Conceptual Model of Source-Term Assessment with the Concrete Degradation of Engineered Barrier

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Radionuclide mobilization and subsequent release from waste package is initiated by water contact after the cover and vault materials allow movement of water into the vault. Failure usually will occur gradually, which results in water percolating into the waste form at a rate gradually increasing with time. To model this gradual failure process, several assumptions are needed that 1) flow through the disposal facility is uniformly distributed and steady, 2) at the time of closure, the combination of cover and vault functions as a perfect barrier to flow, and that this condition will persist for a relatively short time, 3) between the beginning of failure and the completion of failure, the system comprising vault and cover is permeable to flow, and the permeability increases with time. This hydraulic evolution is described by a function produced using the 4SIGHT code. That function is expected to be approximated by a series of steps for a linear function. Eventually, the flow rate reaches the ambient infiltration rate. In this conceptual model, three modes of dissolution are considered such as instant dissolution, congruent dissolution and diffusional release. Radionuclides residing in disposed materials without stabilization are assumed to quickly dissolve into water upon water contact. Dissolution of these radionuclides is assumed to happen instantly. The dissolution is instantaneous, but not necessarily complete. That is, the amount entering the liquid phase may be limited by sorption or solubility. This provides the flexibility to evaluate waste forms such as ion exchange resins, which may be solubility limited. Releases of this kind are often referred as rinse release. Radionuclides residing in some solidified waste forms are expected to dissolve congruently with the waste form corrosion. Dissolution of these radionuclides is assumed to occur at a constant rate with time. This model is typically used for evaluation of activated metals in low-level waste and for paraffin waste forms. This corresponds to the uniform release with a constant dissolution rate. Radionuclides residing in solidified waste forms may be limited by the rate of diffusion through the waste package into the surrounding water.