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Microbiologically Influenced Corrosion of Cast Iron Containers for HLW Storage

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Ductile and corrosion resistant cast iron is investigated as a potential container material to store high-level nuclear waste (HLW) in deep geological repositories (DGR) in claystone bedrock. The dynamic corrosion process is dependent on the conditions present in the DGR which are influenced and/or controlled by geochemical parameters (e.g., redox potential, pH, presence of and ionic concentration in (pore-)water), physical parameters (e.g., pressure), and the influence of metabolically active microorganisms. Cast iron corrosion will occur at the intersection of container and its decontaminable coating with the bentonite backfill material which contains natural microbial populations.
The conditions in a DGR are simulated in microcosm experiments to investigate the impact of microbiologically influenced corrosion (MIC); the microcosms contain: B27 bentonite, synthetic pore water, N2 or N2-CO2 atmosphere, cast iron coupons, as well as the bacterium Desulfosporosinus burensis (isolated from repository depth in Buré, France). Three coupon configurations will be used: untreated, coated with decontaminable coating, and coated with decontaminable coating which has been damaged to simulate possible damages. The microcosms will be examined for bio- and geochemical parameters, such as pH, redox potential, mineral phases, sulphate concentration, Fe(II):Fe(III), changes in microbial populations, and the corrosion process for formation of corrosion products, and potential microbial influence, after a 270-day incubation period at 25℃ under anaerobic conditions. In subsequent experiments, the sorption behavior of lanthanides and actinides onto the membranes of viable cells and spores of D. burensis, as well as the surface of corroded cast iron coupons will be investigated.

Primary authors: KIRSCH, Klemens; Dr MATSCHIAVELLI, Nicole (HZDR)

Presenters: KIRSCH, Klemens; Prof. STUMPF, Thorsten (HZDR); Dr KOERDT, Andrea (Federal Institute for Materials Research and Testing (BAM))

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