



WP4

Innovations in metallic radioactive waste management

PREDIS MAY 25, 2023 ANNUAL WORKSHOP

WP MANAGEMENT TEAM:

**A. ABDELOUAS (IMT /SUBATECH), B. KENT (GSL),
C. CANNES (CNRS), A. SAVIDOU (NCSR D)**



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Presentations

- Overview and state of progress (Abdesselam Abdelouas – IMT Atlantique)
- **Scientific presentations:**
 - Rita Plukiene (FTMC, Lt): Work progress on optimization of metallic waste.
 - Tomo Suzuki (IMT Atlantique, Fr): Development of new radiochemical procedures for DTM radionuclides
- **Students presentations:**
 - Carla Fernandez (CSIC, Spt): Corrosion of Al in magnesium phosphate cements
 - Jessica Hopkin (NNL, UK): Decontamination of oxidized metallic waste



Overview of WP4 Objectives

- Develop innovative and optimised characterisation techniques for metallic wastes.



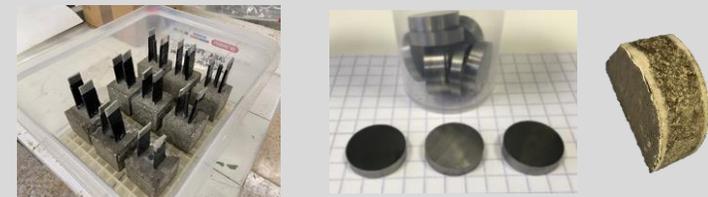
- Demonstrate innovative techniques to decontaminate metallic wastes to quantify the efficiency of decontamination processes and allow more effective application of the waste hierarchy: classification and clearance.



- Develop treatment techniques for secondary waste streams after decontamination.



- Develop innovative conditioning matrices for reactive metallic wastes.

