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Alternative infill materials for disposal of NPP decommissioning radioactive waste –ALMARA project introduction

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Project introduction
The aim 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: CEM –ordinary Portland cement; AFM –alternative filling matrix, which is based on cement and bentonite; NNM –new nano-based matrix, which is based on cement and nanomaterial; GP –geopolymer matrix.
Experimental program started by developing of infill matrixes composition and verifying the pro-posed properties (workability, mechanical and structural stability, compressive strength). Composi-tion of matrixes is followed: CEM –cement type CEM I only, using W/C ratio 0.34; AFM –mixture of cement type CEM I and Ca/Mg bentonite (ratio 80/20 wt.%) with addition of commercial plasticizer and W/C ratio 0.5; NNM –cement type CEM I with addition (1 wt.%) of iron nano-powder (using W/C ratio 0.34); GP –based on composite aluminosilicate and alkaline activator, detailed composition is confidential.
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 tita-nium material (filter from NPP operation) are also studied in this project. These samples were immobi-lised 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.
The degradation of mechanical and chemical properties of matrix materials will be studied after de-fined periods of time (up to 3 years). The chemical composition, mineralogy, structural and mechani-cal properties and microbial activity will be tested and also interaction and migration of radionuclides on degraded materials will be characterised by sorption and diffusion experiments and compared to unaffected matrix materials.
All initial requirements on workability, mechanical and structural stability, compressive strength of matrix materials (CEM, AFM, NNM, GP) fulfilled and materials were characterised by chemical com-position, mineralogy and porosity. Real waste samples of activated steel and titanium filter were characterised for their radiochemical composition and main radioactive contaminants were identified. Sorption and interaction experiments with radionuclide tracers were started.

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