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镧改性沸石改良太湖底泥的磷吸附特征

李佳,詹艳慧,林建伟

上海海洋大学海洋科学学院

Effect of La-Modified Zeolite on Phosphate Sorption of Taihu Lake Sediments

LI Jia, ZHAN Yan-Hui, LIN Jian-Wei

College of Marine Science, Shanghai Ocean University

摘要 采用镧改性沸石对太湖底泥进行改良，通过吸附试验分析镧改性沸石改良太湖底泥的磷酸盐吸附特征。Langmuir和Freundlich等温吸附模型可以较好地描述太湖底泥对水中较高浓度磷酸盐（1～15 mg•L^{-1}）的吸附平衡，根据Langmuir吸附方程，未改良太湖底泥对水中磷的最大吸附容量为791 mg•kg^{-1}，镧改性沸石添加量为10、25和50 g•kg^{-1}的改良太湖底泥对水中磷的最大吸附容量分别为937、1 037和1 505 mg•kg^{-1}。准二级动力学模型可以较好地描述太湖底泥对水中磷酸盐的吸附动力学过程。太湖底泥对水中磷酸盐的去除能力随pH增加而降低，其对磷酸盐的吸附属于自发和吸热过程。改良太湖底泥对水中磷酸盐的吸附能力明显高于未改良太湖底泥，并且其吸附能力随镧改性沸石添加量的增加而增加。镧改性沸石添加量为10~50 g•kg^{-1}的改良太湖底泥的磷吸附-解吸平衡浓度为0.129~0.241 mg•L^{-1}，明显低于未改良太湖底泥（0.386 mg•L^{-1}）。被改良底泥中镧改性沸石所吸附的磷以NaOH-P和HCl-P等较稳定的形态存在，厌氧状态下不易释放。

关键词： 镧改性沸石 改良 底泥 磷酸盐 吸附

Abstract: Through batch sorption tests, effect of La-modified zeolite (LMZ) on phosphate sorption of Taihu Lake sediments was investigated. Langmuir and Freundlich equations were found to be quite useful to describe sorption equilibrium of phosphate (1-15 mg•L^{-1} in concentration) on Taihu Lake sediments in the lake. According to the Langmuir isotherm model, the maximum phosphate sorption capacity of the original Taihu Lake sediment was 791 mg•kg^{-1}, and that of the Taihu Lake sediments amended with 10, 25 and 50 g•kg^{-1} LMZ was 937, 1 037 and 1 505 mg•kg^{-1}, respectively. The pseudo-second-order model could be used to describe phosphate sorption kinetics of the Taihu Lake sediments in the lake. The phosphate sorption capacity of the Taihu Lake sediments decreased with increasing solution pH. The sorption of phosphate on the Taihu Lake sediments was a spontaneous endothermic process. The phosphate adsorption/desorption equilibrium concentration of the Taihu Lake sediments amended with 10-50 g•kg^{-1} LMZ was 0.129 - 0.241 mg•L^{-1}, which wase much lower than that of the original Taihu Lake sediments (0.386 mg•L^{-1}).The phosphate adsorption/desorption equilibrium concentration of the LMZ-amended Taihu Lake sediments decreased with increasing LMZ dosage. Sequential extractions of phosphorus from phosphate-sorbed original Taihu Lake sediments and LMZ-amended Taihu Lake sediments indicate that most of the phosphate adsorbed by LMZ in the sediments existed in the forms of NaOH-P and HCl-P, which are quite stable and unlikely to get released under anaerobic conditions.

Keywords: La-modified zeolite amendment sediment phosphate sorption

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Corresponding Authors: 林建伟 上海海洋大学海洋科学学院 Email: jwlin@shou.edu.cn

About author: 李佳（1988-），女，辽宁朝阳人，硕士生，主要研究方向为水污染控制原理与技术。E-mail:m13788938720@163.com

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