Diffusion of Hydrogen Sulphide through MX-80 Bentonite

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The Mark II used fuel container (UFC) has been selected by the Canadian Nuclear Waste Management Organization (NWMO) as part of the engineered barrier design for the safe containment of used nuclear fuel in a deep geological repository (DGR). The UFC comprises an inner steel core, an outer copper layer that acts as a corrosion barrier and is surrounded by highly compacted bentonite (HCB) that can suppress the movement of corrosive agents to UFC. Under anaerobic conditions, sulphate could be microbiologically converted to hydrogen sulphide which then is transported to the UFC surface and results in corrosion of the copper barrier. Therefore, understanding the mechanism of hydrogen sulphide transport through the HCB layer is critical for an accurate prediction of copper corrosion allowance. Due to the low permeability of the HCB, hydrogen sulphide transport is diffusion limited and therefore the effective diffusion coefficients D_e, is the critical parameter required for performance, safety calculations and assessment of geological disposal of high-level radioactive waste. This study is aimed at quantifying hydrogen sulphide diffusion through MX-80 bentonite using laboratory experiments and determining its effective diffusion coefficients D_e. The diffusion coefficient will be obtained by performing through diffusion experiments of hydrogen sulphide at various DGR conditions including varying temperatures, bentonite densities and ionic concentrations. Hydrus-1D model will be used for back-analysis of the experimental data and to estimate D_e. This presentation will describe the experimental methods and preliminary results of various experiments performed. The results of this study will be used in the design of Canadian DGR, leading to a safe disposal of used nuclear fuel.