Objectives and first achievements of PREDIS WP5

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PREDIS **WP5 Objectives**

- Study of **innovative geopolymers** and their **interactions with RLOW**.
- Development of **direct conditioning solutions** for RLOW from **TRL3 to TRL6** including **validation tests** (real waste) and feasibility **scale-up** tests.
- **Optimization** of geopolymers and formulations for RLOW encapsulation, especially **waste loading** and **matrix performance**.
- Process **robustness** regarding waste, raw materials and process variability including study of the **stability** and **durability** of the final waste form.
- **Disposability assessment** related to Waste Acceptance Criteria and scientific approaches for deeper physico-chemical understanding.

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PREDIS **WP5 Relevance**

- **Societal issue.** Contribution to a **sustainable management of radioactive waste**, limiting the burden to future generations.
- **Environmental and nuclear safety issues.** Long-time storage of large volumes of RLOW awaiting treatment raises questions about nuclear safety and their potential environmental impact (flammability, toxicity, radiolysis…)
- **Technical issues.** Development of **flexible and versatile innovative solutions** that can cover a large part of RLOW without management route.
- **Industrial and economic issues.** Solutions must be acceptable from **technical and economic** points of view for all actors including Waste Management Organisations and RLOW owners.

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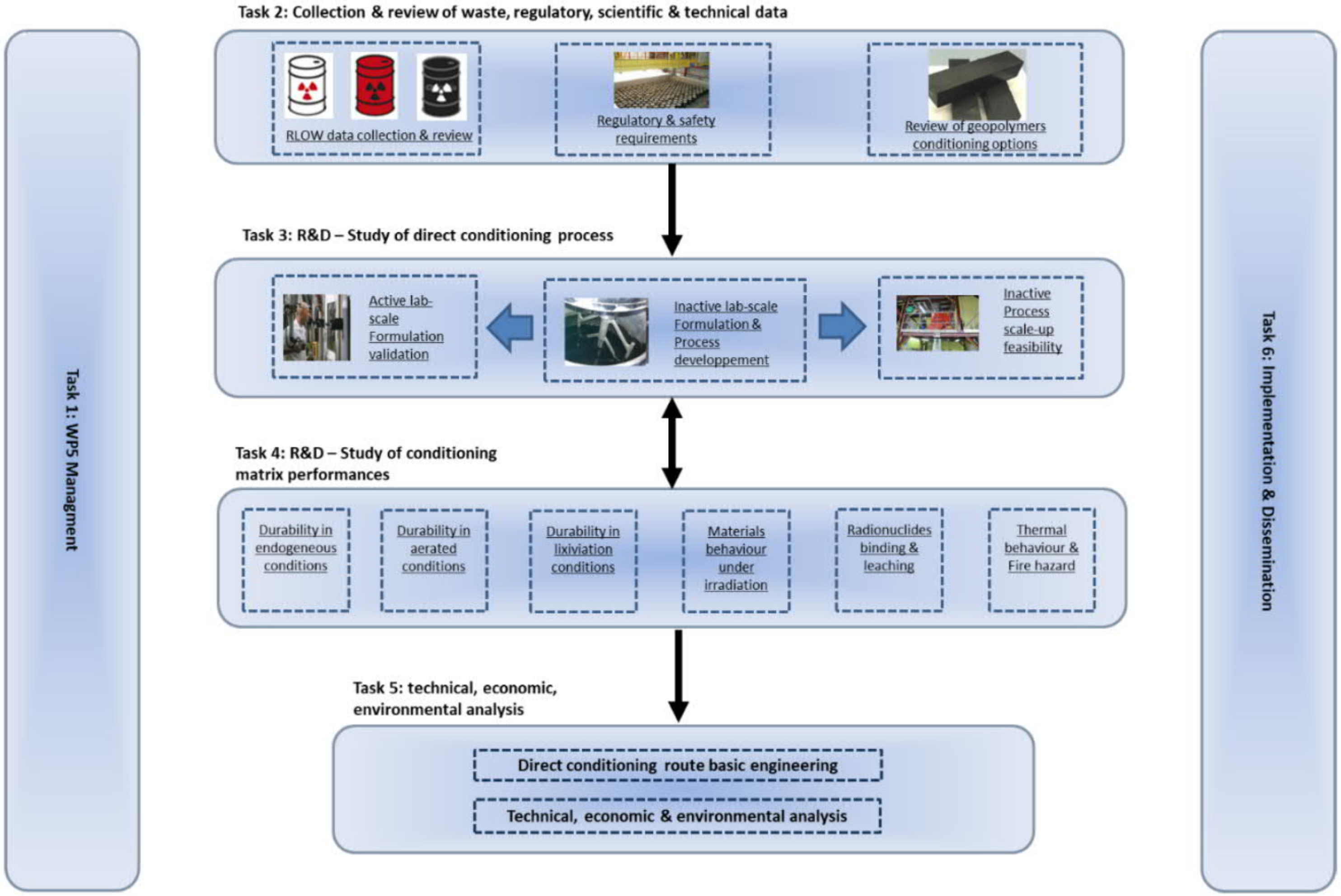
PREDIS **WP5 Partners**

