Bull. Environ. Contam. Toxicol. (1985) 34:623–626

Bulletin of Environmental Contamination and Toxicology

Changes in the Sulfide Content of Bottom Muds in Going from River to Sea

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When determining the level of pollution in rivers and the sea, water is usually analyzed chemically with little attention to bottom mud content. It is generally known that at such water areas at the river mouths, as water is apt to be stagnant, water content and that of mud mutually effect each other. So we think that much more attention should be focussed upon bottom mud content. Chemical oxygen demand (C.O.D), ignition loss, total sulfide, and so on are considered as indicators of organic enrichment of bottom muds and we paid attention to total sulfide from among them. And then the total sulfides in bottom muds in going from the upper stream of a river to its point of opening at the sea were measured and significant results obtained.

MATERIALS AND METHODS

The 10 sampling locations on the Ohta river and Hiroshima bay are shown in Fig. 1. At Stations 1, 2, 3, 4, and 5, muds were collected on March 10, 1983. At low tide muds were collected with a scoop. At Stations 6, 7, 8, 9, and 10, muds were collected with a Smith-McIntyer grab operated from a ship provided by Hiroshima University. Each sample was placed in a washed polyethylene bottle and stored frozen until analysis.

Total sulfide in the muds was determined using Hedorotekku S (Kitazawa Industry Co. Ltd.) within a week following collection. The following procedure was used. Samples were thawed at room temperature and the mud (1-2g) was treated with 18 N sulfuric acid (2 ml) to bring about generation of hydrogen sulfide. The hydrogen sulfide was analyzed by a special detector tube and the total sulfide determined.

RESULTS AND DISCUSSION

In a natural environment, microbes producing sulfides from sulfur-containing amino acids are distributed widely. However, most of the sulfides present in the sea and at river mouths are considered to result from the bacterial reduction of sulfates. Microbes participating in this activity are sulfate-reducing bacteria. It is known that under certain anaerobic conditions these bacteria can produce hydrogen sulfide from the bacterial reduction of sulfates as these bacteria decompose organic matter in order to obtain nutrient sources. Kitamura et al.

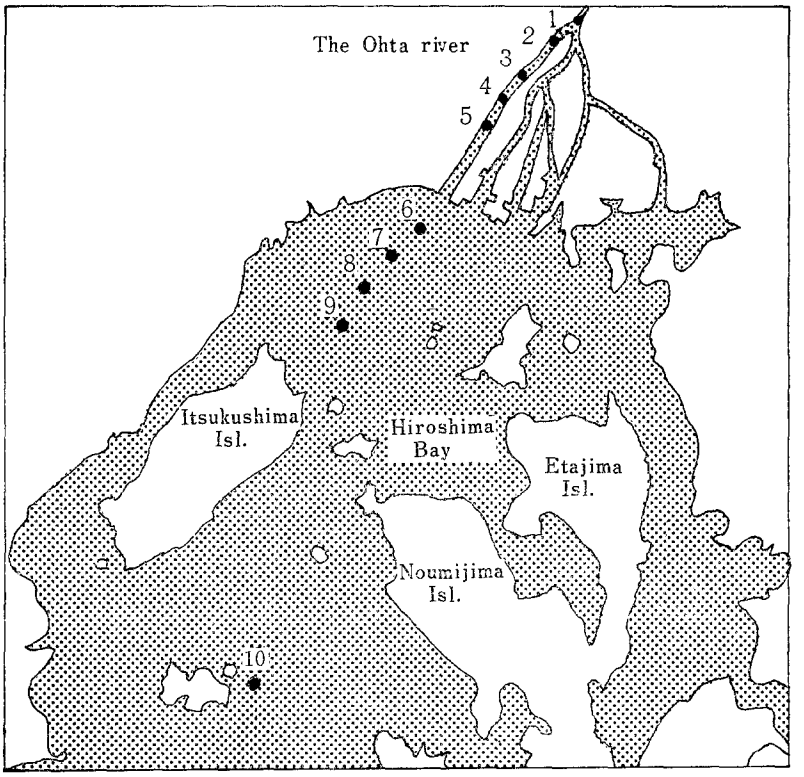

Fig. 1 Sampling points on the Ohta river and Hiroshima bay.

