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Civilian Radioactive Waste Management System
Management & Operating Contractor

Diffusive Barrier and Getter Under Waste Packages VA Reference Design Feature Evaluations

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7.2.10.3 Calculation for Np

As shown in Table 4, a thickness of less than 1 m would, under the simplified and idealized conditions considered, suffice to adsorb all the Np-237, both at times soon after breach of the waste package when the pH is comparatively low and the solubility of the Np-237 is relatively high, and at later times at higher pH and lower Np-237 concentration (CRWMS M&O 1999d, p.29 of 33).

The Np-237 aqueous concentration varies in accordance with pH so long as solid NpO_2 is present. Eventually, at different times depending on the percolation rate and other factors, all the NpO_2 is expected to dissolve. The percolation rate over a range of about 8 mm/yr to about 100 mm/yr significantly affects the thickness of getter apatite required to adsorb all of the radionuclide. These percolation rates correspond to 0.015 m^3/yr to 0.5 m^3/yr (WP seepage flux rate or drip rate), respectively, of water entering a waste package. The range of required thicknesses of getter for Np-237 ranges from about 2 cm for conditions under which the pH is low and the Np-237 concentration relatively high to about 25 cm for conditions of minimal Np concentration (CRWMS M&O 1999d, p.29 of 33).

7.2.10.4 Calculation for Tc

As there is no pH or solubility control for Tc-99, it is all flushed from the waste package relatively early before the pH rises to a near neutral condition. For calculating the required thickness of apatite for Tc-99, an aqueous concentration in the mid-range of calculated values was chosen for each of the three percolation rates. At 60°C for the two lower percolation rates it appears that about 20 cm of apatite getter would suffice, ideally, to adsorb all the Tc-99, but at the highest percolation rate, over 2 m would be needed. If the thickness of emplaced getter is only about 1 m, the expectation would be that approximately half of the Tc-99 that first emerges from the waste package would be effectively adsorbed. Thereafter, the additional Tc-99 coming out of the waste package would pass through the getter without any retardation due to adsorption. After all the Tc-99 is removed from the waste package, the Tc-99 adsorbed on the getter would be gradually removed and flushed into the underlying rock. At 25 °C, much greater thicknesses of getter would be required, approximately 0.7 m at the lower infiltration rates and a little over 9 m at the fastest rate (CRWMS M7O 1999d, p.29 of 33).

Potential interference of adsorption of Np with adsorption of Tc, or vice-versa, was not evaluated. Nevertheless, no significant interference is expected because the Np will be in solution as positively charged ions, at least at pHs below 8 to 9, and the Tc will be in solution as negatively charged ions. In principle they should adsorb onto different kinds of sites on the getter, and therefore, not interfere with each other (CRWMS M&O 1999d, p.29 of 33).

7.3 THERMAL EFFECTS ON THE GETTER DURING POST-CLOSURE

The thermal effects on the diffusive barrier will not be discussed because of its poor post-closure performance, as a barrier on its own. The thermal effects on the getter during post-closure and the effect of the getter on the temperature of the waste packages are discussed below.