CORI

RESEARCH ON CEMENT-ORGANICS-RADIONUCLIDES-INTERACTIONS WITHIN THE COLLABORATIVE EURAD PROJECT

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CORI - Main Objectives

- **Improve the knowledge on the organic release issues which can accelerate the radionuclide migration in the the post-closure phase of repositories for ILW and LLW, including surface/shallow disposal.**
- CORI objectives are addressing topics in the context of cement-organic-radionuclide-interactions.
- Organic materials are present in some nuclear waste and as admixtures in cement-based materials and can potentially influence the performance of a geological disposal system.
- Potential effects of organic molecules are related to the formation of complexes in solution with some radionuclides of interest (actinides and lanthanides) which can (i) increase the radionuclide solubility and (ii) decrease radionuclide sorption.
- Cement-based materials will be degraded with time in the context of waste disposal inducing a large range of alkaline pH conditions according to their degradation state.
- Alkaline pH provides specific conditions under which the organics can degrade, thus increasing their potential impact on repository performance.
- Critical open topics and data needs required to better assess and quantify cement-organic-radionuclide-interactions are defining the three R&D oriented CORI Tasks 2, 3, 4:
  - Coordination, SOTA, training material (Task 1)
  - **Organic Degradation (Task 2)**
  - **Organic-Cement-Interactions (Task 3)**
  - **Radionuclide-Organic-Cement-Interactions (Task 4)**

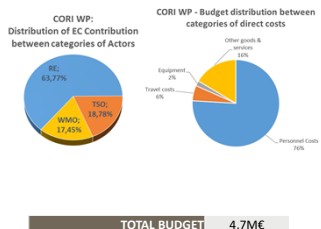
Overarching objectives:

- Support member states to further develop their national RD&D programms and support programms at an early implementation stage.
- Enhance cooperation between the different participating groups and countries.
- Knowledge transfer and training of young researchers in view of future demands for qualified staff is a key aspect of CORI.

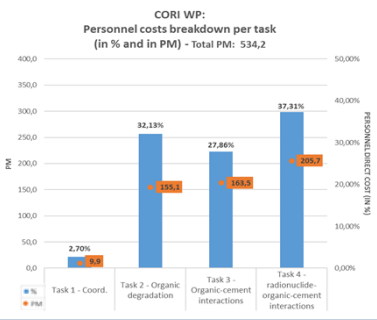
CORI Partner

Organisations
✓**Andra**, France ▪ BRGM, France
✓**CEA**, France
✓**CIEMAT**, Spain ▪ CSIC, Spain
✓**CNRS**, France ▪ UOrléans, France ▪ Subatech, France
✓**CVREZ**, Czech Republic
✓**CPST**, Lithuania
✓**FZJ**, Germany ▪ HZDR, Germany
✓**JSI**, Slovenia

Organisations
✓**KIT**, Germany ▪ Amphos21, Spain ▪ JGU INC, Germany ▪ Upotsdam, Germany
✓**PSI**, Switzerland ▪ EMPA, Switzerland
✓**RATEN**, Romania
✓**SURAO**, Czech Republic ▪ CTU, Czech Republic ▪ UJV, Czech Republic
✓**SCK-CEN**, Belgium
✓**UCY**, Cyprus



TOTAL BUDGET	4,7M€
EC requested contribution	2,3M€



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CORI - Expected Impact

Improved quantification of radionuclide solubility and sorption phenomena in cementitious environments to provide input for improved predictions of radionuclide transport.

Regarding RWM implementation needs. Issues at the repository scale identified:

- Improved scientific basis for the Safety Case for LWL/ILW waste repositories featuring high organic content.
- Co-storage of waste: support decisions on whether or not a mix of various wastes (organics, soluble salts, exothermic waste) can be foreseen.
- Optimization of vault design: limitations of interactions between the vaults regarding their content. CORI will provide information on the organic plume by characterizing the transfer behaviour in cement-based materials.
- Optimization of concrete formulations as regards the potential effect of superplasticizers on radionuclide transfer properties.

Regarding safety

- Characterizing the effect of the organic plume on the behavior of radionuclides in terms of:
- Solubility (limitation of solubility increase).
- Sorption (limitation of retention decrease) in terms of K_d values.
- Retention of potentially ^{14}C-bearing organic molecules (determined in CAST project) in cementitious environments in the case of specific waste.
- Reduction of uncertainties on the current knowledge, which is mainly based on K_d values.
- Improved knowledge on the known organic molecules present in degradation solutions (not considered so far) with their complexing properties: better definition of the organic inventory regarding the waste and the concrete vault (geological and surface repositories).

CORI – R&D Workplan at Task Level

ORGANIC DEGRADATION *(J.Vandenborre, D. Ricard)*

- Improve knowledge on the degradation of organic wastes in conditions representative of disposal facilities.
- Improve understanding of radiolytic/hydrolytic degradation of organic materials.
- Provide characterization and quantification of soluble organic species generated by degradation.
- Degradation studies performed in CORI will focus on two main experimental conditions and include detailed analysis of the degradation products:
  - Radiolytic degradation, Hydrolytic degradation, Characterisation and quantification of soluble organic species, Gas measurements.

ORGANIC-CEMENT-INTERACTIONS *(D. Garcia, P. Henocq)*

- Improve the understanding of the behaviour of anthropogenic organic molecules within cementitious systems.
- Study the sorption and transfer properties of organic molecules that might be released from the organics inventories (including polymers and superplasticizers) present in cement-based materials.
- Investigated organic molecules are (i) main degradation products like ISA, phthalates, etc., (ii) EDTA and low molecular weight molecules, (iii) ^{14}C-bearing molecules identified in CAST, (iv) degradation products resulting from Task 2 (organic degradation).
- Cement. CEM I and CEM V studied at different degradation states (including altered/ or carbonated states), as well as pure solid phases like C-(A)-S-H and AFm-phases/ettringite. One partner will study CEM IV.
- Impact of iron and calcium will be studied to elucidate their potential role as competitors in radionuclides in retention or complexation reactions.

RADIONUCLIDE-ORGANIC-CEMENT-INTERACTIONS *(V. Blin, T. Missana)*

- Improve knowledge on organic-radionuclide complexes mobility in cement-based systems.
- Study competition or synergetic effects in ternary systems (*i.e.* organic/ radionuclide/ cement).
- Provide a mechanistic understanding of radionuclide interactions and quantitative transfer data in cementitious environments.
- Experimental work is combining batch sorption, diffusion, column, speciation, solubility and advanced spectroscopic studies to allow fundamental model development and application-oriented analyses.
- The main radionuclides studied are: Nickel, Uranium, Actinides(III/IV) and/or homologues.
- Organic and cementitious materials investigated are consistent with those studied in Task 2 and Task 3 of CORI and includes Fe and Ca competition.