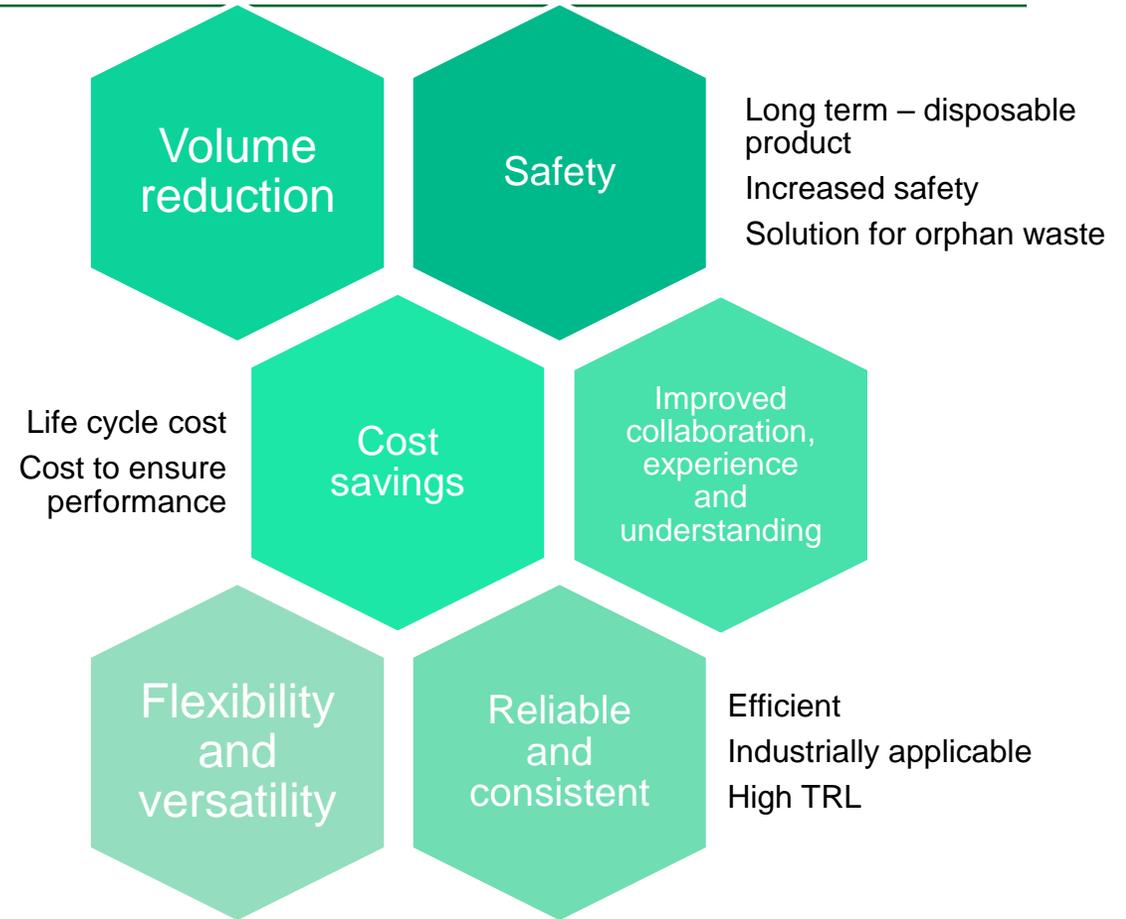


Work Package 4 Structure

- Task 4.1 WP management (IMTA)
- Task 4.2 GAP analyses (IMTA, all)
- Task 4.3 Defining Europe-wide Needs and Opportunities for Management of Metallic Waste Streams (GSL)
- Task 4.4 Development and optimisation of decontamination processes (IMTA)
- Task 4.5 Optimisation of metallic waste characterisation and procedures for waste minimisation and recycling (NCSR)
- Task 4.6 Encapsulation of reactive metals in magnesium phosphate cement-based matrices (CNRS)
- Task 4.7 Dissemination (IMTA)

T4.3 Economic and environmental impacts of decontamination and metal melting

- Strategic analysis, including costs and benefits, of the potential opportunities for metal decontamination and melting, and application of the waste hierarchy in countries across Europe, with particular reference to technologies studied in WP4.
- A **Value Assessment workshop** (MS25) will be a key input to this analysis.
- But what is Value Assessment? Value assessment provides a **toolkit** for decision makers (e.g. End Users) who are considering the merits of alternative technologies for treatment of their wastes



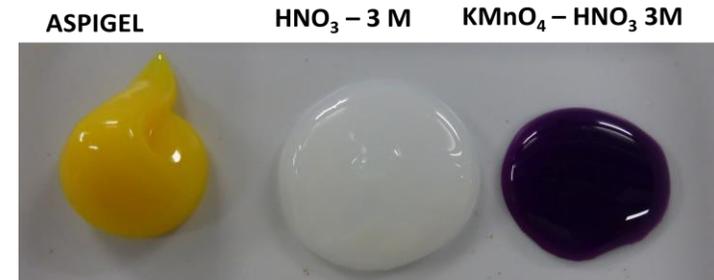
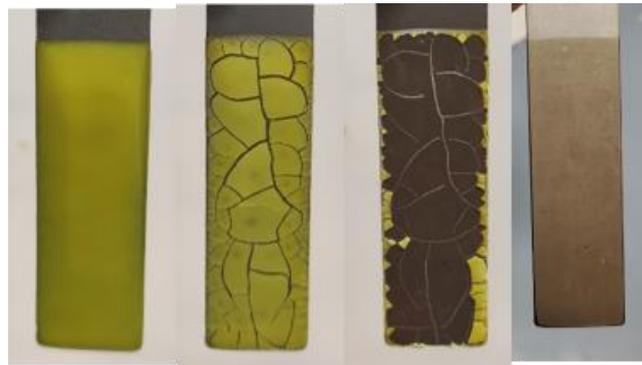
Progress achieved - Task 4.4 (1/2)



- Task 4.4 “Development and optimisation of decontamination processes”
- Decontamination of oxidized stainless steel using corrosive gels

On non-oxidized SS

On strongly oxidized SS



Determination of the mass loss

$$\text{corroded thickness} = \frac{\Delta m}{\text{surface} \times \text{density}}$$

