A separation process concept utilizing tertiary pyridine resin was applied to the separation of rare metal fission products (RMFP), trivalent lanthanides (Ln(III)), trivalent actinides (An(III)) and plutonium (Pu) in mixed oxide (MOX) fuel irradiated at “JOYO”. Further, the mutual separation of americium (Am) and curium (Cm) was performed successfully. The study was carried out with Tokyo Institute of Technology.

The resin has the functions of a weakly basic anion-exchanger and a nitrogen soft donor ligand, and is a salt-free CHON compounds (Fig.1-39).

The separation process (Fig.1-40) can be divided as follows:

STEP-I : Platinum group elements separation
(pre-filtration)

STEP-II : Separation of Ln(III) and other FP, An(III), and Pu

STEP-III : Separation of Am and Cm

Firstly, a 85.ł g HCl solution of MOX with high burnup of 140 GWd/MTM was introduced to the separation process.

STEP-I Antimony-125 and RMFP, mainly ⁹⁹ᵐ⁹⁸Ru in present experiment, were perfectly adsorbed in the resin.

STEP-II The solvent was changed to conc. HCl solution, and passed through the resin embedded in silica beads. The Ln (III) including the other FP, such as ¹⁵²Eu, ¹⁵⁴Ce, and ¹⁰⁴Cs, were separated. Accordingly An(III) were separated. After the removal of An(III), the effluent was changed to diluted HCl to strip out Pu fraction from the resin. (Fig.1-41) STEP-III An(III) solution was changed to nitric acid-methanol mixed solution, and passed through the resin, separating Am and Cm. (Fig.1-42)

The recovery of ²⁴¹Am was more than 95% in this experiment. The Decontamination Factors (DFs) of ¹³³Cs and ¹⁵²⁴Eu in the isolated Am-fraction exceeded 3.9×10⁶ and 1.0×10⁷, respectively. The DF of ²⁴³Cm from ²⁴¹Am was more than 2.2×10⁷. This DF of An(III) is higher than ever achieved. These results proved that a simplified separation process can be used in the advanced ORIENT multifunction cycle with enhanced separation, transmutation and utilization of spent fuel.

Reference