kg which was higher than the specified value (Fig. 1). Site S3 had highest TPH concentration which was near to the effluent discharge point. Results show that as the site is away from the source TPH concentration also decreases. Rai (2010) stated that lentic ecosystems have low capacity of self-purification and pollutant dispersal. Thus high concentration of TPH in lentic water bodies can cause threat to the aquatic fauna and flora via food chain.

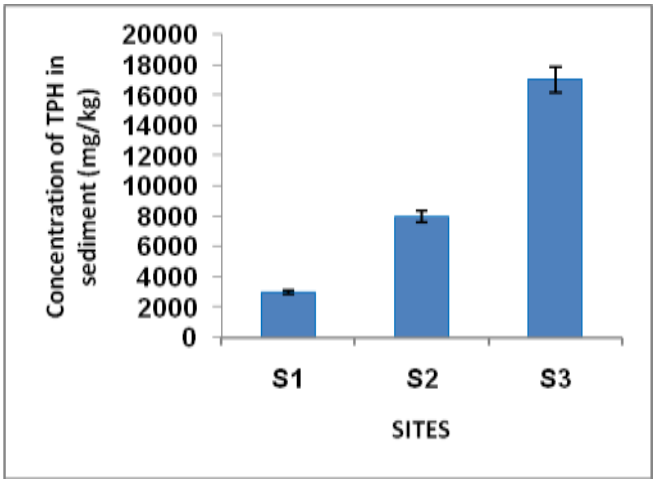

Fig 1: Concentration of total petroleum hydrocarbons in sediments in sites S1, S2 and S3

The level of TPH in sediments revealed that the lentic water bodies in the vicinity of Bongaigaon refinery might have received seepage of refinery effluent over a period of time. Though TPH concentration in surface water was below detectable level, in sediment much higher level was detected (3000 -17000 mg/kg) (Fig. 1). Aquatic fauna as well as flora are exposed to this higher level of TPH which is also responsible for accumulation of heavy metals in sediments. Microbial degradation of these compounds take place in environment and the products of degradation may enter the food chain and cause contamination in higher trophic levels. The findings obtained from this work revealed that analysis of the petroleum contaminated surface water and sediment extracts using the optimised methods yielded higher concentrations of petroleum hydrocarbons in sediments than the specified limits for these compounds. Proper monitoring of surface water and sediment parameters is required to maintain ecosystem health in the vicinity of petroleum refining industries.

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