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Detection of tritium and α -decaying isotopes in L/ILW by helium measurements

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As decay products, helium isotopes can clearly indicate the presence of tritium and alpha decaying isotopes in a closed system. This study presents the helium and neon measurements and their interpretation of long-term headspace gas investigations in L/ILW waste drums from Paks Nuclear Power Plant and closed vaults of the Radioactive Waste Treatment and Disposal Facility, Püspökszilágy, Hungary.

Development of special sampling methods and preparation lines as well as isotope-analytical measurements of the headspace gas samples were done in the Laboratory of Environmental Studies in the ATOMKI. In the gas samples helium isotopes as well as neon isotopes have been determined mass spectrometrically.

While neon content can be of atmospheric origin only, helium can be produced either by alpha decay (^4He) or decay of tritium (^3He). He/Ne ratios have been used to determine the different origin of the helium isotopes. Helium isotope ratios always represented ^3He enrichment in the headspace gases produced by the decay of the tritium in the waste. Using the recent ^3He concentration in headspace gas the total amount of ^3H restored in L/ILW vaults was estimated. The investigated seven different vaults were closed between 1979 and 1995 when they had been full with L/ILW. The calculated tritium activities based on the He measurements showed good agreement with the documented isotope inventory of the vaults.

Typical tritium activity concentrations were between 0.1 and 10 Bq/liter gas in the drums and between 10 and 1000 Bq/liter gas in the vaults. Additionally, one drum showed a higher He/Ne ratio compared to air, which clearly indicates ^4He excess, thus the presence an alpha source in the waste.

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