safe solutions for radioactive waste
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Pre-disposal management of radioactive waste

Treatment and conditioning of the Radioactive Solid Organic Waste within the PREDIS project

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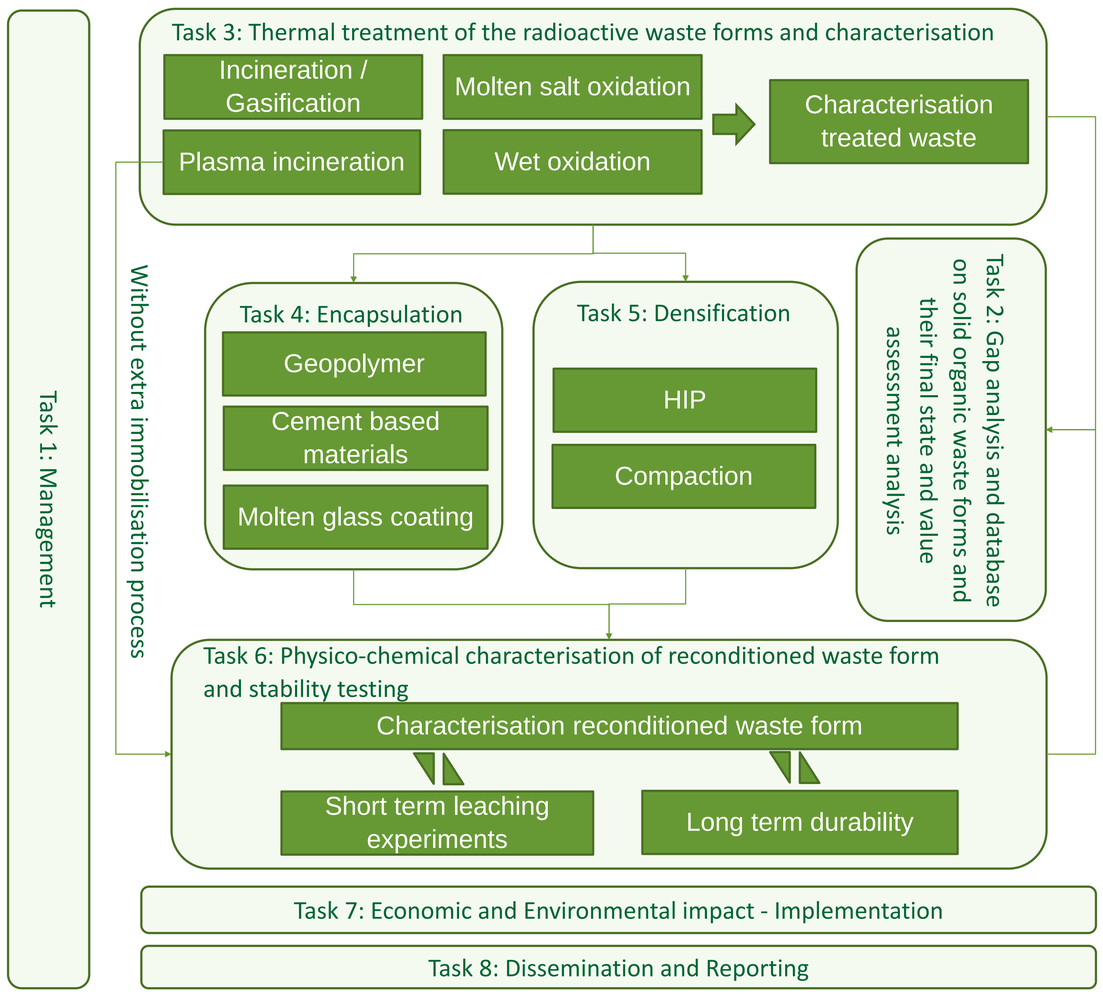
Within the PREDIS project, WP6 addresses innovation in solid organic waste treatment and conditioning by promoting the thermal treatment to transform unstable and/or reactive RSOW into more stable, inorganic end products which would be easier to handle and more compatible with current long-term waste management routes.

Context

The gap analysis performed during the first year of the project confirmed that operational wastes (resins, mixed of plastics and cellulosic wastes), already conditioned wastes (cemented or bituminized wastes) are the most challenging waste streams to manage for the radioactive wastes management organization.

Five thermal treatment routes are considered within the WP6 leading to the production of treated wastes that required an immobilization using geopolymer or cement based materials matrices, or to the production of glassy / ceramics materials without further treatment. Once under their final state, the stability and durability of the reconditioned wastes are evaluate under 'generic' conditions in order to provide relevant characteristics which will allow the end users to draw conclusions according the WAC at their national level.



