7–6 Toward a New Reprocessing Process for the Transitional Period to the Fast Reactor Cycle
— The Development of a Uranium and Plutonium Co-recovery Process (Co-processing Process) —

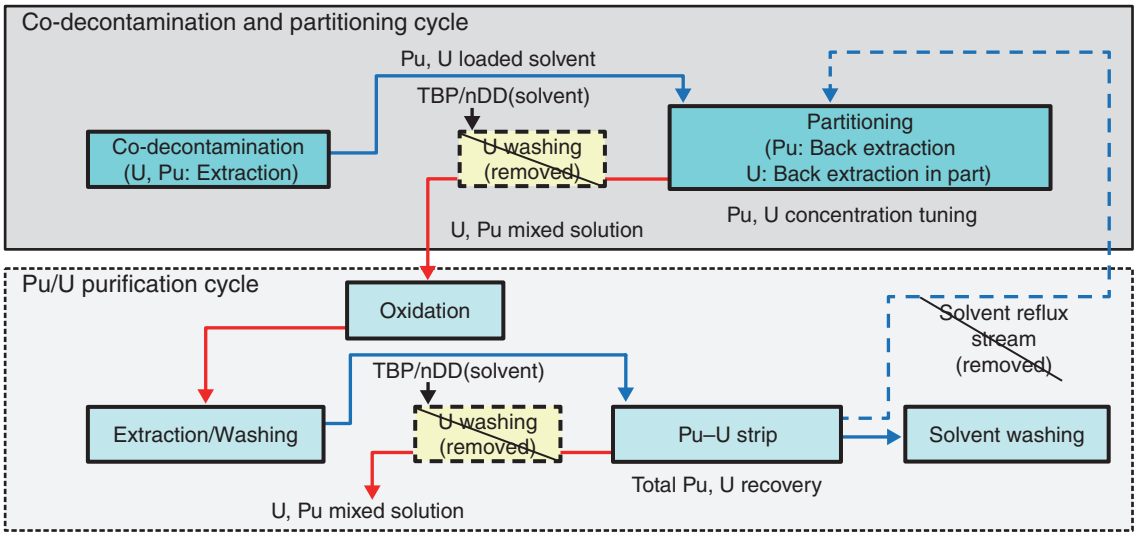

Fig.7-12 Schematic of the co-recovery process
The elimination of the U washing stages and the solvent reflux stream, which are both part of the conventional PUREX process, prevents Pu isolation in the process and improves its proliferation resistance.

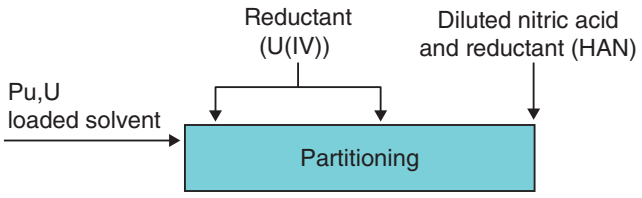

Fig.7-13 Reduction of Pu in the partitioning stage
Pu is stripped into an aqueous phase in this stage by reducing it to trivalency using U(IV) and HAN as reductants.

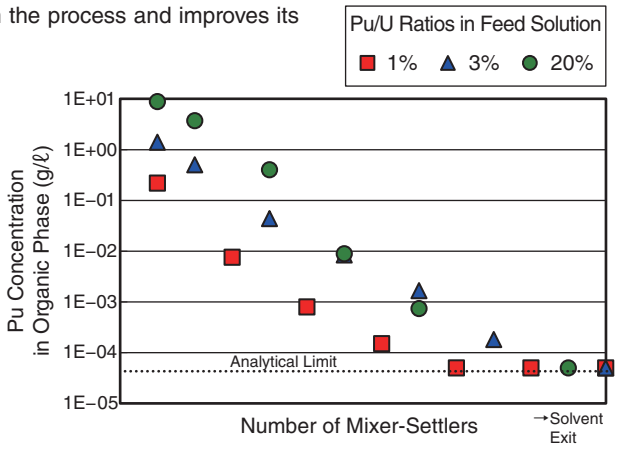

Fig.7-14 Pu concentration profiles in the partitioning stage
Pu is completely stripped in this stage because Pu concentrations in solvent effluents are less than the analytical limit.

The transition from the current light-water reactor (LWR) cycle to the FR cycle will span several decades. In this period, LWRs and FRs will coexist, and not only UO_2 fuel but also mixed oxide (MOX) fuels will be discharged from these reactors. For the purpose of reprocessing these spent fuels with varying plutonium contents, a U-Pu co-recovery process (co-processing process) is currently being developed. In contrast to the conventional reprocessing process (PUREX), which recovers Pu separately from U, the co-processing process will recover the two elements together to prevent the isolation of Pu to improve the proliferation resistance (Fig.7-12).

Mixer-settler tests of the co-processing process have been conducted using U/Pu nitric acid solutions at the Operational Testing Laboratory (OTL) of the Tokai Reprocessing Plant (TRP). To assure complete stripping of Pu in a mixture with U in the partitioning stage, the appropriate usage of reductants (U(IV) and HAN)—which reduce Pu to a non-extractable trivalent state—has been evaluated in the tests (Fig.7-13).

The adopted Pu/U ratios of the feed solutions used in the tests were 1%, 3%, and 20%, considering the composition of the future spent fuels from a LWR, a LWR-MOX hybrid, and a FR-MOX reactor. In the tests, complete stripping of Pu in a mixture with U has been observed at all Pu/U ratios (Fig.7-14), and the U/Pu ratios in the recovered U/Pu mixed solutions could be controlled within the 0.5–2.0 U/Pu ratio range, which was suitable for the fabrication of FR-MOX fuel.

Further tests are to be conducted to improve the process, and will use centrifugal contactors.

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Reference

Yamamoto, K., Ohbu, T. et al., Development of U and Pu Co-Recovery Process (Co-Processing) for Future Reprocessing, Proceedings of International Nuclear Fuel Cycle Conference (GLOBAL 2013), Salt Lake City, USA, 2013, paper 7797, 4p., in CD-ROM.