

Advanced Flow-Sheet for Partitioning of Trivalent Actinides from Fast Reactor High Active Waste

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The processes developed for partitioning of trivalent actinides (TA) from high-level liquid waste (HLLW) generated during reprocessing are all focused on single-cycle approaches for waste minimization. In this process the formation of third phase has to be avoided. Hence, a phase modifier is often employed in most of the processes in vogue, even though the use of the later is more desirable. To avoid these complications advanced symmetrical and unsymmetrical diglycolamides were developed in our laboratory and systematically studied for the group separation from fast reactor simulated high-level liquid waste (SHLLW), and then subjected to single-cycle separations. This method involved the separation of trivalent actinides and chemically similar lanthanides, as a group, from SHLLW followed by mutual separation of lanthanides and actinides from the loaded organic phase using aqueous soluble complexing agents.

The potential solvents identified for the group separation of trivalents from HLLW were 1) 0.2 M TODGA (N,N,N',N'-tetraoctyldiglycolamide) + 5% octanol / n-DD, 2) 0.2 M TODGA + 0.5 M TBP (tri-n-butylphosphate) / n-DD, 3) 0.1 M TODGA + 0.25 M HDEHP (di-(2-ethylhexyl) phosphoric acid) / n-DD, 4) 0.2 M TDDGA (N,N,N',N'-tetradecyldiglycolamide) / n-DD, 5) 0.2 M D3DODGA (N,N-didodecyl-N',N'-dioctyldiglycolamide) / n-DD, 6) 0.4 M DOHyA (N,N-dioctyl-2-hydroxyacetamide) / n-DD. The selective stripping of Am (III) from the loaded organic phase containing trivalent lanthanides was investigated using aqueous soluble bis-1,2,4-triazine derivatives such as SO₃-Ph-BTP, SO₃-Ph-BTBP and SO₃-Ph-BTPPhen in dilute nitric acid solution. The results revealed that the SF of Eu (III) over Am(III) decreased with increase in the concentration of nitric acid in all cases and separation factor (SF) decreased in the order SO₃-Ph-BTP > SO₃-Ph-BTBP > SO₃-Ph-BTPPhen. The co-stripping of lower lanthanides (La, Ce, Pr, Nd) was also observed during the recovery of Am(III). The distribution ratio of Am(III) and Ln(III) in all the organic phases were quite similar. However, TODGA system requires 1-octanol phase modifier for preventing the third phase formation, which is undesirable for safety concerns, whereas the other ligands were modifier-free reagents. Therefore, the other ligands (TDDGA and D3DODGA) developed in our laboratory offered a significant advantage over the TODGA. D3DODGA stripped Am(III) better. As a result the SF for Eu(III) over Am(III) was significantly high (>400) indicating the possibility of using them for MA partitioning. This presentation describes, the summary of our research and development activities carried out at IGCAR towards the development of advanced flow-sheet for TA separation from HLLW generated during fast reactor fuel reprocessing.

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