Objectives

- Close the cycle for treatment of RSOW
- Demonstrate robustness of full treatment cycle for selected RSOW waste streams
- Assess the full treatment cycle in terms of technology and economical assessment, achieved volume reduction factor, final conditioned matrix performance and related WAC for different primary waste stream physico-chemical characteristics

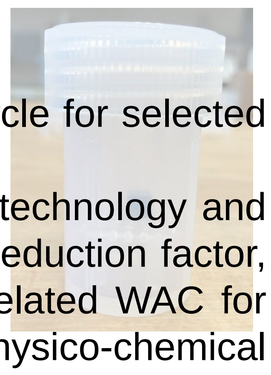
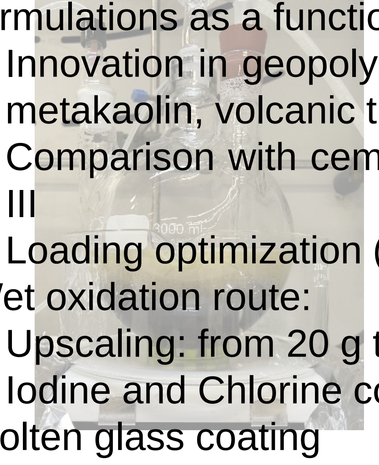


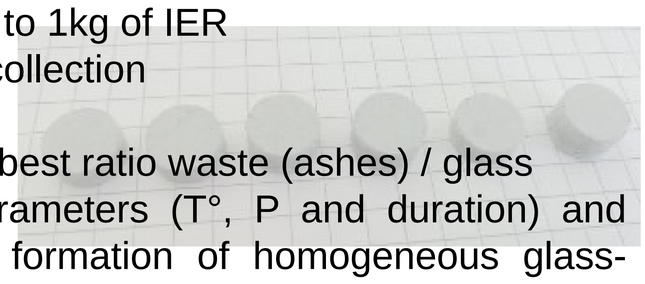
Table 1. *Level technology and Ambition after 4 years of project*

Technology (2019)	Ambition
Molten Salt Oxidation used for the treatment of Radioactive Liquid Organic Waste	Transposition of the technology to the treatment of RSOW (IER). Trials with inactive IER and conditioning of the salt using goepolymer or cement based materials. **TRL from 4 to 6**
Wet Oxidation Route used for the destruction of dissolved organic contaminants	Development and optimization of the process for the destruction of IER leading to the complete recovery of the ^{14}C and associated radionuclide inventory into iron sludge. The sludge will be thermal treated for a complete immobilisation (task 5). **TRL from 2 to 3 - 4**.
Goepolymer immobilisation	Determination of the best geopolymer formulation for a safe and long term immobilisation of treated wastes after thermal treatment (e.g. ashes, salt). **TRL from 2 - 3 to 5**
Cement based materials immobilisation	Determination of the best cement based materials formulation for a safe and long term immobilisation of treated wastes after thermal treatment (e.g. ashes, salt). **TRL from 3 to 5**
New technique: Molten glass coating	Feasibility demonstration of the glass coating for the immobilisation of ashes after incineration of IER at the lab scale. **TRL from 1 to 4.**
HIP technology	Increase the technology level using radiotracers or radioactive samples. **TRL from 2 to 4**
Compaction assisted by thermal treatment	Feasibility demonstration of densification of ashes coming from incineration process by compaction, eventually with adjuvants and temperature. **TRL from 1 to 3 - 4**

Development and optimization of the processes, among others:

- Encapsulation: determination of the most appropriate matrix formulations as a function of the treated waste properties
  - Innovation in geopolymer formulation: blast furnace slag, metakaolin, volcanic tuff, solid activators,...
  - Comparison with cement based materials: CEM I – CEM III
  - Loading optimization (25% of MSO, 10%-20% of ashes)
- Wet oxidation route:
  - Upscaling: from 20 g to 1kg of IER
  - Iodine and Chlorine collection
- Molten glass coating
  - Determination of the best ratio waste (ashes) / glass
- Adjustment of HIP parameters (T°, P and duration) and additive need for the formation of homogeneous glass-crystalline product
- ...





Conclusions

- **Progress was made in the management of problematic Radioactive Solid Organic Waste thanks to the thermal treatments allowing to change their chemical composition and physical properties incompatible with the current Waste Acceptance Criteria.**
- **The durability and stability of reconditioned wastes are investigated under 'generic' conditions representative of a waste repository.**
- **An Economic and Environmental impact evaluation will enable to propose the most suitable and appropriate solution for the management of the RSOW**

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