Recovery of plutonium from polymeric waste matrices using supercritical fluid extraction

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ABSTRACT

Polymers are widely used materials and are indispensable in handling radioactive materials in fumehoods, gloveboxes, etc. Supercritical fluid extraction (SFE) technique is widely employed for the removal of radioactive contaminants from various matrices using supercritical carbon dioxide (Sc-CO₂) modified with suitable ligands as an extraction medium. In the present study, recovery of plutonium from various polymeric matrices, such as neoprene, polyvinyl chloride (PVC) and surgical gloves has been demonstrated using Sc-CO₂ modified with n-octylphenyl N,N-diisobutyl carbamoylmethylphosphine oxide (CMPO) in methanol. The matrix was initially subjected to neat Sc-CO₂ extraction to prevent co-extraction of organic compounds during SFE of plutonium; in the initial extraction with Sc-CO₂, organic compounds added as additives to the polymeric matrix were extracted. In the initial studies, SFE method was developed for the complete recovery of plutonium from simulated polymeric waste matrices. Subsequently, the actual waste, i.e. plutonium present in PVC matrix was processed from a 0.1 L extraction vessel for its recovery. The plutonium recovery was found to be ~97% from the actual PVC waste matrix. The technique was also demonstrated for the recovery of important actinides e.g. americium from simulated neoprene waste matrix. As the disposal of polymer waste is of major concern in nuclear waste management, the SFE technique developed in the present study offers a potential opportunity for the recovery of actinides with generation of minimum secondary waste.

Keywords: Supercritical CO₂; SFE; Plutonium; Polymeric waste matrix; CMPO

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