PREDIS

WP4 Gap Analysis Outcomes

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BERND GRAMBOW

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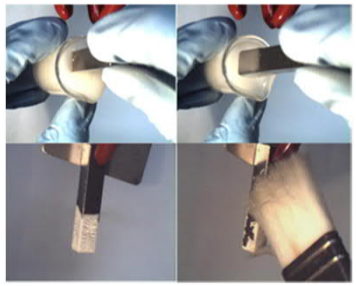
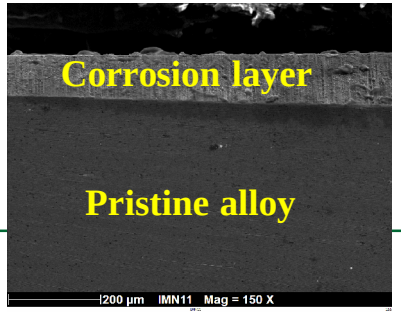
Overview of WP4 Objectives



- Develop innovative conditioning matrices for reactive metallic wastes.
- 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.



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WP4 Implementation of Gap Analysis Outcomes

WP	Task	Identified Issue	Original Handling	Revised Handling	Justification	PM/budget change need?	Partner Work/effort explanations, and relevant PM effort if changes expected
	indicate relevant task	*from gap analaysis as "not in-scope, but could be"*	*indicate how this issue was addressed in original workplans, if at all*	*indicate how this issue will be handled going forward, if at all*	*indicate the justification for the revised handling*	*(yes, no). If yes, euro or effort (person-months) from Party A to Party B.*	
4	4.4	LCA for decontamination of metallic waste.	The issue was roughly addressed.	The required data have been collected and transmitted.	The LCA will help very much into selection of decontamination processes.	No	The work has been included in an ongoing a PhD work without extra charge.

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4	4.5	Reduction of uncertainties in neutron activation calculations.	need of end users	Validation exercises will be added and performed in conjunction with the already the already planned in situ gamma spectrometry measurements.	Optimization of metallic waste characterization	No	Such work can be performed without extra budget as an extension of the MCNPX simulations.

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4	4.6	Waste loading in conditioning matrices for metallic wastes.	The issue was roughly addressed.	Use of data from WMO where possible (ENRESA, ANDRA,….).	Waste loading is important to preserve the integrity of the waste form under disposal conditions.	No	The work does not need any extra budget. We will use available documentation.

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Conclusions

- WP4 gap analysis:
  - Only a few issues identified in tasks 4.4-4.6
  - Plans are established for handling the issues
    - Documents analysis
    - Data collection
    - Report preparation.....
  - No budget/PM change needed

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WP5 Gap Analysis

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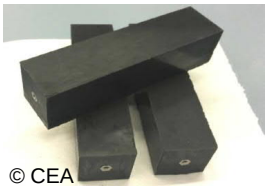
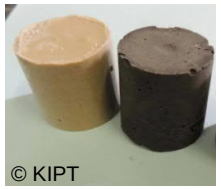
Reminder of WP5 identity





- Implementing **geopolymers** and related **alkali-activated materials** as **mineral binders**, i.e. **direct conditioning solutions for RLOW**.
- Fulfilling **technical and economic** requirements related to Radioactive Liquid Organic Wastes (RLOW):
  - robustness regarding **waste variability**,
  - easiness of **implementation** and **operation** (*e.g.*, mobile units),
  - capacity ranging from **small to large volumes** and limitation of secondary waste,
  - reduction of **disposal costs** by minimization of volumes (pre-treatment and waste loading).
- Leading to final wasteform showing **properties and performances compatible with safety and technical requirements** related to **disposal** but also prolonged **storage** and **transport**.

