ALTERNATIVE CONDITIONING MATERIALS FOR DISPOSAL OF DECOMMISSIONING RADIOACTIVE WASTE PROJECT (ALMARA)

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INTRODUCTION

The goal of the ALMARA project is the optimization of infill matrixes for disposal of intermediate and high-level wastes from nuclear power plant decommissioning, which fulfil requirements that ensure long term safety of deep geological repository over long term period.
The project is also focused on radionuclide interaction and migration with/in the matrix materials and corrosion and microbiological studies.
Finally, technological application will be evaluated for studied infill matrixes.

PROJECT EXPERIMENTAL PLAN AND TESTS

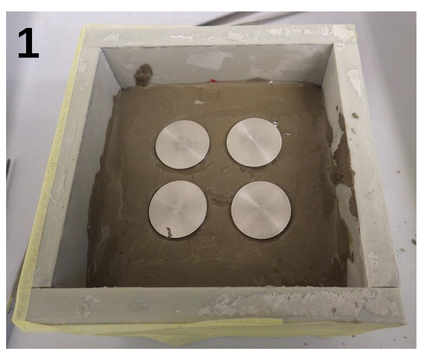
Four different infill matrixes were designed at the beginning of the project. Experimental program started by developing of infill matrixes composition and verifying the pro-posed properties (workability, mechanical and structural stability, compressive strength).

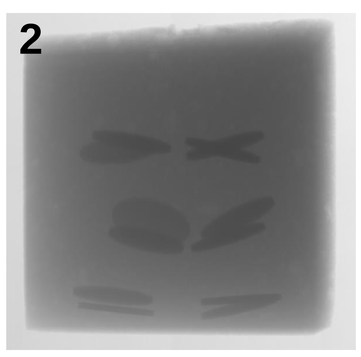
- **CEM** – ordinary Portland cement matrix; cement paste type CEM I 42,5 R, using W/C ratio 0.35.
- **AFM** – alternative filling matrix, which is based on cement and bentonite; mixture of cement type CEM I and Ca/Mg bentonite (ratio 80/20 wt.%) with addition of commercial SIKA plasticizer and W/C ratio 0.45.
- **NNM** – new nano-based matrix, which is based on cement and nanomaterial; cement type CEM I with addition (1 wt.%) of iron nano-powder (NANOFER STAR), using W/C ratio 0.35.
- **GP** – geopolymer matrix; based on composite aluminosilicate and alkaline activator, detailed composition is confidential.

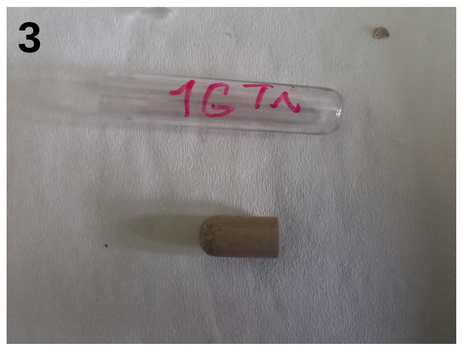
The degradation of mechanical and chemical properties of matrix materials are studied after defined periods of time (up to 3 years). The chemical composition, mineralogy, structural and mechanical properties and microbial activity are tested. Interaction and migration of radionuclides on degraded materials are characterised by sorption and diffusion experiments and compared to properties of unaffected matrix materials.

Experiments studying corrosion processes on stainless and carbon steel (representative materials of NPP decommissioning) are performed in all four types of matrixes. Disc shape specimens of steels were fixed into the tested materials. Two types of samples were casted (cubes with an edge of 5 cm and 10 cm). Testing cubes are placed in synthetic granitic water to simulate the interactions in the repository.

Real waste samples of activated steel from NPP witness samples programme and contaminated titanium material (filter from NPP operation) are also studied in this project. These samples were immobilised in cement and geopolymer matrix. This part of the project is focused on studies of radionuclide release from real wastes into the matrix or surrounding environment.







1 – Steel samples incorporation into the CEM matrix material; cube 10 × 10 × 10 cm
2 – RTG photodocumentation of steel samples position incorporated into the GP matrix
3 – Capsule of real waste (titanium material) prepared for fixation into the GP matrix
4 – Matrix materials (cubes 5 × 5 × 5 cmwith incorporated steel samples for corrosion, microbiological and material studies;) stored under anaerobic conditions

CONCLUSIONS

All initial requirements on workability, mechanical and structural stability, compressive strength of matrix materials (CEM, AFM, NNM, GP) fulfilled and materials were characterized by chemical composition, mineralogy and porosity.

Real waste samples of activated steel and titanium filter were characterized for their radiochemical composition and main radioactive contaminants were identified.

Sorption and interaction experiments with radionuclide tracers are ongoing.

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