Carbon-14 release from irradiated stainless steel

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Carbon-14 (half-life 5,730 years) is a key radionuclide in the assessment of the safety of a geological disposal facility (GDF) for radioactive waste. In particular, the radiological impact of gaseous carbon-14 bearing species has been recognised as a potential issue. Carbon-14 is expected to be released from a GDF over a timescale of several thousand years. A number of radioactive gases will be generated from waste materials within a GDF, with carbon-14 bearing methane ($^{14}CH_4$) likely to dominate any carbon-14 transported in a gas phase, potentially reaching the biosphere at low activity concentrations. Sources of carbon-14 include irradiated graphite, irradiated steels and Zircaloys, irradiated reactive metals, spent ion–exchange resins and spent fuel.

The objective of this work is to measure the rate and speciation of carbon-14 release from irradiated stainless steel on leaching under high-pH anaerobic conditions, representative of a cement-based near field for intermediate- and some low-level wastes (ILW/LLW). In particular, this includes measurements of releases to the gas phase as well as to solution.

The presentation will include initial characterisation of irradiated steel samples to assess their suitability for use in the experiments; the approach selected and the conceptual design of the experiments for measuring carbon-14 releases from irradiated steel samples in a hot cell (i.e. a shielded cell); the design and manufacture of the equipment; the testing of the equipment and all procedures in a blank experiment; installation and commissioning of the equipment in a hot cell; and the leaching experiment including early experimental results.

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