**Further Studies on the Anaerobic Corrosion of Carbon Steel In Alkaline Media in Support of the Belgian Supercontainer Concept**

N.R. Smart1, A.P. Rance1, P.A.H. Fennell1,R. Gaggiano2, C. Padovani1

1Wood, HQ Buidling, Harwell Oxford, Didcot, Oxfordshire, OX11 0GD, UK. nick.smart@woodplc.com

2 ONDRAF/NIRAS, The Belgian Agency for Radioactive Waste and Enriched Fissile Materials, Avenue des Arts 14, 1210 Brussels, Belgium

Abstract

In the Belgian Supercontainer concept a carbon steel overpack will surround high level waste and spent fuel containers and be encased in a cementitious buffer material. A programme of research has been carried out to investigate and measure the rate of anaerobic corrosion of carbon steel in an artificial alkaline porewater that simulates the aqueous phase in the cementitious buffer material and also in solid cement matrices. The main themes of the work to date have been to:

* Measure the corrosion rate of a representative carbon steel in alkaline conditions simulating the porewater containing a range of possible contaminants
* Study the electrochemical behaviour of carbon steel in anoxic alkaline conditions in the presence of a range of possible contaminants
* Characterise the corrosion product layers formed in anoxic alkaline conditions

The corrosion rates and electrochemical behaviour were measured by: (i) monitoring hydrogen evolution using a manometric gas cell technique and using sealed autoclaves equipped with pressure transducers and hydrogen sensors; (ii) by applying electrochemical methods (open circuit potential, linear polarisation resistance and AC impedance); and (iii) by gravimetric analysis.

To date, the programme of work has investigated the effects of radiation, temperature, chloride concentration, the presence of sulphur-containing species and surface preparation (fresh or pre-corroded surfaces) on the corrosion behaviour of carbon steel in alkaline conditions. Analysis of the corrosion product layers formed after several years’ exposure was conducted using a combination of surface analysis techniques, including Focused Ion Beam - Scanning Electron Microscopy, Energy Dispersive X-Ray analysis (EDX) and Raman spectroscopy, to identify the composition of the corrosion product layer and to examine its morphology and thickness.

This paper will provide an update on the results from the programme and summarise recent results, focussing on:

* the use of pressure transducers to obtain higher sensitivity than obtained in previous measurements, together with an improved understanding of the operation of the detection limit of the glass gas cell measuring system
* the latest results documenting the effect of pre-corrosion, environment chemistry and radiation on the corrosion behaviour of the system.