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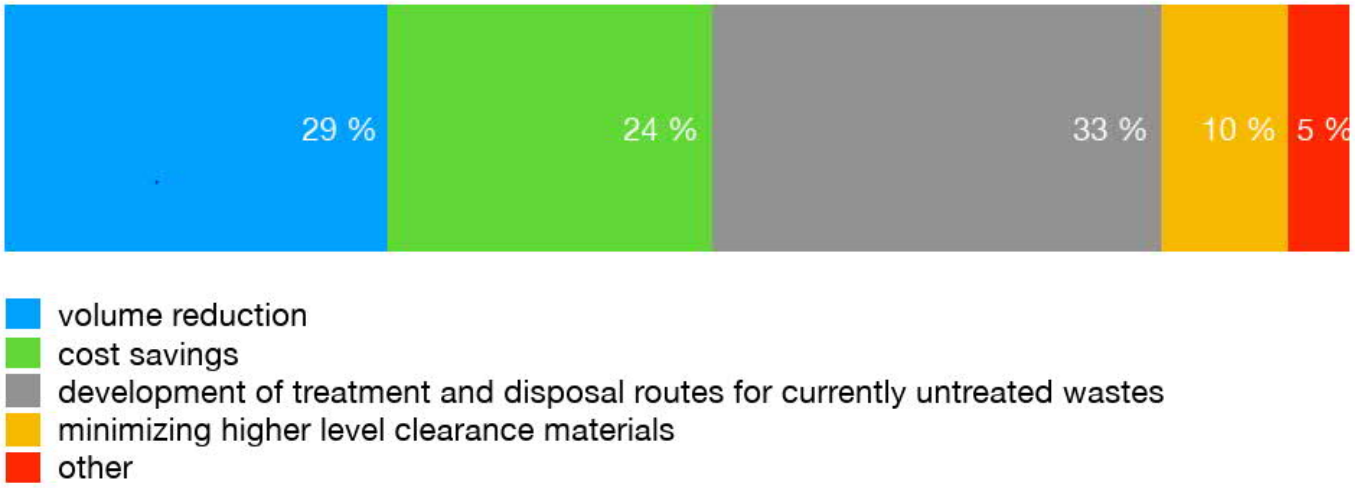
Interests of Stakeholders in RLOW direct conditioning



From PREDIS Gap Analysis Deliverable (D2.2)

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Challenges according to Stakeholders (in brief)

Challenge	Topic of interest	In WP5?
Innovation	Development of matrices for **non-incinerable (without route)** RLOW	T5.3
Optimization	**Improved formulations** in terms of **waste loading**, toxics and surfactant content, workability, physico-chemical properties	T5.3
Stockability	**Wasteform durability** and suitability of properties with WAC	T5.4
Effectiveness	- **Cost effectiveness** - Comparison to **other conditioning routes** (cement and NOCHAR) - **Security of supply** of raw materials	T5.3 T5.5

- Other topics mentioned but **out of scope of WP5**
  - **Alternative treatments routes** (different from direct conditioning): incineration and separation technics to remove problematic chemicals.
  - **Other waste** (different from RLOW): resins (WP6), sludge, reactive metals, biological waste…

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Our keywords to fill the gaps!

- **Credibility**:
  - management of RLOW **without treatment solution** (non-incinerable),
  - demonstration of the ability to reach **high waste loadings**,
  - comparison to existing alternatives: cement and NOCHAR polymers.
- **Versatility**:
  - demonstration of the ability to treat a **wide variability** of RLOW,
  - processability for **various volumes** of waste.
- **Sustainability**:
  - **security of supply**: local raw materials and raw materials from recycling,
  - **disposability of geopolymers** and **compliance with WAC**.

