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Decreasing of Transfer of Caesium and Strontium Radionuclides from Soil to Vegetation

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Decreasing of transfer of radionuclides from soil to vegetation is the main purpose of remediation of radioactively contaminated lands with the aim of their returning to farming industry. The method of addition of sorbents to soils is seemed to be the most afficient in these cases. Using sorbents should possess affinity to natural systems, high specificity and selectivity and also irreversibility of sorption of radionuclides for effective retention of radionuclides as wel as to prevent their migration into vegetation and further movement through food chains. A number of publications suggest to use natural and modified aluminosilicates for remediation of territories but there were no comparative studies of use of various materials, questions of selectivity and reversibility of sorption of radionuclides have not taken into an account.

Comparative study of specificity, selectivity and reversibility of sorption of caesium and strontium radionuclides by natural aluminosilicates (glauconite from Karinskoe deposit (Russia) and clinoptilolite from Shivyrtooinsky deposit (Russia)) and modified ferrocyanide sorbents based on them is presented in this work.

The natural glauconite sorbs caesium from tap water with distribution coefficient Kd = 10(3.5±0.1) mL/g, static exchange capasity of Cs is 11.0 mg/g; it shows lower specificity to strontium: Kd = 10(2.5±0.1) mL/g, static exchange capasity = 9 mg/g. For clinoptilolite these parameters are for caesium Kd = 10(4.4±0.5) mL/g, static exchange capasity 210 mg/g; for strontium Kd = 10(3.5±0.1) mL/g, capasity = 12 mg/g. Ferrocyanide sorbents concentrate caesium radionuclides more effectively: distribution coefficient of Cs from tap water by mixed nickel-potassium ferrocyanide based on glauconite is 10(5.9±1.6) mL/g, static exchange capasity of Cs is (63.0±2.0) mg/g; for mixed nickel-potassium ferrocyanide based on clinoptilolite these characteristics are respectively 10(7.4±1.3) mL/g, 500 mg/g. In case of modified sorbents specificity to strontium remains the same as for natural aluminosilicates.

Reversibility of sorption of caesium by natural glauconite and ferrocyanide sorbent was determined as caesium leaching degree from saturated samples. High caesium leaching rates and degrees are typical for natural glauconite irrespective of leachant salinity: total degree of leaching after 35 days of leaching was: mineral water = 63.4%, tap water = 41.6% and rain water = 28.8%. For flauconite modified by ferrocyanides total degrees of leaching under the same conditions were: mineral water = 1.5%, tap water = 14.6% and rain water = 6.6%. Thus, it could be expected, that there will not be reliable retention of caesium by solid phase after addition of natural aluminosilicates into soil. Surface-modified glauconite and clinoptilolite provide rather lower caesium leaching degrees, so it can be successfully used for remediation of lands contaminated by radiocaesium.

Also the assessment of efficiency of extraction of caesium from soil solutions (solutions after leaching from various types of soils). It is shown that using of modified sorbent is more economically feasible, because it is needed 500 mg of ferrocyanide sorbent vs. 25000 mg of natural glauconite per 1 L of oil solution to achieve the same decontamination degree. The quantity of sorbent to introduce as well as its efficiency will depend on type of soil at contaminated lands. Results of experiments have shown that decreasing of transfer of caesium radionuclides from tested soils to vegetation after addition of mixed nickel-potassium ferrocyanide based on glauconite was 20 times.

Thus, it is shown that modification of natural aluminosilicates by ferrocyanides allows to increase their sorption and mechanical features and to make sorption of caesium more selective and almost irreversible. These features allow to recommend modified aluminosilicates for remediation of radioactively contaminated lands

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