Conditioning of Mg-Zr alloy: corrosion in Na-geopolymer and its synthetic pore solution

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UNGG-Natural Uranium Graphite Gas reactors were operated from the 60s until the mid-80s in France. The reprocessing of spent fuels has generated cladding wastes mainly composed of Mg-Zr alloys. The conditioning strategy of the French Atomic Commission (CEA) is the encapsulation of these Mg-wastes into a hydraulic binder inside a steel container. The choice of a Na-geopolymer formulation with NaF addition as a binder for the Mg-wastes has been made by the CEA. Indeed, the fluoride ion is known to be a corrosion inhibitor for Mg in alkaline media [1] [2].

Therefore, the aim of this study is: (i) to get an insight of the overall corrosion process of a Mg-0.5Zr (wt.%) alloy in the Na-Geopolymer/NaF and (ii) to quantify the long-term damage brought by the corrosion reactions on Mg-Zr alloy.

For these purpose, the corrosion behaviour of Mg-0.5%Zr alloy in Na-geopolymer/NaF and its synthetic pore solution (pH = 12.5) were studied in this work. Exposure of the Mg-Zr samples has been performed up to one year at 23°C. Corrosion kinetics were assessed by Electrochemical Impedance Spectroscopy (EIS). EIS measurements were also used in order to characterise the nature and the growth of the corrosion products in addition to ex-situ analyses with Scanning Electron Microscopy, X-Ray Diffraction and X-Ray Photoelectron Spectrometry. Results have shown that the establishment of a passive film at the surface of the Mg-Zr alloy provides an efficient protection associated with low corrosion rates in the Na-Geopolymer matrix.

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