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WP6 Gap Analysis Outcomes

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This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Reminder of WP6 identity

- Scope:

  Proposes solutions and alternatives for the treatment of ‘problematic’ **Radioactive Solid Organic Waste** streams using thermal treatment (i.e. Ion exchange resins, cemented / polymerised / bituminised wastes…)

- Objectives:
  - Perform a **gap analysis** during the first project year (e.g. to assess the technology readiness and gaps).
  - **Demonstrate the reliability** of alkaline binders for conditioning of residues and secondary wastes stemming from treatment of RSOW. The alkaline binders include both (common) cementitious materials and (novel) materials like geopolymers.
  - **Determine and compare the matrix performance** of final wastes forms

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Implementation of Gap Analysis Outcomes (1)

Identified Topic/Issue *from gap analysis as "not in-scope, but could be"*	Task *indicate relevant task*	Original Handling *indicate how this issue was addressed in original workplans, if at all*	Revised Handling *indicate how this issue will be handled going forward, if at all*	Justification *indicate the justification for the revised handling*	PM/budget change need? *yes or no. If yes, indicate euro or effort (person-months) change from Party A to Party B.*
1. Establish a limiting basis for organic material content in waste packages as part of waste acceptance criteria. Treatment schemes under development in WP6 should lead to complete decomposition of organic material; product residues could be analysed for organic compounds	6.6	Not originally considered at the level of detail specified.	No revisions	The treatment schemes under development in WP6 are not at similar levels of maturity to be able to establish a universal limiting basis for organic content; in some cases, the organic content can't be determined.	No

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Implementation of Gap Analysis Outcomes (2)

Identified Topic/Issue *from gap analysis as "not in-scope, but could be"*	Task *indicate relevant task*	Original Handling *indicate how this issue was addressed in original workplans, if at all*	Revised Handling *indicate how this issue will be handled going forward, if at all*	Justification *indicate the justification for the revised handling*	PM/budget change need? *yes or no. If yes, indicate euro or effort (person-months) change from Party A to Party B.*
2. Pyrolysis (in-drum) of bituminised waste. It is uncertain whether the processes being tested in PREDIS would be suitable for processing bituminized waste. However, WP6 could look to analyse existing samples of plasma glass from treated bitumen waste.	6.3	Pyrolysis (or any treatment) of bituminized waste was not originally included in the scope of WP6.	No revisions	Resources needed to thermally treat bituminzed wastes will not be available to WP6. Moreover, no previously thermally treated samples of bituminized wastes have been identified for further testing/analysis.	No

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Implementation of Gap Analysis Outcomes (3)

Identified Topic/Issue *from gap analysis as "not in-scope, but could be"*	Task *indicate relevant task*	Original Handling *indicate how this issue was addressed in original workplans, if at all*	Revised Handling *indicate how this issue will be handled going forward, if at all*	Justification *indicate the justification for the revised handling*	PM/budget change need? *yes or no. If yes, indicate euro or effort (person-months) change from Party A to Party B.*
3. Harmonisation of treatment and conditioning methods with waste acceptance criteria. To the extent that WAC are available, they are generally not (exactly) the same from one country to another; outcomes of WP6 regarding waste form performance could be compared to various WAC by consortium partners in their national context.	6.7	Not originally considered.	No revisions	Screening of waste forms produced from the schemes tested in WP6 against WAC employed by consortium partners was not orginally included in the scope of the WP6 and would likely be premature relative to process maturity levels. The durability and stability of the produced waste forms will be determined, and the resulting data can be used for preliminary screening assessments potentially in WP2T3 or advocated for such through promotion to the SRA.	No

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Other

- Specific to WP6, the gap analysis was initiated and based on the outcomes of the **THERAMIN** project (2016-2020), where the benefit of the thermal treatment on the volume reduction and the destruction of the organic compounds was proved.

