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MINERALS AS MATRIX FOR IMMOBILIZATION OF TRITIUM

OSTAPENKO, G. T., KOMOV, I.L. & MITSYUK, B.M. (Centre of Radiogeochemistry, Kiev, Ukraine). E-mail: center@radgeo.freenet.kiev.ua

Tritium is one of the most hazardous β emitters. Its large amounts are contained both in the cooling water of nuclear reactors and settling basins, and it can escape into the environment in case of leakages. The same can occur in subsurface radioactive waste repositories, which thus can become the sources of underground water contamination. In the sorption process, materials such as vermiculite, clay or diatomaceous earth can be used to adsorb measured quantities of tritiated liquid. Tritium absorption effect had been marked in palygorskite-alkaline type interaction. Ion exchange and molecular sorption effects prevail at tritium isotope absorption processes. Even though these materials are being used, some disposal sites no longer accept absorbent materials and require a free standing solid for disposal. Additional problems may result from breaching of the waste container and subsequent release of the absorbent material into the surrounding medium.

Solidification of tritiated water with cement or other materials that form a monolith provides a waste package of high integrity that is more acceptable for disposal. They provide no better retention of the tritium. It should be noted that, regardless of the treatment provided prior to packaging, tritium is capable of migrating out of the waste package and into the surrounding medium to some degree. Barriers can significantly reduce this migration and will be the subject for the development of a forming technique for blocks made of the matrix minerals with the entrapped tritium and the elaboration of protective self-packing layers (barriers) for these blocks and other purposes, which will self-pack in case of water leakages using hydration reactions for the conversion of relatively weakly fixed adsorbed T_2O into the chemically bound one in mineral crystal matrix. Tritium quantities that exceed 1 TBq per package may require additional barriers, such as high density rigid polyethylene liners, asphalt barriers and multiple packagings. We examine the current knowledge of the phase equilibria, crystallography, thermochemistry and kinetics of reaction for calcium sulphate; the sorptive capacity of anhydrite for radionuclides; and effects of radiation on anhydrite and related phases; development of a method for tritium water adsorption by clay minerals, zeolites and other natural adsorbents and the following chemical binding of the adsorbed T_2O in the crystal structure matrices of minerals resulted from hydration of additional compounds ($CaSO_4 \cdot 0.5\ H_2O$, CaO, etc.) mixed with the adsorbents; development of a forming technique for blocks made of the matrix materials with the entrapped tritium and elaboration of protective self-packing layers (barriers) for these blocks and other purposes, which will self-pack in case of water leakages using hydration reactions for the conversion of relatively weakly fixed adsorbed T_2O into the chemically bound one in mineral crystal matrix. As a result, *tritium water will be bound much more rigidly than the merely* adsorbed one. Consequently, mineralogical and geochemical barriers containing clay minerals and adding sulphate or heat treatment should be more effective than ones using only clay minerals.