NUCLEAR ENERGY RESEARCH INITIATIVE

Selective Separation of Americium from Lanthanides and Curium by Aqueous Processing with Redox Adjustment

PI: Kenneth L. Nash, Washington State University

Project Number: 05-082

Collaborators: Idaho National Laboratory

Related Program: AFCI

Project Description

This project investigates application of conventional chemical methods for selective separation of actinide isotopes from lanthanides in mixed oxide (MOX) fuels using aqueous processing with oxidation state adjustment. Increased application of mixed oxide (MOX) fuels and longer burnup times for conventional fuels result in production of higher concentrations of the transplutonium actinides americium and curium and also several heavier species. The half-lives of the americium isotopes (up to 7,370 years) are significantly longer than those of the other isotopes. With the removal and transmutation of americium, radiation of high level wastes are reduced to levels approaching uranium mineral within less than 1,000 years, as opposed to the 10^4 to 10^5 year time-frame required for natural decay. The Advanced Fuel Cycle Initiative (AFCI) established a separation factor exceeding 10^4 as a goal for selectively isolating Am from spent fuel. Because the chemistries of trivalent lanthanides and actinides under aqueous processing conditions are so similar, satisfying this objective is extremely challenging. Since trivalent ion-recognition techniques cannot provide an adequate thermodynamic basis for such a separation in an acceptable number of contacts, this project will investigate oxidation state adjustment methods to achieve selective partitioning of Am from lanthanides and Cm using a multifaceted approach employing conventional and unconventional aqueous separations methods and materials.

The research goal is to develop strategies for adjusting the oxidation state and demonstrating a successful separation based on oxidation of americium. Additional studies will be conducted on the most promising candidate process identified.

Work Scope

- Investigate application of conventional aqueous separation processes to americium
- Examine methods of facilitating the spontaneous organization of molybdenum to self-assemble around an oxidized americium species. Using a material naturally present in fission products is advantageous for waste management.
- Investigate use of room temperature ionic liquids as media for americium oxidation state adjustment.