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Consolidation of the EXAm process: towards the reprocessing of a concentrated PUREX raffinate

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Abstract

Recycling americium alone from the spent fuel is an important issue currently studied for the future nuclear cycle (Generation IV systems) as Am is one of the main contributors to the long-term radiotoxicity and heat power of final waste. The solvent extraction process called EXAm has been developed by the CEA to enable the recovery of Am alone from a PUREX raffinate (with U, Np and Pu already removed). A mixture of DMDOHEMA and HDEHP diluted in TPH is used as the solvent and the Am/Cm selectivity is improved using TEDGA as a selective complexing agent to maintain Cm and the heavier lanthanides in the acidic aqueous phase (HNO₃ 5-6M). Americium is then selectively stripped from the light lanthanides at low acidity (pH 2.5-3) with a polyaminocarboxylic acid (DTPA). An additional step is necessary before Am recovery, in order to strip molybdenum which would otherwise be complexed by DTPA and contaminate the Am raffinate. In order to make the process and its associated future plant more compact, the objective is now to adapt the EXAm process to a concentrated raffinate.

With a concentrated PUREX raffinate, the process operates under conditions close to saturation both for the solvent and complexing agent TEDGA during the Am extraction step. Consequently, some changes were needed to adapt the flowsheet to higher concentrations of cations.

Before the test on a real PUREX raffinate in the CBP shielded line at ATALANTE (at the end of 2015), the EXAm flowsheet had to be consolidated and achievable target performances ensured. A series of experiments and tests was performed: on laboratory scale (batch experiments), to identify the good operating conditions and to simulate the main phenomena involved (2010-2014); first on an inactive surrogate feed solution at G1 facility (2011 – 2013), and then on a surrogate feed solution with trace amounts of americium and curium (spiked test) in the C17 shielded line at ATALANTE (2014).

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Keywords: EXAm process; concentrated PUREX raffinate; Am separation; DMDOHEMA; HDEHP; TEDGA; DTPA

1. The EXAm process

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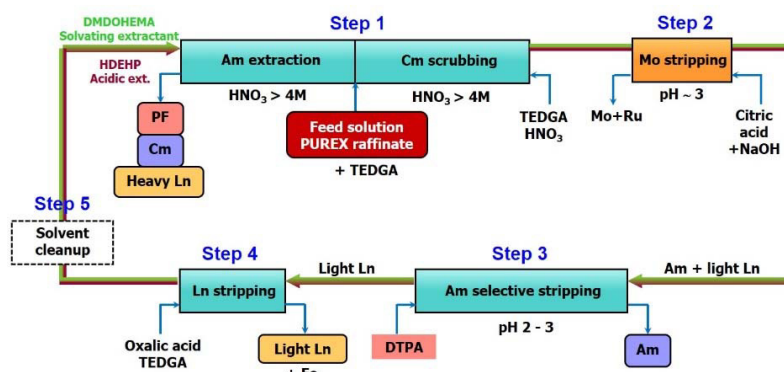


Fig. 1. The EXAm simplified flowsheet

With a concentrated PUREX raffinate, the process operates under conditions close to saturation both for the solvent and complexing agent TEDGA during the Am extraction step. Consequently, some changes were needed to adapt the flowsheet to higher concentrations of cations.

Nomenclature

AX	Am extraction step
AS	Cm scrubbing step
DMDOHEMA	N,N' dimethyl- N,N' dioctyl-2 (2 (hexyloxy)ethyl)-malonamide
DTPA	Diethylenetriaminepentaacetate
EXAm	Extraction of americium
HDEHP	Di-2-ethylhexylphosphoric acid
HEDTA	N -(2-Hydroxyethyl)-ethylenediaminetriacetate
TEDGA	N, N, N', N' Tétra-éthyl diglycolamide

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