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ORIGINAL PAPER

Continuous sorption of synthetic dyes on dried biomass of microalga *Chlorella pyrenoidosa*‡

Miroslav Horník*, Anna Šuňovská, Denisa Partelová, Martin Pipíška, Jozef Augustín

Department of Ecochemistry and Radioecology, Faculty of Natural Sciences, University of SS. Cyril and Methodius in Trnava, Nám. J. Herdu 2, SK-917 01 Trnava, Slovakia

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The sorption of thioflavine T (TT) and malachite green (MG) cationic synthetic dyes on dried biomass of green microalga (*Chlorella pyrenoidosa*) immobilised in polyurethane foam under continuous column systems conditions using spectrophotometric methods of detection was investigated. Data characterising the sorption of TT and MG on microalgal biomass immobilised in polyurethane foam in a column system from single (C_0 = 25 μmol dm^{-3}) or binary equimolar (C_0 = 25 μmol dm^{-3}) dye solutions in the form of breakthrough curves were well described by the Thomas (R^2 = 0.994–0.912), Yoon–Nelson (R^2 = 0.994–0.911), and Clark (R^2 = 0.993–0.911) models. Useful parameters characterising the sorption column system were obtained from these mathematical models. The Thomas model, in particular, provided the Q_{max} (maximal sorption capacity in μmol g^{-1}) parameter for characterisation of biosorbent and also for evaluation of competitive effects in the TT and MG dyes sorption. For the purposes of biomass regeneration, a one-step desorption of the dyes studied from the microalgal biomass in batch and continuous column systems was performed. Efficiency of TT desorption from microalgal biomass increased in the order: deionised H_2O (50.7 %), 99.5 vol. % 1,4-dioxane (67 %), 20 mmol dm^{-3} $NiCl_2$ (83 %), 96 vol. % ethanol (85 %), 0.1 mol dm^{-3} HCl (89 %), 1 mol dm^{-3} acetic acid (89 %). In the case of MG, the desorption efficiency increased in the order: deionised H_2O (13 %), 20 mmol dm^{-3} $NiCl_2$ (50 %), 0.1 mol dm^{-3} HCl (91 %), 99.5 vol. % 1,4-dioxane (94 %), 1 mol dm^{-3} acetic acid (99 %), 96 vol. % ethanol (> 99 %). The presence of carboxyl, phosphoryl, amino, and hydroxyl groups, the important functional groups for sorption of cationic xenobiotics, was also confirmed on the algae biomass surface by potentiometric titration and ProtoFit modelling software. The data obtained showed that the dried immobilised algae biomass could be used as a sorbent for removing toxic xenobiotics from liquid wastewaters or contaminated waters and also presenting the possibilities of mathematical modelling of sorption processes in continuous column systems in order to obtain important parameters for use in practice.

Keywords: synthetic dyes, sorption, desorption, *Chlorella pyrenoidosa*, continuous column system, modelling

Introduction

Water contamination with xenobiotics such as synthetic dyes is a serious environmental issue and represents a hazard to public health. Dyes are synthetic, aromatic, water soluble, dispersible, organic colorants, with potential applications in various industries (Khataee et al., 2011). Annually, more than 7×10^5 tons of synthetic dyes are produced worldwide. The textile industry produces large volumes of inten-

*Corresponding author, e-mail: hornik@ucm.sk
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