Nanochemistry and Nanobiotechnology

On the nature of the sludge nanocomposites for land application

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The total quantity of municipal sewage sludge (biosolids) production is currently estimated in more than 10 mln tons in year as dry solids. The biosolids are natural nanocomposite which includes heavy metals compounds (in slightly soluble or insoluble forms as phosphates, sulphates, carbonates, hydroxides and so on) combined by biomaterial (cells and their metabolites, humic substances etc.) into heteropolysaccharides matrix. The matrix after drying on air turns on in biogel nanocomposite.

We have succeeded in working out the biotechnology for conversation of sludge biosolids into material for land application. This technology bases on initiation of microbial activity in sludge nanocomposite, bioleaching of excess of toxic heavy metals to appropriate level for plant nutrition. It is known that a deep transformation of initial material can occur as a result of microbial activity.

So the main goal of our work was to estimate the influence of microbial activity of natural nanocomposites on their mineralogical components. The objects of our study were the natural nanocomposites: native (initial) and conditioned by our biotechnology biosolids, forest grey soil, black soil and sand.

It is established the quartz domination in all natural objects under study. Also there were the traces of kaolinite and sylvite in black soil, along with sylvite and amphibole in gray forest soil.

In the native biogel the minor components of feldspar and calcite were defined but under the influence of biogenic metabolites these were eliminated. The destruction of the feldspar group minerals resulted in formation of the new minerals of zeolite group. All biosolids nanocomposites contain much amorphous material of organic matter as a main component. The crystallinity of sludge nanocomposites was not so high as in soil ones.

The mentioned above changes in the mineralogical phase of natural nanocomposites reflect on their water-holding capacity. This parameter correlates with the organic component of the nanocomposites and increases in the row: sand, gray forest soil, black soil, native biogel, conditioned biogel.