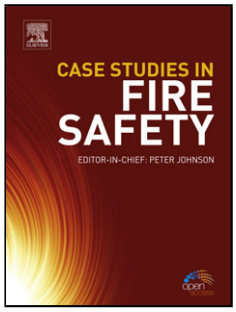

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The Corrosion of Copper in Irradiated and Unirradiated Humid Air.

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Highlights

- Corrosion of Cu in non-irradiated and irradiated H_2O aerated vapour investigated.
- The corrosion layer on the corroded areas reached a limiting thickness after ≤30 d.
- Low γ dose rates exhibited only a marginal influence on generally corroded areas.
- The depth of corrosion penetration into the Cu was relatively minor.

Abstract

Copper corrosion in aerated water vapour has been studied as a function of temperature, relative humidity in the presence and absence of a low gamma radiation dose rate. On surface areas covered by a thin water layer corrosion ceased after ≤ 30 days by the formation of CuO on the surface of a Cu_2O layer. At the locations of condensed water droplets corrosion was more extensive since the corrosion product developed porosity. Radiation accelerated the formation of Cu_2O on corroded areas and increased the number and size of the more extensively corroded locations. The distribution of condensed water was the dominant feature controlling corrosion penetration.

Introduction:

The accepted method for the permanent disposal of spent nuclear fuel in Canada is to bury it in a deep geologic repository (DGR) in a suitable dense intact rock. The fuel will be sealed within a corrosion resistant used fuel container (UFC) and emplaced in boreholes subsequently backfilled with bentonite clay. The chosen UFC involves a dual-walled container fabricated with an inner carbon steel load-bearing vessel and an outer Cu corrosion resistant barrier. To avoid design issues associated with fabrication and welding while taking advantage of the CANDU (CANadian Deuterium Uranium) fuel bundle dimensions, a container with a thin Cu coating on a welded steel vessel is being designed.[1] The coating will be applied using commercial processes such as cold spray deposition and electrodeposition[1] and, since the required corrosion allowance is expected to be small, the corrosion performance of coatings with a thickness of a few millimeters are being evaluated.[2,3] Such a design revives the possibility that γ-radiation, emitted by the fuel waste-form,