Application of the CORD process

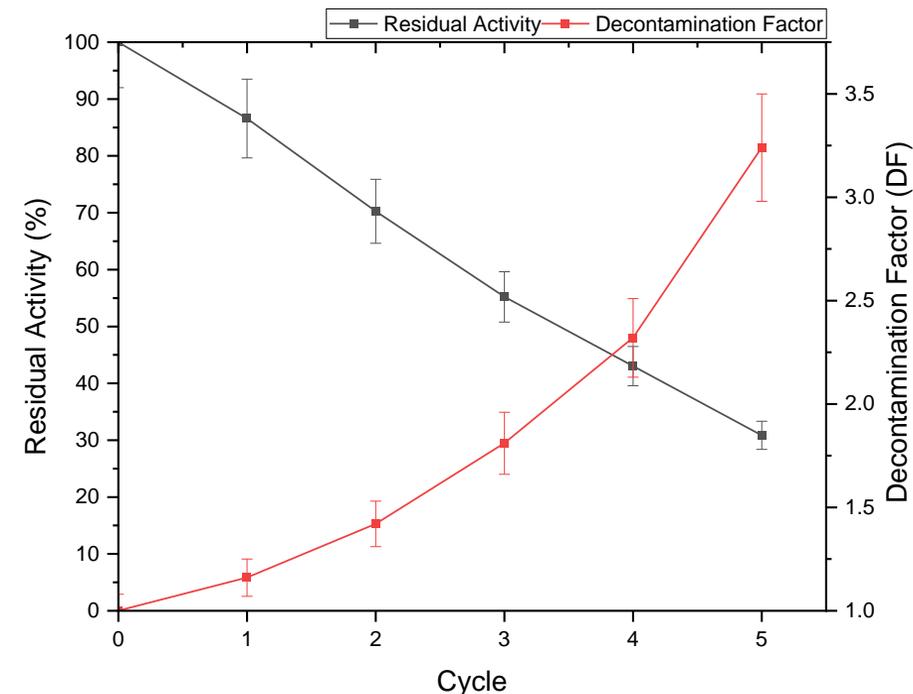
Progress achieved - Task 4.4 (2/2)



- Decontamination of Inconel A600 sample from steam generator using CORD process

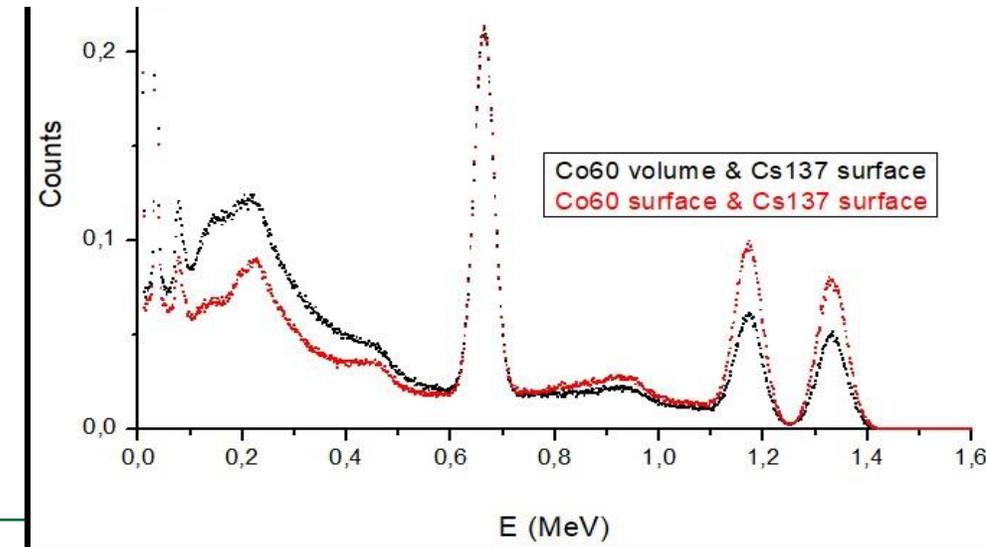
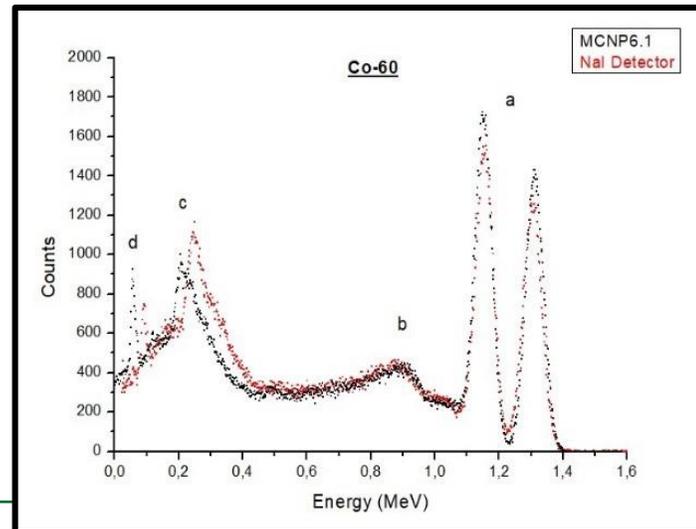
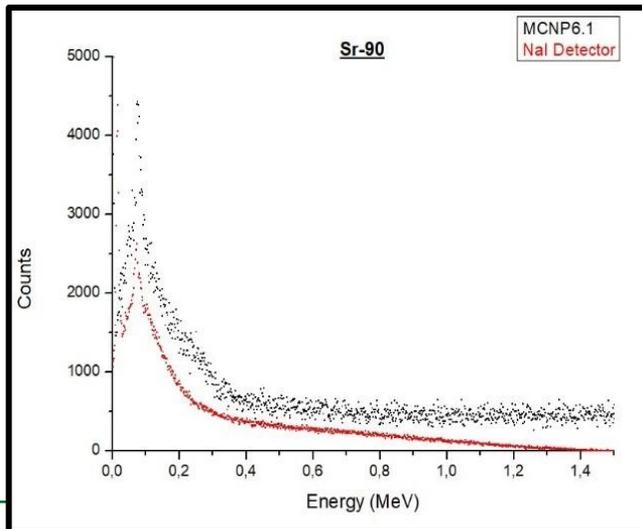


