Glenn T. Seaborg Center Seminar

Dissolution and Separation of Lanthanides and Actinides in Supercritical Fluid Carbon Dioxide – A Green Technology for Nuclear Waste Treatment

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Supercritical fluid carbon dioxide with its moderate critical constants, nonflammable nature and low cost provides an attractive alternative for replacing organic solvents traditionally used in chemical manufactory processes. Minimizing liquid waste generation, easy separation of solutes, and tunable solvation strength are some of the advantages of the supercritical fluid extraction technology over conventional solvent extraction methods. Lanthanides and actinides in liquid or solid samples can be extracted by supercritical CO_2 using CO_2-soluble complexing agents such as fluorinated beta-diketones and tri-n-butylphosphate. Direct dissolution of uranium dioxide and lanthanide oxides in supercritical CO_2 can be achieved utilizing a tributylphosphate-nitric acid complex as an extractant. A current demonstration project using the supercritical fluid dissolution method for treating uranium and gadolinium contaminated wastes generated by nuclear fuel fabrication plants is described. In this demonstration project, separation of uranium and gadolinium complexes dissolved in the supercritical fluid phase is accomplished by a countercurrent water stripping process. Potential applications of the supercritical fluid extraction technology for managing other nuclear wastes including reprocessing of spent nuclear fuel are also discussed.

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