Thank you

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WP 7 Gap Analysis Outcomes

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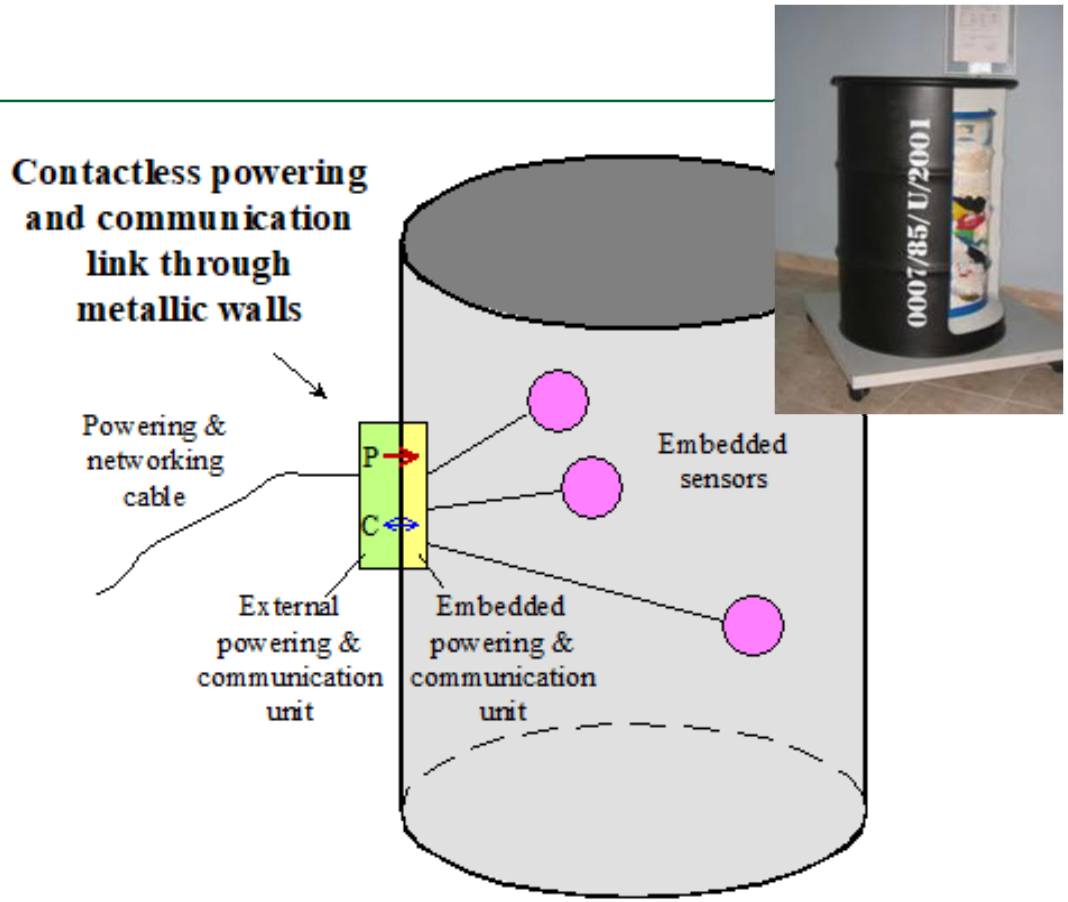
This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

WP7 Innovations in cemented waste handling and pre-disposal storage

- **Objectives**

- State of the art of current methods and procedures for cemented waste management with specific focus on monitoring/long-term storage
- Identify, evaluate and demonstrate store and package quality assurance (mainly NDE) and monitoring technologies
- Adapt and demonstrate digital twin technology
- Develop and demonstrate methods for data handling
- Develop and demonstrate a digital decision framework
- Identify opportunities for process automation, reducing human exposure to radiation
- Identify options for post treatment of packages and potential approaches to improve package design, construction and maintenance.



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WP7 Implementation of Gap Analysis Outcomes

Identified Topic/Issue	Task	Original Handling	Revised Handling	Justification	PM/budget change need?
from gap analysis as "not in-scope, but could be"	*indicate relevant task*	*indicate how this issue was addressed in original workplans, if at all*	*indicate how this issue will be handled going forward, if at all*	*indicate the justification for the revised handling*	*yes or no. If yes, indicate euro or effort (person-months) change from Party A to Party B.*
1. **Monitoring of pH and aging effects.**	7.2, 7.3	Implementation of an embedded or surface-applied fiber optic sensing system and wired, wireless, and passive radio frequency identification (RFID)-based sensors embedded into waste packages to detect acoustic emissions, which are	An updated concept for RFID sensors to include monitoring of pH and aging effects (i.e., cracking, etc.) will be produced by M24.	The revised handling addresses the identified gap topic/issue earlier than previously scheduled and allowing for earlier feasibility assessments.	no

Complete table available in PREDIS Milestone 17

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WP7 Implementation of Gap Analysis Outcomes I

Monitoring of various (additional) parameters, such as (examples only!)

