Potential for corrosion in disposal systems for high level radioactive waste by *Meiothermus* and *Desulfovibrio*

Peter A. Masurat

Department of Cell and Molecular Biology, Microbiology, Göteborg University, Medicinaregatan 9C, Box 462, SE-405 30, Göteborg, Sweden

Abstract

Atomic energy is used worldwide to produce electric energy. It is a technique that produces large amounts of energy from relatively small amounts of fuel. The produced high level waste (HLW) is however extremely toxic and the responsibility to safely handle the waste for a time period of 10^6 years is huge. The HLW is to be stored in a two-phase system: interim storage and long-term storage. The time the HLW spends in the interim storage allows the HLW to become less toxic and thereby making long-term storage possible.

The interim storage takes place in large water filled concrete basins lined with stainless steel at the Central interim storage facility for spent nuclear fuel (CLAB). The proposed long-term storage will be a deep geological storage situated 500 metres below ground level. It is a multi-barrier system where the HLW will be encapsulated in copper canisters. The copper canisters will be stored in drilled holes and surrounded by a bentonite buffer. In 1982 microbiology became part of the performance assessment and it has ever since become increasingly clear that microorganisms can effect the disposal systems for HLW. One way microorganisms can affect technical systems is by microbially influenced corrosion (MIC).

In CLAB the metal lining of the basins could be subjected to corrosion and in the deep geological storage corrosion of the copper canisters is a major concern. In this study MIC in CLAB and the possibility of MIC in the deep geological storage was investigated in situ. In CLAB, study of biofilm and cell morphology together with molecular techniques revealed presence of a biofilm, dominated by the genera *Meiothermus*. It was further found that corrosion in CLAB could be coupled to the biofilm and a presumed corrosion product was found in the biofilm.

Regarding the deep geological repository, sulphide production by sulphate reducing bacteria (SRB) in compacted bentonite was investigated. It was found that sulphide production is hampered at high bentonite densities. It was further found that SRB can exist in a dormant state in dry bentonite and that they can become re-activated. These dormant SRB were found to be heat-tolerant and were identified as belonging to the *Desulfovibrio* genera.

Microbially influenced corrosion is a potential threat in any system with bacteria. The microbial presence and activity in the disposal systems for HLW is today known and should be considered in the design and safety of the systems. The data in this study indicate that MIC is ongoing in the interim storage system and showed that SRB can be introduced into the deep geological storage system by the buffer material.

Keywords: Bentonite, biofilms, copper, MIC, stainless steel, sulphate-reducing bacteria

Göteborg 2006 **ISBN 91-628-6773-3**