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Evaluation of Iron Application Method to Remediate Coastal Marine Sediment

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Abstract : Sediment is an important habitat for organisms and act as a store house for nutrients in aquatic ecosystems. Hydrogen sulfide is produced by microorganisms in the water columns and sediments, which is highly toxic and fatal to benthic organisms. However, the irons have the capacity to regulate the formation of sulfide by poising the redox sequence and to form insoluble iron sulfide and pyrite compounds. Therefore, we conducted two experiments aimed to evaluate the remediation efficiency of iron application to organically enrich and improve sediments environment. Experiments carried out in the laboratory using intact sediment cores taken from Mikawa Bay, Japan at every month from June to September 2017 and October 2018. In Experiment 1, after cores were collected, the iron powder or iron hydroxide were applied to the surface sediment with 5 g/ m2 or 5.6 g/ m2, respectively. In Experiment 2, we experimentally investigated the removal of hydrogen sulfide using (2mm or less and 2 to 5mm) of the steelmaking slag. Experiments are conducted both in the laboratory with the same boundary conditions. The overlying water were replaced with deoxygenated filtered seawater, and cores were sealed a top cap to keep anoxic condition with a stirrer to circulate the overlying water gently. The incubation experiments have been set in three treatments included the control, and each treatment replicated and were conducted with the same temperature of the in-situ conditions. Water samples were collected to measure the dissolved sulfide concentrations in the overlying water at appropriate time intervals by the methylene blue method. Sediment quality was also analyzed after the completion of the experiment. After the 21 days incubation, experimental results using iron powder and ferric hydroxide revealed that application of these iron containing materials significantly reduced sulfide release flux from the sediment into the overlying water. The average dissolved sulfides concentration in the overlying water of the treatment group was significantly decrease ($p = .0001$). While no significant difference was observed between the control group after 21 day incubation. Therefore, the application of iron to the sediment is a promising method to remediate contaminated sediments in a eutrophic water body, although ferric hydroxide has better hydrogen sulfide removal effects. Experiments using the steelmaking slag also clarified the fact that capping with (2mm or less and 2 to 5mm) of slag steelmaking is an effective technique for remediation of bottom sediments enriched organic containing hydrogen sulfide because it leads to the induction of chemical reaction between Fe and sulfides occur in sediments which did not occur in conditions naturally. Although (2mm or less) of slag steelmaking has better hydrogen sulfide removal effects. Because of economic reasons, the application of steelmaking slag to the sediment is a promising method to remediate contaminated sediments in the eutrophic water body.

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