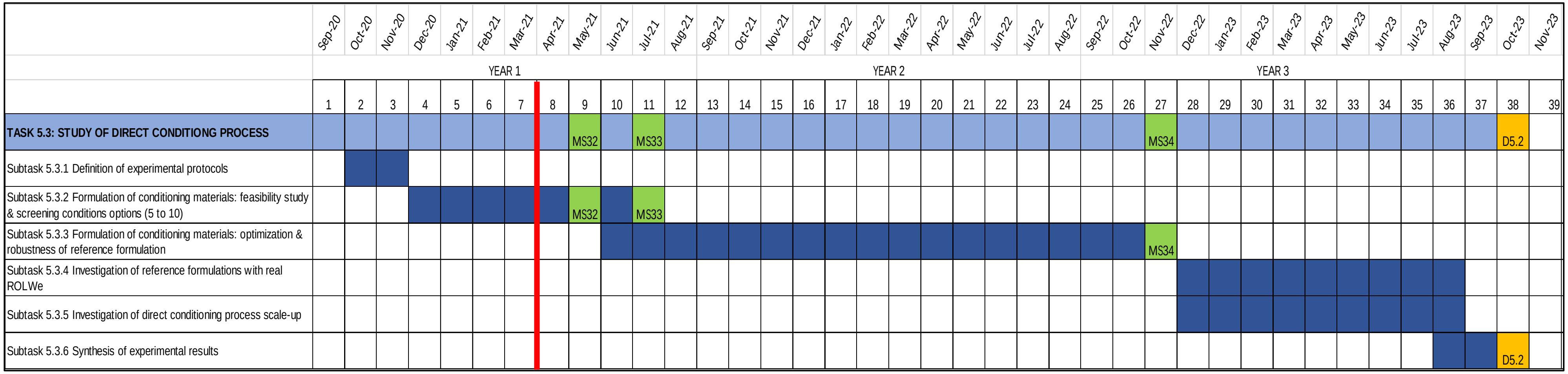
Total effort: 617 Person/Months, among 19 partners

PREDIS **WP5 Structure**



- Task 1 WP5 Management
- Task 2 Collection and review of waste, regulatory, scientific and technical data
- Task 3 Study of direct conditioning process
- Task 4 Study of conditioning matrix performances
- Task 5 Preliminary technical, economic and environmental analysis
- Task 6 Implementation and dissemination

PREDIS **Task 5.3 Study of direct conditioning process**



- **Assess** exploratory conditioning options (5-10) and to select most promising reference formulations (3) to be further studied and developed **(MS32)**
- **Optimize** and assess robustness of selected reference formulations **(MS34)**
- **Further consolidate** reference formulations from tests with real RLOW
- **Investigate** feasibility of scale-up from exploratory pilot scale tests

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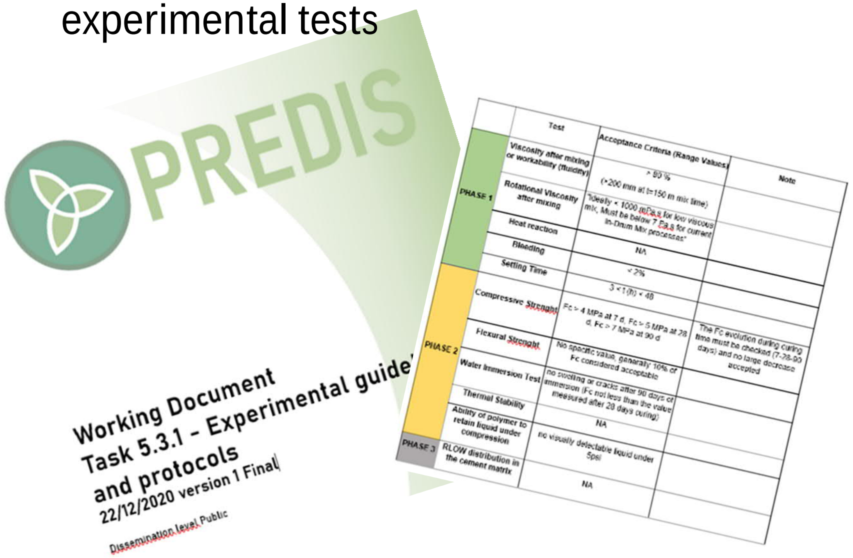
PREDIS **Task 5.3 – First achievements and outcomes**