Radionuclide	Energy	Intensity	Average Activity	
	keV		(Bq/g)	error
Mn-54	834.85	99.98	112.21	22.65
Co-57	122.06	85.51	13.59	6.94
Co-60	1173.23	99.85	24442.50	1391.60
	1332.49	99.98		
Sb-125	427.87	29.55	116.87	31.28
	463.36	10.48		
	600.6	17.76		
Total (Bq/g)			24559.37	1391.95
Total (Bq)			12002.16	680.25



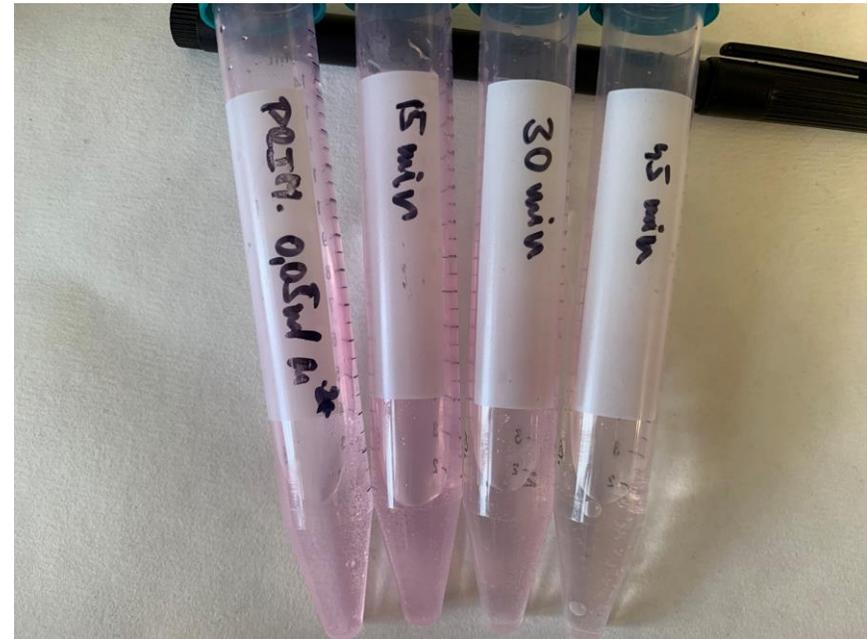
Progress achieved - Task 4.5 (1/2)

- A non-destructive γ -spectrometry technique for interpretation of γ -ray spectra of activated and/or contaminated components is investigated.
- A spectrum is produced by MCNP simulations based on the activities of ETM determined in a sample;
- This spectrum is compared with the experimental one.



