Summary of doctoral dissertation „Biosorption of Ni(II), Pb(II) and Zn(II) ions from multi-metal solutions on calcium alginate bed" by Agata Przewłocka

The objective of this study was to evaluate the possibility of use calcium alginate beads as a biosorbent to remove heavy metal ions from aqueous solutions.

Alginate gels have many applications in the food and pharmaceutical industries, and have great potential for the removal of toxic metals from wastewaters.

Thesis describes biosorption process conducted to remove Ni(II), Pb(II) and Zn(II) ions from aqueous solutions using 2% calcium alginate beads as a biosorbent. Process was carried out in batch and dynamic system.

Effects of basic process parameters such as solution pH, contact time, adsorbent dosage, metal ion concentration and temperature on the adsorption process have been studied. The adsorption influencing parameters for the maximum removal of metal ions were optimized.

Batch experiments of the adsorption process in single and multimetal systems were carried out to determine the adsorption kinetics and equilibrium isotherm. The biosorbent showed significant metal sorption capacity for lead, nickel and zinc from aqueous solutions

The experimental data were analyzed using the isotherm models such Langmuir, Freundlich, Sips, Koble-Corrigan and Redlich-Peterson models. The Koble-Corrigan isotherm model was suitable to describe the Ni(II) sorption equilibrium. For Pb(II) and Zn(II) ions Redlich-Peterson isotherm model was better to describe sorption equilibrium.

The kinetic data of biosorption process were evaluated using pseudo-first and pseudo-second order equations. Kinetic studies showed that the adsorption followed a pseudo second-order model. The intraparticle diffusion of Weber and Morris model was employed to describe the metal ions diffusion in biosorption process.

The continuous column experiments were carried out for the adsorption in single and binary metal systems from aqueous solution using calcium alginate beads. It was investigate the effect of various variables such as the effect of bed height, flow rate and initial feed concentration on breakthrough profile and heavy metal ions removal efficiency. A Ni(II), Pb(II) and Zn(II) adsorption in fixed bed column process was modeled using COMSOL Multiphysics.

The calcium alginate beads in batch experiments were regenerated using 0.1 M $CaCl_2$, HCl and NaCl. After regeneration process biosorbent was reused for three adsorption-desorption cycles.

The calcium alginate bed in column was also regenerated after adsorption. The elutant used for the regeneration of the adsorbent was 0,1 M $CaCl_2$. The column regeneration studies were carried out for three adsorption–desorption cycles. It was found that the adsorption capacity decreased with increase in the number of regeneration cycles.

The results of this study suggest that calcium alginate beads can be used as an effective adsorbent to removal Ni(II), Pb(II) and Zn(II) ions from aqueous solutions and industrial wastewaters.

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