Uranium nanoparticle synthesis from leaching solution

Z. Sadowski[1], A. Sklodowska[2]

[1] Wroclaw University of Technology, Wroclaw, Poland

[2] University of Warsaw, Warsaw, Poland

E-mail address of corresponding author: asklodowska@biol.uw.edu.pl

The removal of uranium from leaching and bioleaching solutions is of great significance for an environment protection. In comparison with conventional separation techniques, synthesis of uranium nanoparticles has a number of benefits. It has been demonstrated that the uranium nanoparticles show high catalytic activity. In the present studies a variety of synthesis systems have been used for reduction of uranium from bioleaching solution. Among various catalytical templates the hematite Fe_2O_3 nanoparticles are most interest It was presented the report on development of synthesis method to produce nanostructured Fe_2O_3 particles. The efficiency of hematite nanoparticles for adsorption of uranium ions from bioleaching solutions was investigated. Bacterial leaching is alternate technique used to extract uranium from mining wastes. The bioleaching process is environment friendly and gives the extraction yield of over 90%. The bioleaching solutions were obtained from bioleaching experiments using waste materials from different places at Lower Silesia (Kowary, Grzmiaca, Kopaniec, Radoniow). Chemoautotrophic bacteria were used for bioleaching tests.

The significant adsorption capacity of U(VI) onto iron oxide and hydroxides (goethite, hematite, and magnetite) was observed. The sorption of U(VI) onto the hematite surface was connected with the chemical reduction of U(VI) to U(IV) by Fe^{2+} ions. The initial reaction system contained excess of Fe^{2+} ions which were used to reduce of U(VI). The reduction of U(VI) occurred at pH at the vicinity of pH=2.4. The colloid particles of hematite with UO_2 nanoparticles were obtained.

The results of zeta potential measurements of hematite nanoparticles showed that at the ionic strength equals 10^{-3}M NaCl, the average zeta potential was +32.4±3.5 mV at pH = 2.6. The interaction of hematite nanoparticles with the bioleaching solutions led to decrease of positive zeta potential to the value of 6.4± 2.7 mV.