Sub-task 5.3.1 - Definition of the experimental guidelines and protocols that will be used during the laboratory activities and of some general acceptance criteria range for the experimental tests



Sub-task 5.3.2 – Feasibility study & screening conditions options

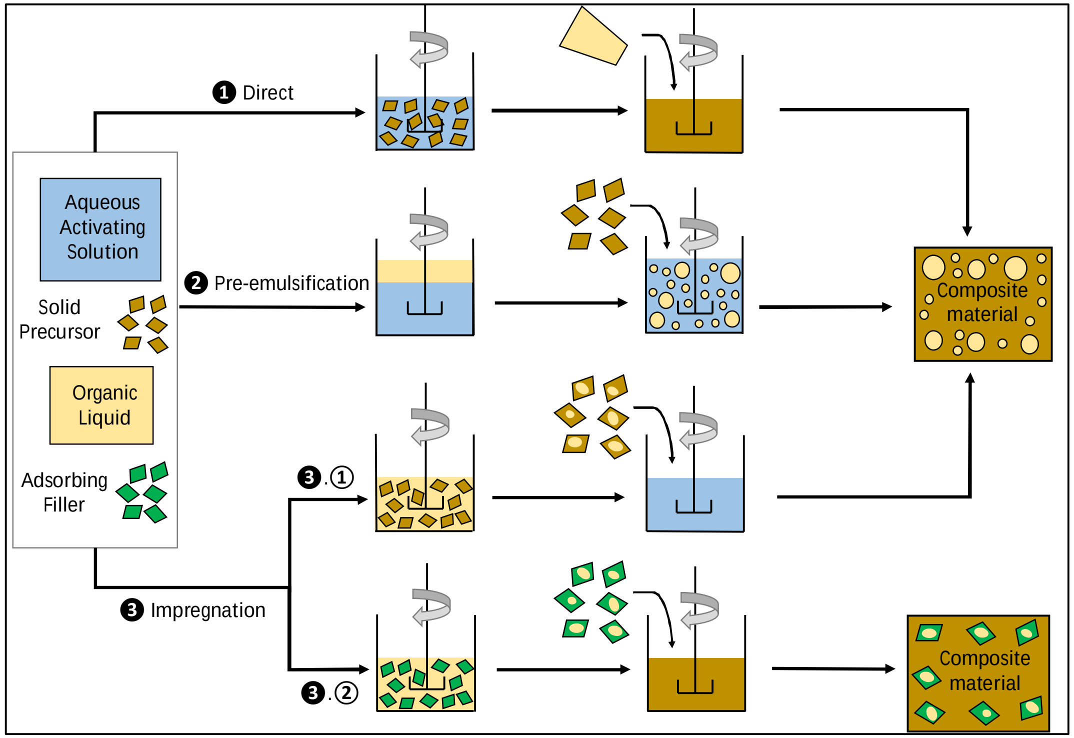
SOGIN – RATEN – CIEMAT – KIPT – NNL/USFD NUC – POLIMI – SCK-CEN

PREDIS **WP5 – Task 4 :** **Study of conditioning matrix performances**

Making the most of the current crisis:
Gap analysis

Three main processing routes for the incorporation of OL into alkali-activated materials have been identified and described in an open access review paper (see reference below).

Nota: Incorporation of OL in Portland cement is only achieved for a few %oil



Published as [Reeb et al. Ceramics International, Gold Open Access, DOI: 10.1016/j.ceramint.2020.11.239, 2021]

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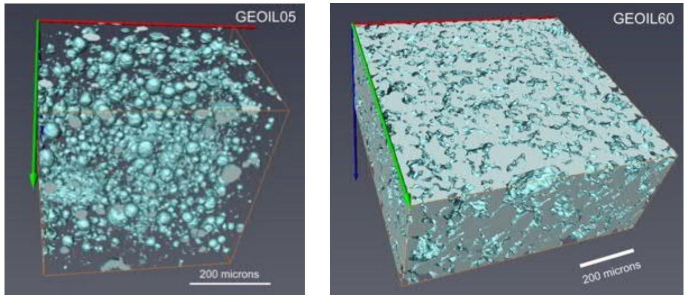
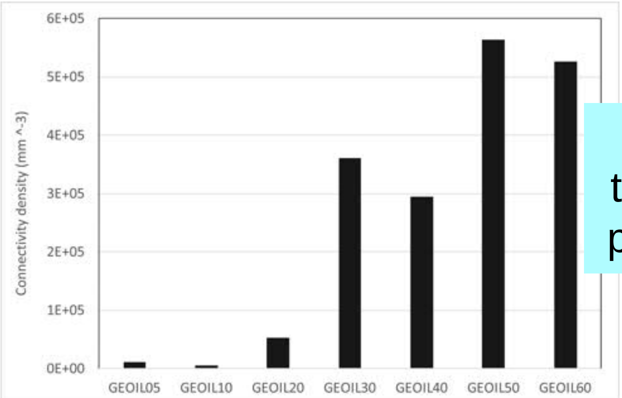
PREDIS **WP5 – Task 4 : Study of conditioning matrix performances**

