Impact of the PREDIS project in relation of use of geopolymers for the immobilization of organic radioactive waste

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

The Hungarian context

- Formerly considered methods for solidification of ion exchangers and sludge, currently stored in a semi-liquid form in PAKS NPP, were based on cement.
- In recent years, immobilization and/or encapsulation of radioactive waste in a geopolymer matrix has gained global interest as an alternative to standard Portland cement blends.
- PREDIS activities on geopolymer application has further increased our interest in considering this matrix in the future..
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The Hungarian actors involved 1.

- ***Waste generator (NPP)***
  - ✓ The decision on the selection of the conditioning method is up to the waste generator.
  - ✓ Ensure that any waste form (geopolymer), aligns with relevant disposal WAC.

- ***Disposal facility operator (PURAM)***
  - ✓ Establish WAC.
  - ✓ Ensure that (geopolymer) waste form, aligns with relevant disposal WAC, a series of tests are necessary.
    - ✓ These tests establish the durability performance of the waste form over extended time periods, in conditions that simulate representative disposal conditions.
  - ✓ Verify the matrix/package performance according to a set of WAC.

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The Hungarian actors involved 2.

- ***Regulator***
  - ✓ Before regulatory approval of WAC, PURAM has to demonstrate the composite stability under disposal conditions.

- ***TSO***
  - ✓ PURAM rely on the R+D capabilities of specialized institutions.
  - ✓ In PREDIS project Isotoptech Ltd. was the leading company on the subject of state of the art methods for waste form characterisation.
  - ✓ Isotoptech Ltd. is ready to continue both within EURAD-2 or IAEA CRP.
    - ✓ The IAEA has recently proposed CRP which aims to benchmark established cementitious protocols against emerging procedures developed for geopolymer matrix testing.
    - ✓ The goal is to facilitate the establishment of future waste form testing protocols for using geopolymers as matrices for immobilizing radioactive waste.

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Envisaged investigation programme

studies	method
Choosing the samples with appropriate physical and structural properties	NMR relaxometry and microscopic measurements
Measuring the transversal relaxation time of water confined in the pore structure of the hardened geopolymers	taking microscopic images of the samples
Study of the geo-polimerization process for the chosen geopolymers	NMR relaxometry
Leaching studies – Analysis of the leached phases including pH-, conductivity measurement and determination of the leached model ion contents (e.g. Cs-, Ni-, Nb, Nd-, Re-, I-ions) – Analysis of the leached organic molecules	ICP-MS high- field NMR
– Determination of the self- diffusion coefficient of water in the geopolymer samples – Examination of the permeability between the water types in the samples. – Study of the structural changes of the geopolymers during the leaching process	NMR diffusometry NMR relaxometry

studies	method
– Determination of the effective diffusion coefficient, the leaching kinetics and leaching rate of the model ions – Determination of the bound and bulk 133-Cs content of the geopolymers	elemental analysis NMR measurements
Structural characterization Study of the interaction with water Characterisation of the pore structure and water types in the hardened geopolymers	 – low- field NMR relaxometry – microscopic images of the solidified samples
– Evaluation of the effect of additives – Study of the hardening process of the geopolymers (geo-polymerisation) Determination of the pore sizes in the hardened binders	NMR relaxometry NMR cryoporometry and relaxometry
Long-range study of the structure of geopolymer	in situ in the radioactive waste disposal repository

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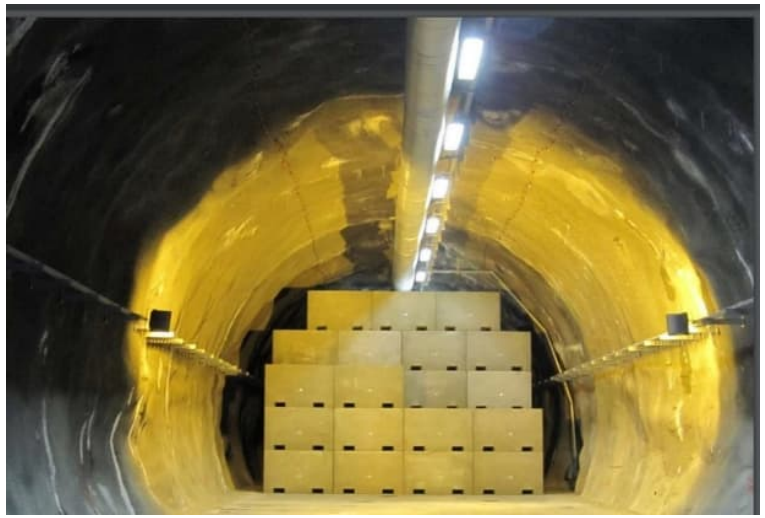
Congratulations to all PREDIS actors for the successful implementation of the project and helping the disposal society.



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