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MODELLING OF LEAD REMOVAL BY AN AQUATIC MOSS

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Abstract

Aquatic bryophytes are frequently used as biomonitors for trace metals in aquatic ecosystems. Nevertheless, their special characteristics also allow using them as biosorbents to clean industrial wastewaters. As biosorption is a low cost and effective method for treating metal-bearing wastewaters, understanding the process kinetics is relevant for design purposes.

In this study, the ability of the aquatic bryophyte *Fontinalis antipyretica* to remove lead from simulated wastewaters was evaluated. Three kinetic models (pseudo-first order, pseudo-second order and Elovich) were fitted to the experimental data and compared by the *F-test*. Previously, the effect on biosorption of parameters such as the initial solution pH, contact time and initial metal ion concentration was investigated. The initial pH of the solution was found to have an optimum value is in the range 4.0-6.0. The equilibrium sorption capacity of lead by *Fontinalis antipyretica* increased with the initial metal concentration. For an initial metal concentration of 10 mg L^{-1}, the uptake capacity at equilibrium was 4.8 mg g^{-1}. Nevertheless, when the initial concentration increased up to 100 mg L^{-1}, the uptake of lead was 10 times higher. The pseudo-second order biosorption kinetic model provided the better correlation with the experimental data (R^2=1.00). The applicability of the Langmuir and Freundlich adsorption isotherms to the present system was also assessed. The maximum lead sorption capacity by *Fontinalis antipyretica* was 68 mg g^{-1}.

Key words
Aquatic mosses; biosorption; Fontinalis antipyretica; kinetics; lead; removal.

INTRODUCTION

The increasing environmental contamination by toxic metals is a relevant worldwide occurrence. They are not biodegradable and tend to accumulate in living organisms. The consequences of their presence in aquatic ecosystems to human health, living organisms in water and consumers of contaminated plants or animals are well known (Volesky, 2000). Lead has been recognized as a potentially dangerous pollutant, in the same class as mercury, arsenic and vanadium (Lazaridis et al., 2003). Tackett (1987) reports that lead was found to be markedly toxic to human beings when accumulated in high amounts. An adult ingests between 0.3 to 0.6 mg of lead in his diet and a value close to 10% is retained in the organism. As a consequence, lead can damage the kidney, liver and reproductive system, brain functions and basic cellular processes (US EPA, 1984).

Lead is released into the environment through waste streams from lead smelting, lead mining and coal combustion, lead-based paints use and lead-containing pipes in water supply systems, and additionally, from pigments, photographic materials, ceramic glazes, automobile batteries and cosmetics manufacturing (Vincent et al., 2001; Vilar et al. 2005).

Thus, the removal of toxic metals and particularly lead from waters is an important environmental issue (Naeem et al., 2007). Traditional methods used for heavy metals removal from aqueous effluents (chemical oxidation or reduction, chemical precipitation, coagulation, complexation) are insufficient to achieve the limits imposed or recommended by national and international water