Contribution ID: **315** Type: **ORAL**

ADVANCED FLOW-SHEET FOR PARTITIONING OF TRIVALENT ACTINIDES FROM FAST REACTOR HIGH ACTIVE WASTE

Wednesday, 28 June 2017 15:30 (20 minutes)

Partitioning of radiotoxic elements present in the high-level liquid waste (HLLW) followed by transmutation of them (P&T strategy) into stable or short-lived products in accelerated driven systems or fast-reactors is a viable option for the safe management and minimizing the radiotoxicity of HLLW. In this context, a typical high-active waste (HAW) arising from reprocessing of spent carbide fuel, (U0.3Pu0.7)C irradiated to a burn-up of 155 GWd/Te in the Fast Breeder Test Reactor (FBTR) was characterized by various analytical techniques. The composition of this fast reactor high-active waste (FR-HAW) differed significantly from the HAW, arising from thermal reactor fuel reprocessing in terms of radioactivity and elemental composition of various metal ions, which are likely to pose several challenges in the handling, treatment, management and disposal of FR-HAW. A method has been developed for partitioning of minor actinides from the FR-HAW using a solvent system composed of 0.2 M n-octyl(phenyl)-N,N-diisobutylcarbamoylmethylphosphine oxide (CMPO) –1.2 M tri-n-butylphosphate (TBP) in n-dodecane (n-DD), and subsequently demonstrated with the actual (FR-HAW) (155 GWd/Te) using a 16-stage ejector mixer settler in hot cells. The results established the recovery of >99% of trivalents (Am(III) + Ln(III)) using citric acid-nitric acid formulation, developed for back extraction. About 5 - 10% of 106Ru was found in the product and nearly 20% of radioruthenium was carried to the lean organic phase after the first cycle requiring cleanup of the solvent.
However, the demonstrated method and the other the existing methods available in various countries for partitioning of trivalent actinides from high level liquid waste (HLLW) use organic phase modifiers in significant concentrations to maneuver the undesirable third phase formation encountered during trivalent actinide partitioning, even though the solvent system without any phase modifier was desirable. To avoid these complications novel unsymmetrical diglycolamides (UDGAs) and diglycolamic acids were developed in our laboratory and systematically studied for the group separation of Ln(III)-An(III) as well as for Ln-An separation from fast reactor simulated high-level liquid waste (SHLLW). In this paper, it is proposed to provide the summary of our research and development activities carried out at Chemistry Group, IGCAR towards the development of advanced flow-sheet for trivalent actinide group separation, lanthanide-actinide separation and demonstrations with real high-active waste.

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Session Classification: 4.3 Partitioning and Sustainability

Track Classification: Track 4. Fuel Cycle: Sustainability, Environmental Considerations and Waste Management Issues