(1957) report that total sulfate reducers are usually distributed evenly at high concentration in mud throughout sea-water, brackish, and fresh water zones.

The results obtained by the present study are shown in Table 1 and Fig. 2. Total sulfide contents in the bottom muds of Stations 1 and 2 were 0.051 mg/g dry mud and ND, respectively. Station 1 was a fresh water zone and Station 2, a tidal zone. The bottom muds of Stations 1 and 2 were extremely low in total sulfide. In the case of Station 1 the main cause for this was considered the low amount of organic matter and sulfate content available for sulfur production, and at Station 2, organic matter was extremely low.

Total sulfide content gradually increased from 0.58 to 1.7 mg/g dry mud at Stations 3, 4, 5, and 6. It is considered that in these water areas the concentration of sulfates was always greater than that necessary (150ppm SO_4^{2-} or more: Murakami 1971) since as a result of the mixing of river and sea water which contain 2560 ppm SO_4^{2-} as average (Hanya 1971). As a lot of organic matter contained in water are precipitated at the mouth, bottom mud of the mouth become to abound in organic matter, and these bacteria are particularly plentiful in the muds at the river mouth and coastal waters (Taga 1974).
On the basis of the above-mentioned, it is inferred that the total sulfide contents are high at river mouth (Stations 3, 4, 5, 6).

Table. 1 Total sulfide Content at each sampling point on the Ohta river and Hiroshima bay.

Station No.	1	2	3	4	5	6	7	8	9	10
Content of total Sulfide (mg/g dry mud)	0.051	ND	0.58	0.70	1.3	1.7	0.74	0.36	0.11	0.098

ND : Not detected.

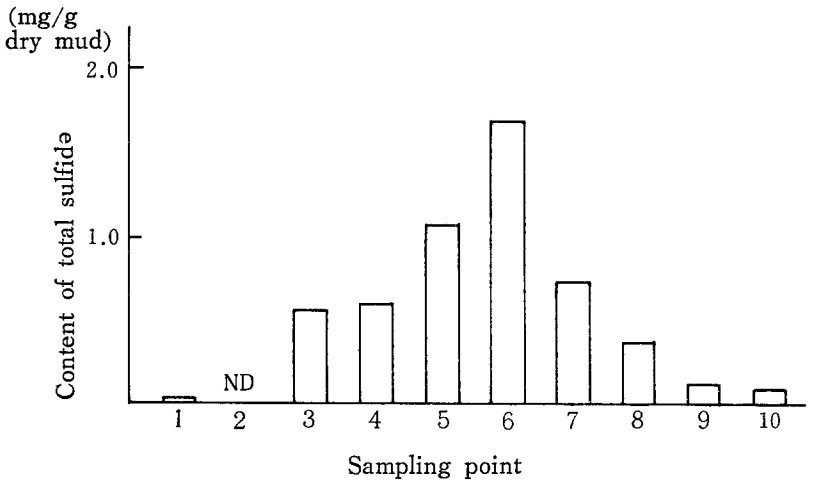

Fig. 2 Total sulfide Content at each sampling point on Ohta river and Hiroshima bay.

At Stations 7, 8, 9, and 10, the total sulfide gradually decreased from 0.74 to 0.098 mg/g dry mud. Murakami et al. (1971) reported that when sulfate-reducing bacteria are present and the SO_4^{2-} content is 150 ppm or more under anaerobic conditions, sulfide production occurs in proportion to the quantity and quality of the organic matter. Since at Stations 7, 8, 9, and 10, sulfates and sulfate-reducing bacteria were sufficiently present, it is considered that the total sulfide content gradually decreased owing to the gradual decrease in quantity of organic matter.

The above results indicate that production of sulfides is highest in the muds of a river mouth. Kitamura et al. (1955) reported that C.O.D. values are closely correlated to total sulfide content. And the data of the Hiroshima Environmental Bureau on bottom muds in public water areas of Hiroshima prefecture were analyzed statistically by us and it was found that C.O.D. values and ignition loss of bottom muds were significantly correlated to total sulfide content ($p<0.05$). The mud of such water is apt to be polluted and have an adverse influence on water with which it comes into contact. Therefore, it is considered that due caution should thus be directed to such water regions.

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Received July 24, 1984; Accepted August 8, 1984.