Nanocomposites and nanomaterials

Protection of groundwater from compounds of uranium

N. V. Zhdanyuk

National Technical University of Ukraine " Igor Sikorsky Kyiv Polytechnic Institute", Kiev, ave.Peremogy, 37, 03056, Ukraine.
E-mail: zhdanyukn.kpi@gmail.com

A new class of nanoscale zero-valent iron particles supported on natural montmorillonite (MMT) and organo-montmorillonite (OMMT) were synthesized and the feasibility for the removal of U(VI) was examined through laboratory batch test.

The usage of composite as a supporting material is justified by the fact that clay minerals are abundant, environmental-friendly and much cheaper than activated carbon and technologies such as pump-and-treat. Moreover, montmorillonite is a kind of clay mineral with a layered structure, high surface area and strong adsorption characteristic.

Zero-valent iron particles (nZVI) were prepared by a liquid phase reduction method with borohydrate. This method is considered as the most common one due to its productivity and simplicity.

The mechanisms of U(VI) reduction by Fe^0 are a cyclic and involve multiple reactions of electrochemical corrosion. Removal of U(VI) takes place on the following mechanism. Initially, the reaction Fe^0 acts as a reducing agent, which further facilitates the removal of uranium. Interaction Fe^0 and products of oxidation of Fe(II) and Fe(III) leads to the formation of adsorption centers.

It should be noted that the transition U(VI) to U(IV) is a solution of particles near Fe^0 resulting electrochemical reaction. As a result, the transition of uranium compounds in the solid state and deposition on the surface of iron. Also, the sorption complexes of U(VI) can form a solid mixture of U(IV) / U(VI).

The results of studies demonstrate the effectiveness of nanomaterials for remediating uranium-contaminated groundwater. Nanocomposites showed an outstanding ability to remove metal ions because of high surface activity and low particle size. After the contact with U(VI), the reduction of those was highest with OMMT/nZVI, followed by MMT/nZVI and unsupported nanoparticles nZVI, what may thus offer an economically and environmentally friendly usage of organoclay nanocomposite as an exceptional solution to one of the most aggravating ecological problems.

1. *N. Groza*, «Zero-Valent Iron Used for Radioactive Waste Water» // Treatment Chem. Bull. "POLITEHNICA" Univ. (Timisoara). – 2009. Vol. 54(68), 1. -P. 21-25.