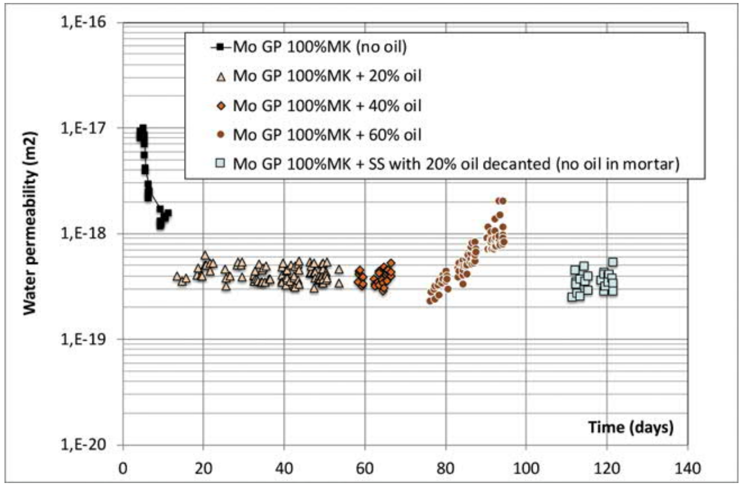
Former research on the structure and durability of OL/geopolymer composites (direct route)



X Ray micro-CT of oil emulsions (5 or 60%vol) in hardened geopolymer



Without surfactants, the hardened OL/geopolymer percolates from 20-30%vol OL



Water permeability of hardened OL/geopolymer mortar is smaller than for mortar alone, and stable with time up to 20%vol oil (no test at 30%)

Published as [Planel et al. Cement and Concrete Research, DOI: 10.1016/j.cemconres.2020.106108, 2020] and [Davy et al. Journal of the American Ceramic Society, DOI: 10.1111/jace.16142, 2018]

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PREDIS **WP5 – Task 4 : Study of conditioning matrix performances**

Structure of Task 4 (i.e. 5.4)

- T5.4.1: Definition of experimental protocols (M8-M9) ← Starting soon with a methodology similar to Task 5.3.1
  Contributors: ECL, USFD, CEA, NNL, SIIEG, CIEMAT, ENEA, CVRez, SCK•CEN, IRSN, IMTA, UJV, POLIMI, UNIPI
- T5.4.2: Durability in endogeneous conditions (M10-M45)
  Contributors: ECL/CEA, CIEMAT, SIIEG, CVRez, SCK•CEN/IRSN, ENEA
- T5.4.3: Durability in aerated conditions (M10-M45)
  Contributors: ECL/CEA, CIEMAT, SIIEG, CVRez, SCK•CEN/IRSN, ENEA
- T5.4.4: Durability in leaching (acid and alkaline) conditions (M10-M45)
  Contributors: ECL/CEA, CIEMAT, SIIEG, CVRez, SCK•CEN/IRSN, ENEA
- T5.4.5: Materials behaviour under irradiation (M10-M38)
  Contributors: IMTA
- T5.4.6: Radionuclides binding & leaching (M10-M38)
  Contributors: UJV, POLIMI/NUC
- T5.4.7: Thermal behaviour and « fire hazard » (M10-M38)
  Contributors: UNIPI
- T5.4.8 – Synthesis of experimental results (M39-M41)
  Contributors: ECL and USFD WITH CEA, NNL, SIIEG, CIEMAT, ENEA, CVRez, SCK•CEN, IRSN, IMTA, UJV, POLIMI, UNIPI
- T5.4.9: Disposability assessment (M39-M44)
  Contributors: GSL, SOGIN

We will also take advantage of RILEM committee reports on durability assessment of AAM and John Provis input

(T5.4.2 – T5.4.7) ← Main scientific tasks starting M10 (June 2021)

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Thank you for your attention !

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