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Aqueous leaching of high burnup UO₂ fuel under hydrogen conditions

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Leaching results on fragments of high burnup (65 MWd/kgU) UO₂ fuel from a commercial pressurized water reactor are presented. The experiments were performed in simplified granitic groundwater under a hydrogen pressure of up to 5 MPa, representing conditions in a water intrusion scenario for a Swedish KBS-3 design spent nuclear fuel repository. The freshly crushed fragments were pre-washed under aerated conditions for 6 days to remove part of the instant release fraction of the radionuclide inventory and transferred to an autoclave for leaching under hydrogen conditions. Following an initial release of U attributed to dissolution of oxidized phases from the aerated handling, the U concentration decreased to levels of $2\text{-}5 \times 10^{-9}$ M, in-line with the solubility of amorphous UO₂. The release of radionuclides such as Cs and Sr gradually declined indicating a transition towards inhibition of the fuel matrix dissolution.

Summary

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