

## **Improvement of Semi-Enclosed Water Environment by Means of Artificially Promotion of Water Circulation and Sand Capping on the Seabed**

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In recent years, oxygen-deficient water is being formed in many semi-enclosed waters, such as canals, ports and pockets after getting the sand, due to the load from rivers in addition to oxygen consumption in bottom sediment and poor water circulation. In general, one of the major methods is dredging, but it has a problem that there is much bottom sediment and little space to dump it. An alternative method is to artificially promote water circulation in order to move the surface water that has a high dissolved oxygen concentration to the bottom.

In summer of 1997, this method was applied in the port of Kishiwada, Osaka bay, Japan. The renewal project has been carried out at its seaside area, but the odor was generated when the oxygen-deficient water was flown up from pockets to the surface. The water circulation system consists of air compressors, rubber tubes and unique pipes. One end of a pipe was fixed on the bottom and the other end was kept in the water by floats. Air floated up through the pipe, so the bottom water flowed up to the surface. Two months after starting to run the system, the dissolved oxygen concentration of lower water was higher than 2 mg/l, which is the criterion of water quality standard grade five, thus showing the effectiveness of the system. Furthermore, from 1998 to 1999, heavy amount of dredged sand was thrown into the pockets in order to cap the bottom sediment and decrease the volume of lower water.

In 2000, we surveyed the Kishiwada port in order to clarify the effects of two methods. The period, that the oxygen-deficient water was being formed, was shortened. However, the oxygen-deficient water was being formed in July and August. We investigated the dissolved oxygen consumption rate of water. The bottom sediment was collected with core samplers, and the dissolved oxygen consumption rate was measured. Then, the material flow of oxygen was calculated in the lower water. It was found that the amount of oxygen supply into the lower water was a half of the amount of oxygen consumption.