PERMEABLE GEOCHEMICAL BARRIERS BASED ON NATURAL CLINOPTILOLITE AND MATHEMATICAL MODELING OF THE RADIONUCLIDES SORPTION DYNAMICS

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The numerous anthropogenic accidents in the world resulted in significant environmental pollution including radioactive contamination. Various approaches are used to solve such severe environmental problems, one of which is based on creating permeable geochemical barriers. To prevent the diffusion of radioactive pollutants to the environment, which originated from underground accident nuclear explosion for peaceful purposes at the site "Kraton-3" (Yakutiya, 1978), it was decided to create a geochemical barrier utilizing clinoptilolite-containing tuffs (CLT) from the deposit Khonguruu, Yakutiya. High selectivity of CLT to radionuclide (Cs, Sr), its availability and low cost makes expedient its use for the above mentioned purposes.

The scales of the processes, which take place within geochemical barriers, make it difficult to predict final results without mathematical modeling. However, the mathematical model of dynamic sorption, which would take into account peculiarities of kinetic and describe the ion-exchange process on CLT from the diluted solutions, has not been developed yet [1].

Based on the series of the equilibrium and dynamics experimental data the physico-chemical and mathematical models of the process for two-steps sorption kinetics on CLT were created. A computer program for calculation of the ion-exchange process on CLT was developed, that allow to predict behaviour of a geochemical barrier under specific conditions (width of the barrier, flow rate, the grains size of CLT, the filtration interruptions, etc.) . Mathematical treatment of all the experimental breakthrough curves allowed to calculate the averaged kinetic particle diffusion coefficients Sr^{2+} - $D = 7.10^{-10} cm^2/s$ (mesoporous), $\gamma = 10^{-6}$ s^{-1} (microporous). The breakthrough time of a geochemical barrier for the least sorbed ion (Sr^{2+}) under various conditions (flow rate, a sorbent grain size, width of a barrier, breaks in filtering, etc.) was determined . It was shown that the results of the calculations provided a good fit to the experimental data.

References

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