Nanocomposites and nanomaterials

Synthesis of composite polypropylene fibers with surface coated ferrihydrite nanoparticles

Y. Bondar[1], S.Kuzenko[1], D.H.Han[2], H-K.Cho[2]

[1] *Institute of Environmental Geochemistry, 34a Palladin ave., Kiev 03142, Ukraine, juliavad@mail.ru*
[2]*School of Chemical Engineering and Technology, Yeungnam University, 214-1 Dae-Dong, Gyeongsan 712-749, South Korea*.

The natural iron (III) oxyhydroxide ferrihydrite (Fh) is a unique case among the mineral species because it exists exclusively in nanosized state. Ferrihydrite exhibits two different crystalline phases, namely low-crystalline 2 line ferrihydtrite (2L-Fh) and more crystalline 6-line ferrihydrite (6L-Fh) according to the number of broadened reflections in X-ray diffractograms.

Fh is widely distributed in surface and subsurface environments, and because of its high specific surface area it is well known as a scavenger for dissolved chemical species. Recent investigations have revealed an important role of Fh as a transportation carrier for radionuclides (U, Pu, Am, Np and Tc) in natural waters. Understanding interaction of radionuclides with Fh is crucial to model their behavior in subsurface and surface environments and to development new technologies for nuclear waste treatment and long-term remediation strategies for contaminated soils and groundwaters.

Synthetic Fh can be easily obtained by rapid hydrolysis of Fe(III) solution in the lab and used as slurry in the adsorption tests. However, it is rather difficult to separate the ferrihydrite colloidal slurry from the studied solution. To overcome this drawback we developed two-stage synthesis of composite polypropylene (PP) fibers covered with ferrihydrite nanoparticles. The aim of the investigation was to answer the questions whether it is possible to synthesize stable composite fibers with Fh nanoparticles and whether it is possible to use them as a model of interaction of the natural Fh with radionuclides.

Applying our synthesis method the composite fibers covered with Fh nanoparticles were synthesized. XRD analysis confirmed the formation of 2L-Fh phase. Scanning electron microscope study revealed that Fh forms a homogeneous layer of nanosized aggregates (70-100 nm) which are rather regular in shape and closely fit one to another forming a compact texture. The synthesized composite fibers were shown to be stable in aggressive solutions for long time. Adsorption of uranyl ions onto the synthesized composite fibers was investigated in batch mode with variation in initial uranium concentration and contact time. It was found that uranyl uptake is a fast process and equilibrium is attained within 20-30 minutes.