Mercury Pollution in Vembanadu Lake and Adjoining Muvattupuzha River, Kerala, India

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1. INTRODUCTION

Heavy metals are highly poisonous when they get accumulated or undergo biomagnification processes. The long existence of heavy metals in the aquatic environment is obtained by the bonding with sediments. Among those heavy metals, mercury is considered as the most dangerous pollutant to natural environment because of the ability of plants and animals to accumulate it (Porvari and Verta, 2003) and because of its detrimental effects even at very low concentration (Nriagu, 1979). Mercury present in air and water has increased dramatically in the last century owing to anthropogenic activities. Recent studies suggest that the total global atmospheric mercury has increased between 200 and 500 percent since the beginning of the Industrial Age (UNEP, 2002). Reports also indicate that its levels in rivers, coastal waters, and soil and food items are well above the acceptable levels especially in developing countries like India (Toxics Link, 2003). Pulp and paper, chloralkali, and other industries have used mercury for various purposes and it was prescribed that they were losing some of it in their wastewater. The losses of mercury from paper and pulp industry are without doubt a serious problem because much mercury is incorporated in the fibers that settle and remains in the sediments downstream (Hanson, 1971). Fertilizers, pesticides and fungicides are also a source of mercury pollution.

The coastal zone represents one of the earth’s complex and dynamic ecosystems such as estuaries and backwaters. In these areas which fringe the continents of the globe, the intricate terrestrial and marine systems become ever more complex as they respond to the pressure created by man (UNESCO, 1976). The estuaries of Kerala, which lie in the southern corner of peninsular
India are exception in the sense that a number of rivers open into a single estuary through backwaters or lakes. Vembanadu lake is the largest brackish, humid tropical wetland ecosystem on the southwest coast of India. This lake system is fed by 10 rivers and is one of the Ramsar sites of India. The Vembanadu lake is connected with Arabian sea through the Cochin estuary. Not only the tidal effect but also the fresh water input during the southwest monsoon is affecting the water quality of the lake. Muvattupuzha river is discharging a large amount of the agricultural waste and effluents from paper and pulp industry into the central part of the lake. No systematic study was conducted to assess mercury pollution in this area.

The present study deals with the contamination in the bed sediment and surface water on a part of the Vembanadu lake with respect to point sources of pollution at Muvattupuzha river.

2. MATERIALS AND METHODS

Vembanadu estuary situated between 76°15′E and 76°25′E to 9°30′N and 10°10′N is one of the major estuaries of Kerala on the west coast of India (Fig. 1). The estuary receives a constant inflow of land runoff and industrial effluents. Vembanadu estuary acts as a sink for different trace metals. Point sources of pollution play an important role in the occurrence and distribution of heavy metals in the study area. The study area receives factory effluents mainly from Hindustan Newsprint Limited (HNL) from the major river Muvattupuzha. Accumulation and biomagnification of mercury in biota plays a significant role in the toxicity of this metal. Bed sediments and surface waters were analysed for the appraisal of the mercury content in the study area and other work underway.

Out of twelve sampling stations which were fixed, seven were from the Muvattupuzha river and five were from the Vembanadu lake (see Fig. 1). Surface water and bed sediment samples were collected using a precleaned plastic bucket during premonsoon (February, 2004) and monsoon (July, 2004) (Fig. 1). Nitric acid and potassium dichromate were added to water samples as preservatives for mercury analysis. The sediment is kept in low temperature until the analysis is carried out. Salinity and pH is determined by potable water quality analysers and percentage of organic matter is obtained by Walkey and Black method (Trivedi and Goel, 1986).

Mercury content in water and sediment is determined by mercury analyser, which is operated on Cold Vapour Atomic Absorption Spectrometry (USEPA, 1998). The sediment is dried and powdered and digested with aqua regia at 95°C in a water bath for 2 min, cooled, and added to milli-Q water and potassium permanganate (5%) solution and again kept in the water bath for 30 min. at 95°C. Cool and add hydroxylamine hydrochloride (12%) to reduce excess permanganate and make up to 50 ml (Anderson, 2000). The total