Abstract of Main Thesis

Title of Thesis

Studies on Ion Adsorption-Desorption Characteristics of Biofilm Matrices

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Abstract on the Content of the Applicant's Thesis

The ability of biofilm to attract and retain ion, including nutrient ions, is highly relevant to various functions of biofilm as a predominant habitat of microbes such as nutrient cycling and preservation of microbial gene pool. In this study, nutrient ion concentration inside biofilms during the biofilm forming process and ion adsorption-desorption characteristics of biofilm matrices, including how ions retained in the biofilm matrices, were investigated. The biofilm formed relatively quickly taking just a week to reach biomass found for the mature biofilm. The interior of the biofilm is rich in nutrient (hundreds to thousands times greater in nutrient ion concentration) compared with the surrounding water from a very early stage of the biofilm formation. Both positively and negatively charged sites exist in the biofilm polymers. A physicochemical interaction between these charged sites and ions in the surrounding water seems to promote the ion adsorption to the biofilm through an attractive electrostatic interaction and an ion exchange mechanism. The attracted ions may be reserved in two regions; 1) the regions between biofilm polymers and 2) on the charged sites of biofilm polymers. The main factor regulating the ion retaining ability inside of biofilms seems to be an electrostatic interaction between the ions and the charged sites of biofilm polymer. The greater electrostatic attraction between the retained ions and the charged sites of biofilm polymers will hinder the release of the ions from the biofilm matrices. The result obtained by the present study enable us to characterize the internal region of biofilm exchanging ions dynamically with outside environment and to find out the determinant factor regulating this dynamic exchange of ions applicable for various biofilms. According to the results of this study, biofilms may play important roles to stabilize the aquatic ecosystem concerning ion concentrations.