CEIDEN: La Plataforma Tecnológica de I+D de Energía Nuclear de Fisión

CEIDEN-NNL UK

1-2 February 2016

Topic 3: “Advanced Separations & Recycle”

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Participants from CEIDEN: EEAA, IDOM, CIEMAT, UPM

Points from NNL presentation taken by CEIDEN:

1. Aqueous recycle SRP
    1. Plutonium multi-recycling
    2. Minor actinide
    3. International collaboration (SACSESSS,…) and beyond
2. Pyrochemical separations (industrialization & molten salt management)
3. Recycle

Additional points from CEIDEN:

1. Recycled fuel impact on reactor operation and fuel cycle
    1. Am & Cm recycling
    2. Fuel evolution during irradiation
2. Design and synthesis of selected extractants for aqueous reprocessing
3. Extractant process feasibility and stability studies
4. Simulation of closed nuclear fuel cycle scenarios including transitory events/phases
5. Optimization of fuel cycle scenarios along decades

Topic 3: Advanced Separations. Aqueous recycle

Strategies for the waste management

- MOX Fabrication
- Conditioning & Partictioning(P&C)
- Partitioning & transmutation (P&T)

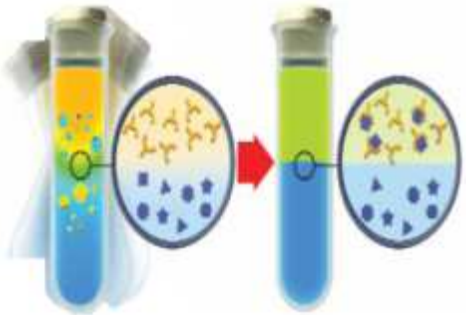
Separation process

Pyrometalurgical

Hidrometalurgical

Strategies for the waste management

- Liq-liq Extraction
- Selective metallic complex formation



PUREX Process: Plutonium Uranium Recovery by EXtraction

- ***Organic extractans***

  Design, synthesis, screening & setup of the extraction process.

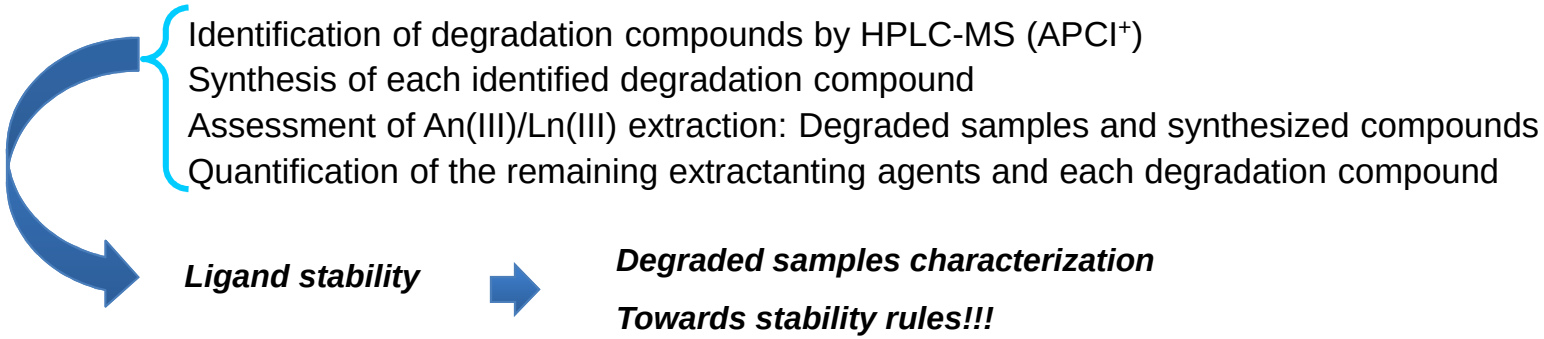
Development of Advance cycle from SF reprocessing

Topic 3: Advanced Separations & Recycle

FP5 PartNew, CalixPart, 2000-2003 (FIKW-CT-2000-00087)
FP6 Europart, 2004-2007 (FI6W-CT-2003-508 854)
FP7 ACSEPT, 2008-2012 (FP7-CP-2007-211 267)

