538b Reprocessing Spent Nuclear Fuel Using Environmentally Sustainable Solvents

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Supercritical fluid carbon dioxide and room-temperature ionic liquids are considered environmentally-friendly solvents for chemical separation processes. The feasibility of using supercritical CO2 as a solvent for reprocessing spent nuclear fuel has been reported in the literature. Direct dissolution of uranium dioxide (UO2) in supercritical CO2 with a tributylphosphate (TBP)-nitric acid complex, converts UO2 to CO2-soluble UO2(NO3)2(TBP)2 is one possible approach of the CO2-based reprocessing technology. Oxidizing UO2 to (UO2)2+, followed by complexation with a fluorinated beta-diketone and TBP in supercritical CO2, is another possible approach of the reprocessing technology. Information on current demonstrations of the supercritical fluid technology for reprocessing spent nuclear fuel will be reviewed. In addition, dissolution of lanthanides and actinides in room-temperature ionic liquids and their subsequent extraction from ionic liquids by supercritical CO2 have been demonstrated recently. The feasibility of using a coupled ionic liquid-supercritical fluid CO2 extraction technique for dissolution and separation of lanthanides and actinides will be discussed.