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Study of irradiated and non-irradiated MOX fuel reprocessing

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ABSTRACT

An important R&D program on reprocessing of MOX nuclear fuels is on-going at the French Alternative Energies and Atomic Energy Commission. This program covers both experiments on real nuclear fuels with different characteristics and modelling developments. It is lead in support of Orano's industrial project of a future polyvalent dissolution unit at La Hague facility called TCP (French acronym for "specific fuel treatment") workshop [1].

Plutonium-rich fuels being hard to dissolve, a specific dissolution process has been designed for the TCP unit. In the UOX standard reprocessing flowsheet, the sheared nuclear fuel is dissolved in a nitric acid solution. In the case of MOx fuel, hulls and undissolved particles possibly obtained after this dissolution step still contain significant quantities of plutonium which have to be recovered. That's why a complementary oxidizing dissolution step is added by using silver ion [2-3]. In the presence of silver ions, the plutonium dissolution is enhanced by the modification of its oxidation state from IV to VI. This promising process is studied in order to optimize the operating parameters, with analysis performed on both liquid and solid phases. The process gas treatment is also investigated in particular regarding the release of gaseous ruthenium. The R&D program aims to validate the efficiency of the TCP dissolution process on different kinds of MOX fuels: sodium fast reactor (SFR) fuels and light water reactor fuels (LWR) of different Pu contents, burnups, claddings and manufacturing methods. All the experiments are performed at laboratory scale in the Atalante facility.

The results on SFR and LWR fuels show that the TCP process achieves very good performances with yields over 99.98%, whatever the used fuel (see below). Thus, thanks to the steps of oxidizing dissolution, the plutonium recovery efficiency is significantly improved.

In parallel with the experimental studies, simulations are developed using Computational Fluid Dynamics to support the design and the geometry definition of future industrial equipment [4-5].

	Initial Pu content %	Burnup GWd/tHMi	Global Pu recovery rate with TCP process %
LWR MOX	6.5	0	99.98
FR RNR	22.5	124.4	99.99
FR RNR	20.8	156.1	99.99
FR RNR	28.2	143.4	99.99

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