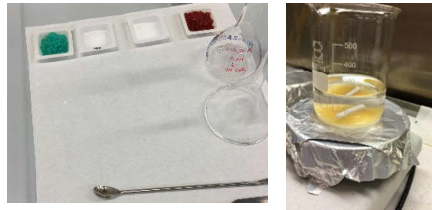


WET OXIDATION – Fenton-like process

Decomposition of organic matter by reaction of H_2O_2 with $FeSO_4$ catalyst to form hydroxyl radicals.

- $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + \cdot OH + OH^-$
- $C_8H_8SO_3 + 20 H_2O_2 \rightarrow 8 CO_2 + 23 H_2O + H_2SO_4$

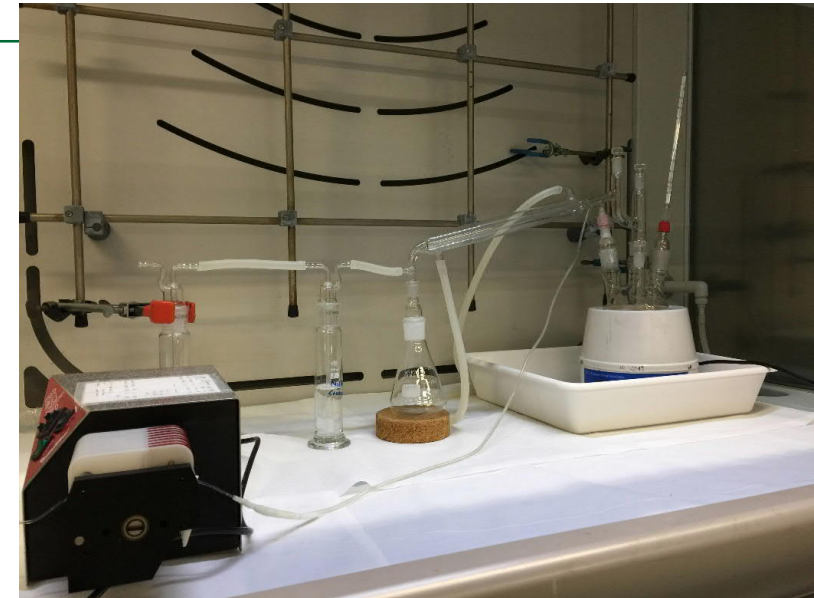
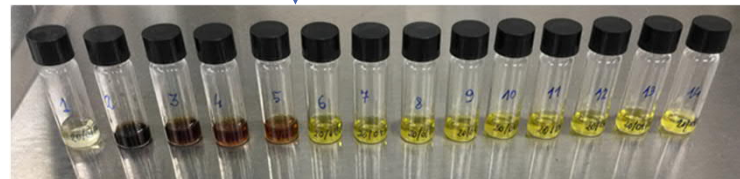
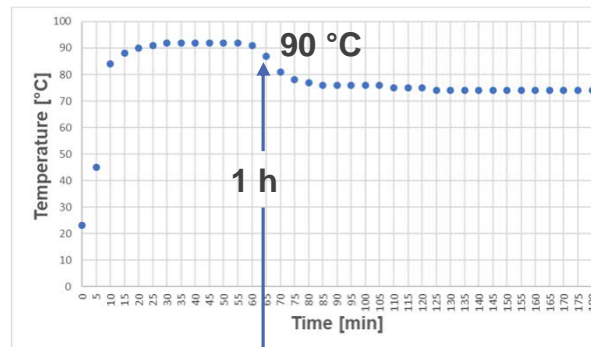


1. Surrogate waste

- Cationic resin loaded with Co, Cs, Sr and Ni ions as representatives of activation and fission products

2. Treatment method

- Dissolution of about 10 g of organic resin into a glass reactor by dropwise addition of H_2O_2 under vigorous agitation for 3 hours



3. Optimization

- Fe^{2+} concentration, H_2O_2 amount and inlet flow rate
- Reaction temperature peak at about $90^\circ C$ within 1 h

WET OXIDATION – Fenton-like process

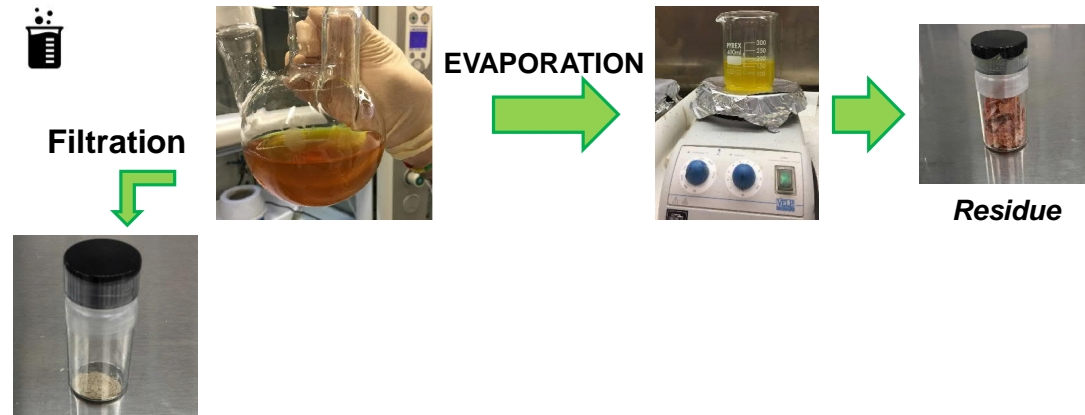
- Evaporation process at controlled temperature for about 24 hours

4. Characterization

- Visual inspection of solution colour, as qualitative check of process evolution over time
- FT-IR, FT-Raman and XRD analyses on aliquots collected along the process and on the left residues to assess total organic decomposition and identify obtained inorganic compounds.
- Evaluation of nuclides distribution by ICP-MS analysis

Results

- Clear yellow solution along with a very small amount of a white fine residue without any visible resin bead
- Small quantity of a homogeneous precipitate and residue thereby achieving a weight reduction rate of about 40%.
- Presence of only inorganic sulfates in the residues (**to be confirmed**)



OUTLOOK

- Confirmation of **organic decomposition** by FT-IR, FT-Raman and XRD analyses on the obtained residues
- Evaluation of **nuclides distribution** in the residue by ICP-MS analysis
- ▶ **Scale-up** of the process from lab to intermediate scale (10 g → 100 g)
- ▶ **Encapsulation of residues** into geopolymeric matrix

Fenton wet oxidation at USFD

- Mixed organic cation & anion resins
- Aqueous processing using H_2O_2 at 90-95 °C
- Dual Cu & Fe catalyst for wider pH range processing
 - Capable of processing at near-neutral conditions
- Solid inorganic wastes will undergo hot isostatic pressing (HIP) to create a glass wasteform
 - Many radionuclides expected to precipitate as insoluble phosphates / hydroxides
 - Liquid wastes suitable for on-site effluent treatment or evaporation & immobilisation
- Currently laboratory fumehood scale – low TRL