- pH, pressure, aging effects
- compressive strength, hardness
- leachability
- microbiology

Handling

Integration: update monitoring concepts of RFID sensors

Information: commercial systems available, include in reporting

Assessment: detailed analysis → include or forward to SRA

Forward to SRA (relevant but out-of-scope)

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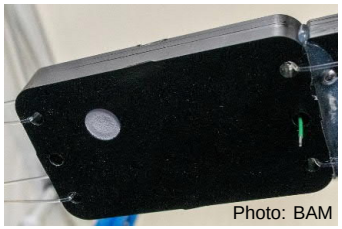
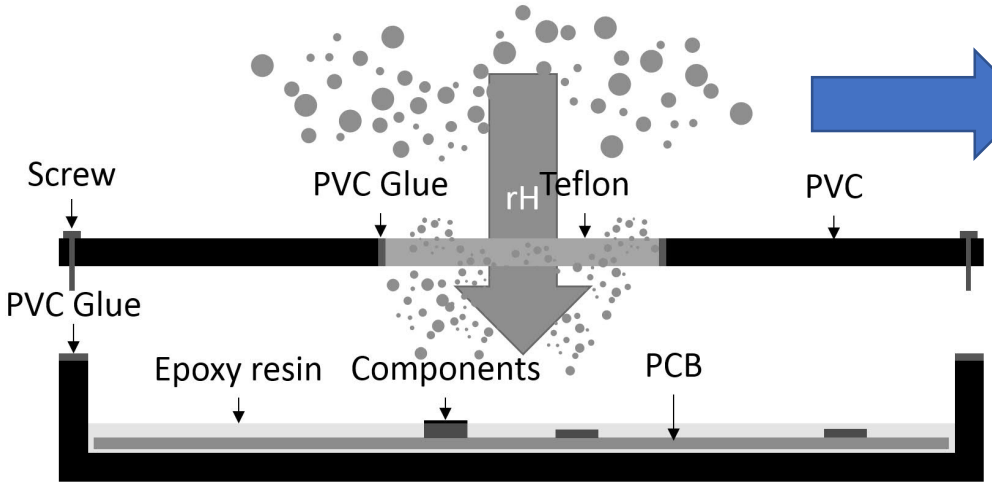
WP7 Innovations in cemented waste handling and pre-disposal storage