Progress achieved - Task 4.5 (2/2)

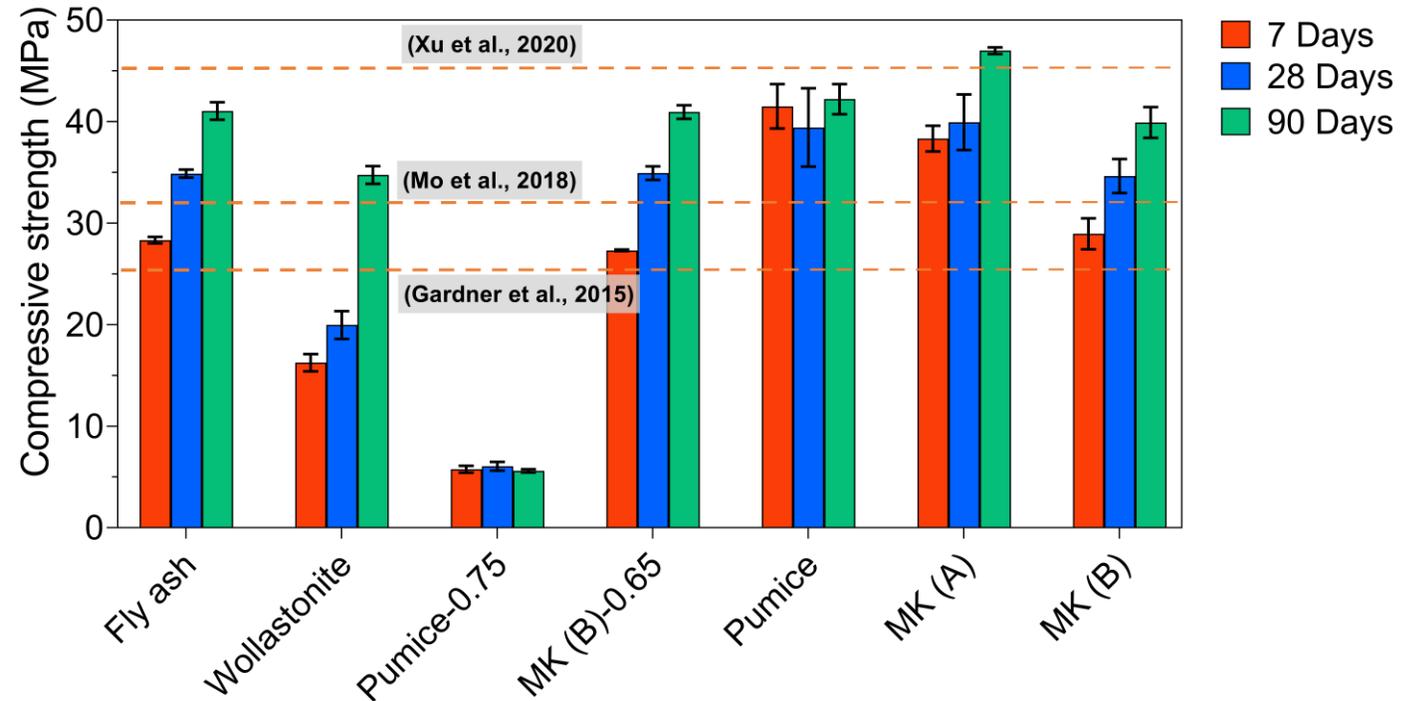
- Development of new radiochemical procedures for DTM radionuclides (electrodeposition).
 - **Parameters setting:**
 - Cathode radius 1 cm, current density 1.25 A/cm²
 - **Experiment:**
 1. Addition of 4 ml of 0.1M Ni²⁺ solution and 38 ml of 30 g.L⁻¹ H₃BO₃ into the electrodeposition cell
 2. Electrodeposition whilst sampling the solution into an extraction tube in 15 minute intervals
 3. Nickel extraction
 4. Spectrophotometric determination



Samples after the process of electrodeposition

Progress achieved - Task 4.6 (1/1)

