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Modeling of Heavy Metal Transformation in Soil Ecosystem

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The intensification of industrial activity leads to an increase in heavy metals pollution of soils. In our opinion, sludge from biological treatment of municipal waste water, stabilized under aerobic-anaerobic conditions (commonly known as biosolid), may be considered as concentrate of natural soil. In their chemical, physical and chemical and biological properties these systems are similar gel-like nanocomposites. These contain microorganisms, humic substances, clay, clusters of nanoparticles of heavy metal compounds, and so on involved into heteropolysaccharides matrix.

It is known that microorganisms play an important role in the transformation of different nature substances in soil and its health maintenance. The regularities of transformation of heavy metal compounds in soil ecosystem were studied at the model of biosolid. At biosolid swelling its structure changing (gel-sol transition, weakening of coagulation contacts between metal containing nanoparticles, microbial cells and metabolites, loosening and even destroying of the nanocomposite structure) can occur [1, 2]. The promotion of the sludge heterotrophic microbial activities leads to solubilization of heavy metal compounds in the system. The microbiological process can be realized in alcaligeneous or acidogeneous regimes in dependence on the type of carbon source and followed by the synthesis of metabolites with the properties of flocculants and heavy metals extragents [3]. In this case the heavy metals solubilization (bioleaching) in the form of nanoparticles of hydroxycarbonate complexes or water soluble complexes with oxycarbonic acids is observed. Under the action of biosolid microorganisms the heavy metals-oxycarbonic acids complexes can be transformed (catabolised) into nano-sizing heavy metals-hydroxycarbonates complexes. These ecologically friendly complexes and microbial heteropolysaccharides are able to interact with soil colloids, stay in the top soil profile, and improve soil structure due to the formation of water-stable aggregates.

The alkaligeneous microbiological process in natural ecosystems by co-metabolism of appropriate carbon source is more advantages for environment.

Thus the possibility of solubilization of heavy metal compounds in the soil due to stimulating its biological activities of native microorganisms is proved.

The studies on the interactions in the system of sludge solid has allowed to develop the “green” biotechnological process of heavy metals solubilization in contaminated soils and sludges.

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