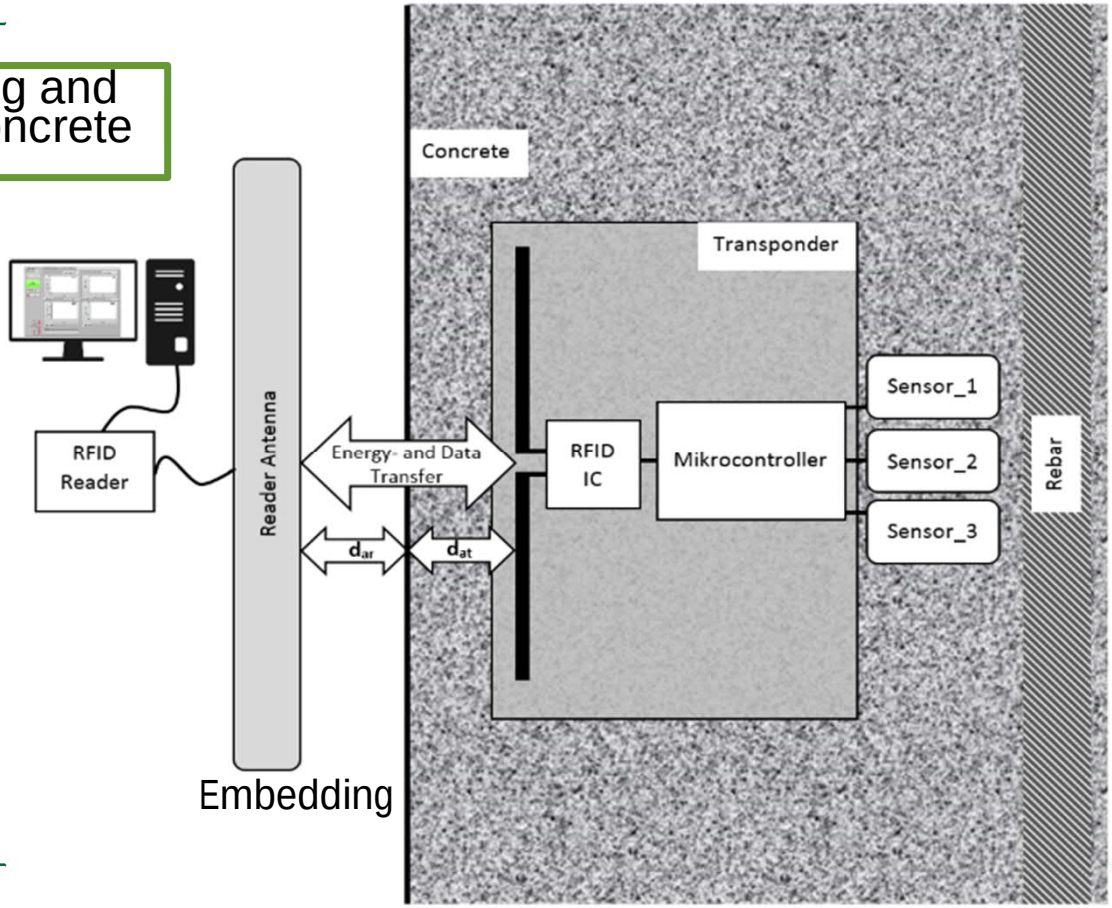
RFID: Embedded monitoring of waste canisters Technology concept



contactless powering and communication in concrete

Encapsulation





Embedding

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WP7 Implementation of Gap Analysis Outcomes II

Investigate **heterogeneous waste** inside cemented packages

- Non-destructive testing (NDT)
- Physical sampling

Handling

Integrated: e.g muon imaging

Integrated: mockups with different embedded waste types

out-of-scope
(forward to SRA)

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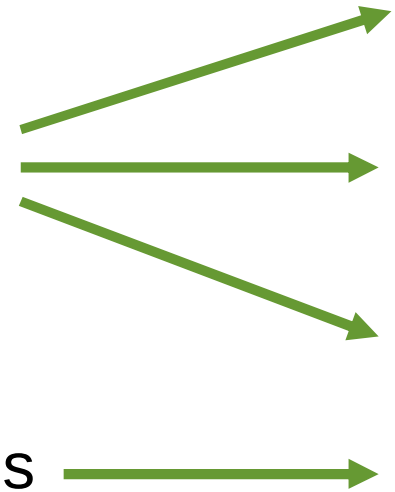
WP7 Implementation of Gap Analysis Outcomes III

NDT for **physico-chemical properties**, imaging, characterization

- Set of phyico-chem. properties
- Information on issues of chemical reactions



Handling

- Integrated: NDT monitoring concepts
- Integrated: mockups with different embedded waste types
- Integrated: digital twin simulation for long-term stability predictions
- Information, potential inclusion (SoTA analysis)

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Conclusions

- WP7 gap analysis:
  - Several issues identified in tasks 7.2-7.5
  - Clear plan for handling
    - Already integrated
    - Will be integrated (concept updates)
    - Provide information (reporting)
    - out-of-scope
    - Forward to SRA
  - No budget/PM change needed

Thank you for your attention!

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