THE MECHANISM OF ANOXIC WATER GENERATION DUE TO CONTAMINATED SEDIMENTS

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Water quality in enclosed coastal seas is still contaminated in spite that the amount of sewage loads considerably decreased as compared with the 1970's. Especially in summer, anoxic water is generated in bottom water in the bay. In anaerobic condition, the nutrient is released from bottom sediments to water body. This behavior means the internal loads of nutrient salts for coastal waters.

In order to improve the water quality in Tokyo Bay, it is necessary to improve bottom sediment quality as well as the reduction of the amount of wasted loads discharged from surrounding areas. From the viewpoint, Yokohama municipal government carried out the sand capping constructions at Yokohama Port in Tokyo Bay since 1994 to 2000. In order to know the effect of the sand capping technique on nutrient release reduction from bottom sediments ant its lasting effect, we carried out the undisturbed sampling of bottom sediments and laboratory tests for nutrient release rate from the sediments. Then we carried out numerical simulation for anoxic water generation to verify the importance of the improvement of bottom sediment quality by using ecological mathematical model.

We carried out undisturbed sediment sampling from St.1 to St.3 and normal sediment sampling from St.1 to St.5. The sampling data at St.1 is the sediment without sand capping, and the sampling data at Sts. 2 and 3 are the sediments with sand capping at 6 years and 10 years ago, respectively. The sediment qualities at St.1 are dark black color, bad smell, high moisture, and fine silty mud. On the other hand, the sediment qualities at Sts. 2 and 3 are dark ocher color, no smell, low moisture content, and sand mixed silt. However, there is thin dark mud layer, which is accumulated on the sand capping materials. The thickness of these mud layers is about 1 cm at St.2 and 5 cm at St.3.

By using the undisturbed sediment samples, we carried out laboratory tests for nutrient release rate from the sediment. Figs. 1 and 2 show the results of laboratory experimental tests of Ammonium Nitrogen concentration and Phosphoric Phosphate concentration from the initial stage to 72 hours later. From these figures under the aerobic condition, there is no release from the sediments for both nutrient salts. On the other hand under the anaerobic condition, however, both nutrient salts of Ammonium Nitrogen concentration and Phosphoric Phosphate are released from the sediments. The order of the

concentrations of released nutrients is the sampled water at St.1, St.3 and St.3 for both nitrogen and phosphate salts. The results show that the nutrient release rate from the sediment is dependent upon the thickness of mud layer accumulated on the bottom.

In order to verify the effectiveness of sediment quality improvement by sand capping technique on water quality improvement, numerical experiments of dissolved oxygen concentrations were carried out by using an ecosystem model. In the study, we consider the nutrient release of NH_4-N and PO_4-P, and consumption of dissolved oxygen by contaminated sediment in case without sand capping. Then we assume that there are no nutrient release and no consumption by sediment in case with sand capping.

By the study, following conclusions are obtained. (1). By laboratory tests for nutrient release, it is found that the nutrient release rate from the sediment is dependent upon the thickness of mud layer accumulated on the bottom and the concentration of dissolved oxygen of bottom water. (2). By numerical experiments of ecosystem model, it is shown that the role of contaminated sediments on water quality degradation is quite large. (3). The sand capping technique has still effect on nutrient release reduction, but the effectiveness of the sand capping is decreased due to the accumulation of dark mud on the sea bottom.

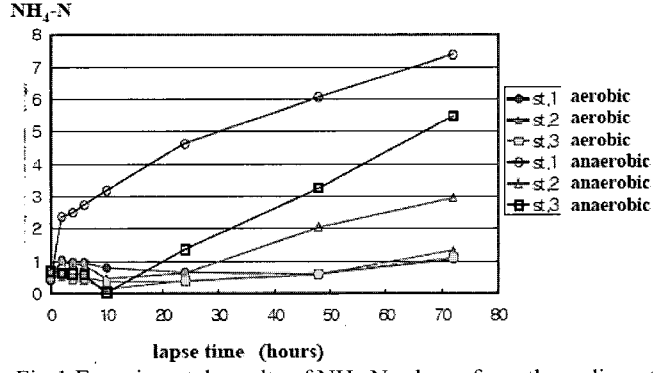

Fig.1 Experimental results of NH_4-N release from the sediment

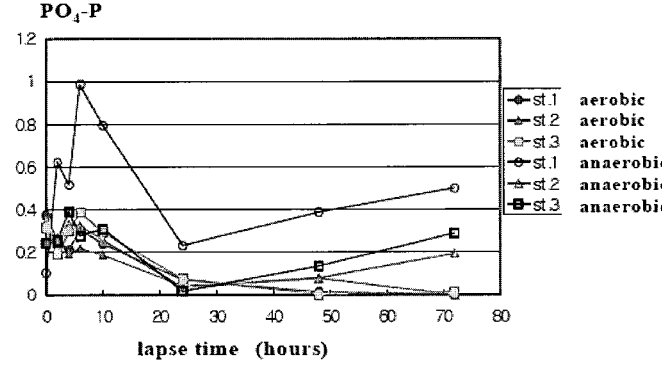

Fig.2 Experimental results of PO_4-P release from the sediment.