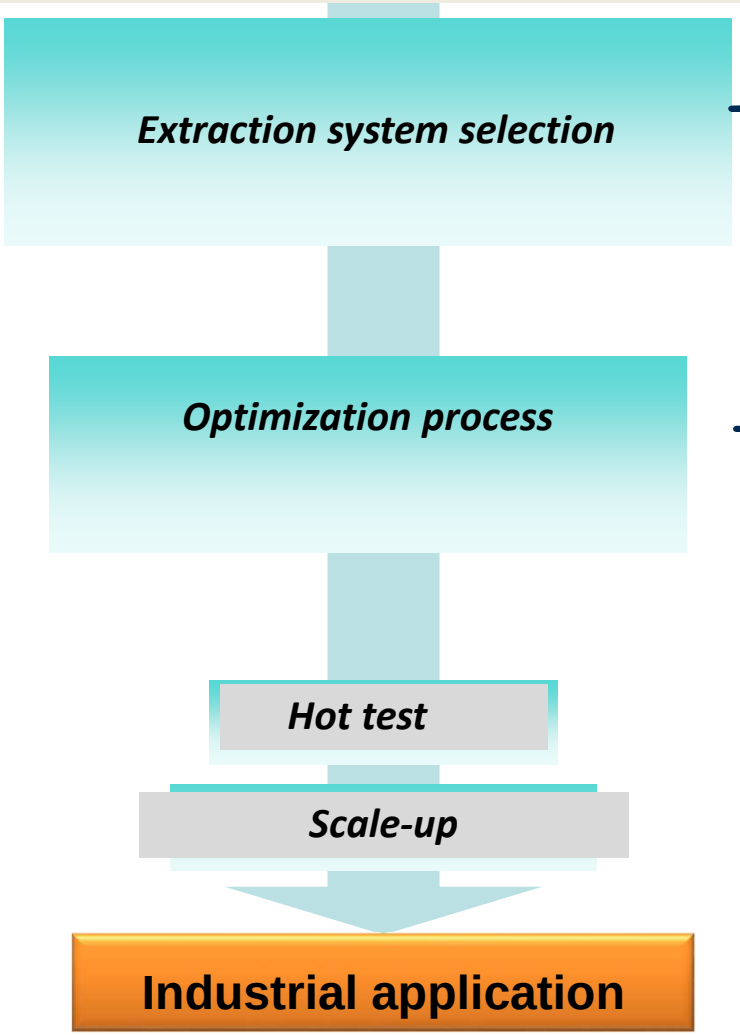
- ***Assessment of extracting and complexing properties***
  - Screening test of extraction of Ln(III) [Eu-152] , An(III) [Am-241], An(IV) [238Pu] y An(V) [237Np]
  - Studies of complexing properties: stoichiometry of complex, selectivity
- ***Process development***
  - **Optimization of extraction systems**

    Study of: solubility, extraction kinetics, back-extraction conditions and kinetics, solvents loading capacity, etc.
  - **Assessment of the stability of selected molecules (manly UAM-069 and TODGA)**



Topic 3: Aqueous partitioning

Hidrometallurgical process development



Design and extractants synthesis

- *Depending of the nature of the radionuclide*
- *Media dependence: lipophilic & hidrophils.*

Complexation properties:

- *Extraction / re-extraction selectivity*
- *Thermodynamics*

Properties improvement :

- *Charge capacity*
- *Kinetic*
- *Mass transfer*
- *Continues extraction*

Long term application:

- *Radiation stability*
  - *Characterization of irradiated samples*
  - *Sub-products synthesis and analysis*
  - *Improvement of the stability extractans/ extraction systems.*
  - *Dose calculation*

Pyrometallurgical

Facilities prepared for Cl and F salts studies

Topic 3: Advanced Separations & Recycle Facilities

•Radioactive facility CIEMAT IR30 &IR08:

"Laboratory to manipulate long life radionuclides"

Limits IR30		*α (≠ U y Th nat)*	*U / Th Nat*	*β / γ*
S1-26	storage	**5 MBq**	20 MBq	**5 GBq**
	Process	5 MBq	2 MBq	10 MBq
S1-21	Analysis	0.5 MBq	2 MBq	0.5 GBq

- CIEMAT IR-08 1 glovebox
- CIEMAt S1-26: *Experimental lab. Process*
  - 3 Anoxic gloveboxes
  - 5 Fume-hood
- CIEMAT S1-21: *Analysis lab.*
  - 2 Fume-hood

- Surface solid characterization
  1. Particle size
  2. Porosity & surface area
     1. BET (N2, Kr, ...)
  3. Thermal treatments (atmospheric control)
     - Climatic chamber
     - Furnace
     - TGA - DSC
  1. XRD high pressure
  2. Raman high P&T
  3. Optical & SEM
- Chemical Analysis
  1. ICP-MS
  2. HPLC-MS, HPLC
  3. UV-Vis
- Spectrometry
  1. Gamma GeHP
  2. Alpha α-Analyst (Canberra)

Nayade@CIEMAT gamma irradiation facility

Facilities@CIEMAT for Cl and F salts

Topic 3: Recycling and Fuel cycle modelling

- New fuels for current or future reactors with U, Pu recycling: MOX, reprocessed irradiated U, etc.
- Alternative fuels with small amounts of minor actinides as demo for transmutation.
- Separation of fission products.

- Dose rate estimations for separation processes.

- Fuel optimization for an advanced fuel cycl
  - Modeling of the whole fuel cycle scena