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Dissolution of irradiated MOx fuel with high Pu content

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The use of MOx with high plutonium contents as a fast reactor fuel is under consideration to help manage plutonium inventory. These plutonium contents are above those typically reprocessing and posse a number of challenges. Increased plutonium content makes the fuel dissolve more slowly and leads to an increase in plutonium-rich residues. Increasing the dissolver cycle time to allow for the slower dissolution kinetics will impact upon reprocessing throughputs.
In this study dissolution experiments on irradiated MOx fuel containing high amount of plutonium was done, the irradiation experiments had been conducted in the High Flux Reactor in Petten, the Netherlands and aimed to assess the irradiation behaviour of high Pu content mixed oxide fuels, meant for operation in fast reactors. The MOx fuel had been fabricated by hybrid sol-gel method, all pellets have annular form, with Pu content Pu/(Pu+U)= 0.45. The fuel has been irradiated for 74.1 effective full power days. The samples made available for the dissolution study are slices of about 2 mm thickness with a weight of fuel about 0.37 g each.
Due to its high plutonium content, the fuel was expected to dissolve slowly with high residues poorly in standard nitric acid (PUREX process) dissolution steps. Therefore, a series of dissolution experiments with varying conditions were proposed: i) Dissolution in hot concentrated nitric acid, ii) Dissolution in hot concentrated nitric acid with fluoride as a catalyst and iii) Oxidation with in-situ chemically generated Ag(II). All methods have been applied and the samples have been dissolved. During the dissolution experiments sub-samples have been taken and analysed for U and Pu content using TIMS method to get information on dissolution rate.

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