Bacterial Cells as Biosorbents for Heavy Metals

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The heavy metal and radionuclide contaminations of environment are the most dangerous types of pollution. The treatment of low charge effluents, conciliating economic and technical constraints is impossible with traditional physics-chemical processes. It has been suggested that biomass could be used to decontaminate these wastes and to concentrate metals [1]. Biological methods of removal of heavy metals and radionuclides are the most ecologically appropriate techniques. Besides the advantages of microbial treatment are: self-reproducibility, adaptability, recyclisation of bioproducts, specificity, and good cost/benefit ratio [2].

This study focuses on removal of such metals as uranium and stable strontium by biomass from mine and other wastewater. As biosorbent was used exopolysaccharide producing bacterium, *Bacillus polymyxa*.

The main characteristics of the process of sorption were determined. The rate and extent of U(VI) and Sr uptake were subject to such parameters, as biosorbent properties, pH, concentration of radionuclides, interference by certain cations. It is shown, the pH plays an important role in biosorption phenomena: an optimal range of pH for uranium sorption is 4.0-6.0, for Sr - 4.0-8.0. The experimental data showed that both processes of uranium and strontium sorption by *B. polymyxa* can be described well by the Langmuir isotherm with q_{max} = 1000 μmol/g, k = 11.11 and q_{max} = 435 μmol/g, k = 3.3, respectively. In order to investigate the biosorption mechanism, characteristic constants of biosorption were determined using a pseudo-first-order equation of Lagergren [3] and a pseudo-second-order equation (H_0 equation) [4]. It is shown that the pseudo-second-order model fits better the biosorption kinetics of metal ions by *B. polymyxa* than the pseudo-first-order one. This suggests that the rate-limiting step of this sorption system may be chemical sorption or chemisorption involving valency forces through sharing or exchange of electrons between sorbent and sorbate [4]. Effect of mono- and divalent cations on metals biosorption processes was studied. A number of displacing agents have been tested for their ability to release bound U(VI) and Sr ions from cells of *B. polymyxa*. The most effective displacing agents for strontium are HCl, $MgCl_2$ and $CaCl_2$, for uranium - Na_2CO_3.

Although the application of biological approaches to treat metal contamination has been slow, tighter environmental legislation in combination with the inherent limitations of existing chemical approaches will surely mean that microorganisms will play a very significant role in controlling metal contamination in XXI century.

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