

Laboratory Investigation of Deterioration and Natural Remediation of the Ariake Sea Tidal Flat Mud Caused by the Sea Laver Treatment Practice and Upward Seawater Seepage

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ABSTRACT In this paper, a series of laboratory infiltration tests were carried out to investigate the deterioration and natural remediation of the Ariake Sea tidal mud caused by the sea laver treatment practice and upward seawater seepage. The test results reveal that with the infiltration of the sea laver treatment agent in the tidal mud, mud sulfide content increased while pH decreased. The remediation test results indicate that with the infiltration of the fresh seawater, the sulfide content of the Iida site mud considerably reduced and pH value increased to an acceptable range for benthos living in the tidal flat mud.

KEY WORDS: Ariake Sea; pH; sulfide; tidal mud.

INTRODUCTION

The Ariake Sea, which is located in the Kyushu region of Japan, is one of the well-known semi-closed shallow seas in Japan. The Ariake Sea has a vast tidal flat area, which almost covers 40% of the total tidal flat in Japan. The tidal flat area is well-known for a large amount of production of sea lavers (*Porphyra Spp.*) and benthos such as *Agemaki* shell (*Simonovacula constricta*). According to the unpublished data from the Ministry of Agriculture, Forestry and Fisheries of Japan, recently the annual catch of some benthos decreased. For example, the catch of the *Agemaki* shell which lived in 0-700 mm zone below mud surface dropped from 170 tons in 1976 to practically nil by 1992 (Fig. 1). The reason for this observed decrease is still not clear. One of the possible reasons can be the deteriorated environment in the mud of the Ariake Sea since it was observed that the mud in the tidal flat areas of the Ariake Sea recently has considerably unpleasant odor and the color of the Ariake Sea tidal flats became darker. The considerable unpleasant odor is considered as a consequence from the mud contamination of the sea laver treatment practice, which is used by the local sea laver farmers to treat the sea lavers using a type of acid titled "sea laver treatment acid" during the cultivation season (from late of December to next February). However, so far, detailed studies on how the sea laver treatment practice affects the geoenvironmental properties of the tidal mud have not received sufficient attention.

On the other hand, the field test on the Iida tidal mud of the Ariake Sea shows that the deteriorated tidal mud is becoming "clean" now in terms of decrease in the sulfide content at a depth of 100 mm. The field

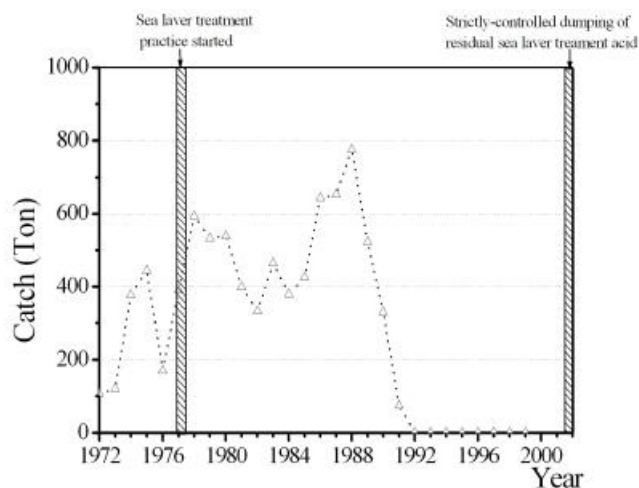


Fig. 1 Change of annual catch of *Agemaki* shells in Saga Prefecture

investigation shows that downward seepage of seawater in the mud during the flood tide of the sea laver cultivation period. A recent field investigation shows that a downward and an upward seepage of seawater would occur in the Iida tidal flat mud during the flood tide and ebb tide of the Ariake Sea, respectively. These two opposite seepage direction of seawater in the tidal flat mud are thought to have played important roles in the mud deterioration and remediation process. It is thought that during the cultivation of the sea laver season, the sea laver treatment acid would transport into the mud driven by the downward seepage. Under appropriate condition (i.e., relatively high temperature such as in Spring, Summer and Autumn seasons), phosphorus (P) contained in the sea laver treatment acid would enhance the activity of sulfate-reducing bacteria and thereby enhance the bio-chemical reactions that generally occur in the marine sediments. As a result, sulfide content of the Iida tidal flat mud increases, which represents undesirable inhabitation condition for the *Agemaki* shells. The upward seepage flow of Ariake Sea water in the Iida tidal mud is thought to have a natural remediation effect in terms of washing out those chemical compounds which lead to the unpleasant odor (e.g., hydrogen