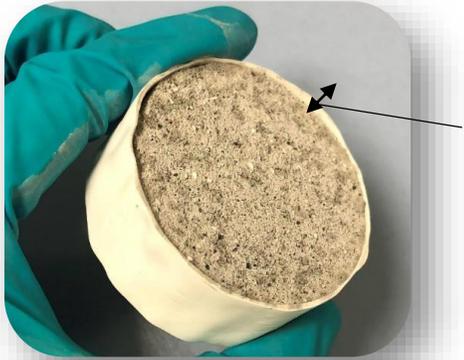
- Development of magnesium phosphate cement formulations.



$H_2O/(MgO+KH_2PO_4)$ mass	0.51	0.51	0.75	0.65	0.51	0.51	0.51
Filler/(MgO+KH ₂ PO ₄) mass	1	1	1	1	0.40	0.40	0.40

Progress achieved - Task 4.6 (2/2)

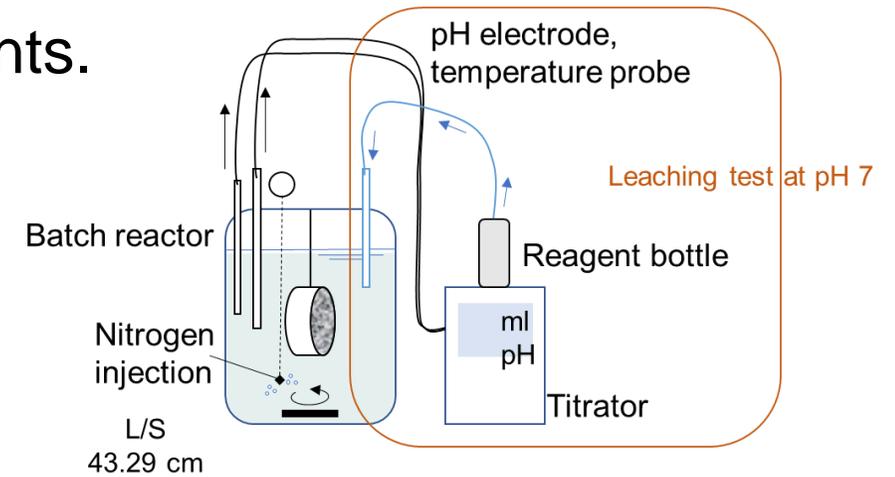
- Leaching behavior of magnesium phosphate cements.



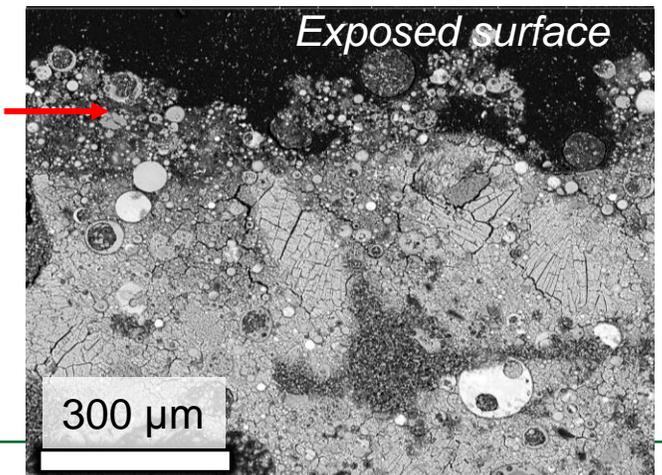
Interface retreat ($\Delta_{\text{thickness}}$):

at 28 days: $-0.55 \text{ mm} \pm 0.15 \text{ mm}$
 at 90 days: $-1.32 \text{ mm} \pm 0.16 \text{ mm}$
 at 210 days: $-2.08 \text{ mm} \pm 0.17 \text{ mm}$

The longer the time of leaching, the higher the interface retreat and thus, the loss of material (surface erosion)



Residual layer
 (0 – 200 μm)



Students involvement and dissemination

- 11 PhD
- 3 MSc

- **Dissemination**
 - 5 peer reviewed articles published
 - 15 talks and posters (RadChem 2022 ; NUWCEM 2022 ; ICEM 2023 ; etc.)