

ACCELERATED IRRADIATION TESTING OF SYNROC USING FAST NEUTRONS

by

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Abstract

The effects of radiation on the stability of SYNROC containing high level waste are an important consideration in assessing the ability of the matrix to retain radwaste elements for the required storage time of up to 10^6 years. Radiation damage can produce changes in volume, leach rate, stored energy, macro- / micro-structure and mechanical properties.

Fast neutron irradiation is being used to produce displacement damage in SYNROC and its constituent phases (barium hollandite, perovskite and zirconolite), to simulate alpha particle and actinide recoil damage which will accumulate in SYNROC containing radioactive waste. The macroscopic, microscopic and crystal structure effects are being measured for 'SYNROC ages' up to 10^6 years, obtained by irradiation to a fast neutron dose of 4.8×10^{20} n cm⁻² (≥ 1 MeV). Materials variables include the fabrication method (hot pressing and cold pressing and sintering) and the presence or absence of simulated radwaste.

All materials have exhibited a volume expansion and corresponding decrease in density with increasing fast neutron dose. For the same dose, the volume expansions increase in the order barium hollandite $\approx$ hot pressed SYNROC B < perovskite $\approx$ zirconolite $\approx$ SYNROC C < cold pressed and sintered SYNROC B. Microcracking occurs in SYNROC at expansions greater than 4 volume per cent, producing only a small increase in open porosity. For SYNROC C the neutron dose for microcracking is equivalent to a SYNROC age of 2×10^5 years. Radiation damage to this level has no dramatic effect on leach rate.