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SNETP Forum

EURAD WP15 ConCorD: An overview of 3 years of jointly coordinated canister materials R&D

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1. Motivation

Long-lived containers for the deep geological disposal of spent nuclear fuel and high-level waste have been shown to be feasible and safe.

- Can their performance be optimised?
- Can the prediction of their lifetime become more accurate and robust?

2. Objectives

The work package ConCorD (Container Corrosion under Disposal conditions) aimed to:

- Explore the potential of novel container materials for the optimisation of container design and performance.
- Deepen the understanding of coupled interfacial processes influencing container performance under repository-relevant conditions.
- Support performance assessment by demonstrating mechanistic understanding and by developing predictive models.

3. Methodology

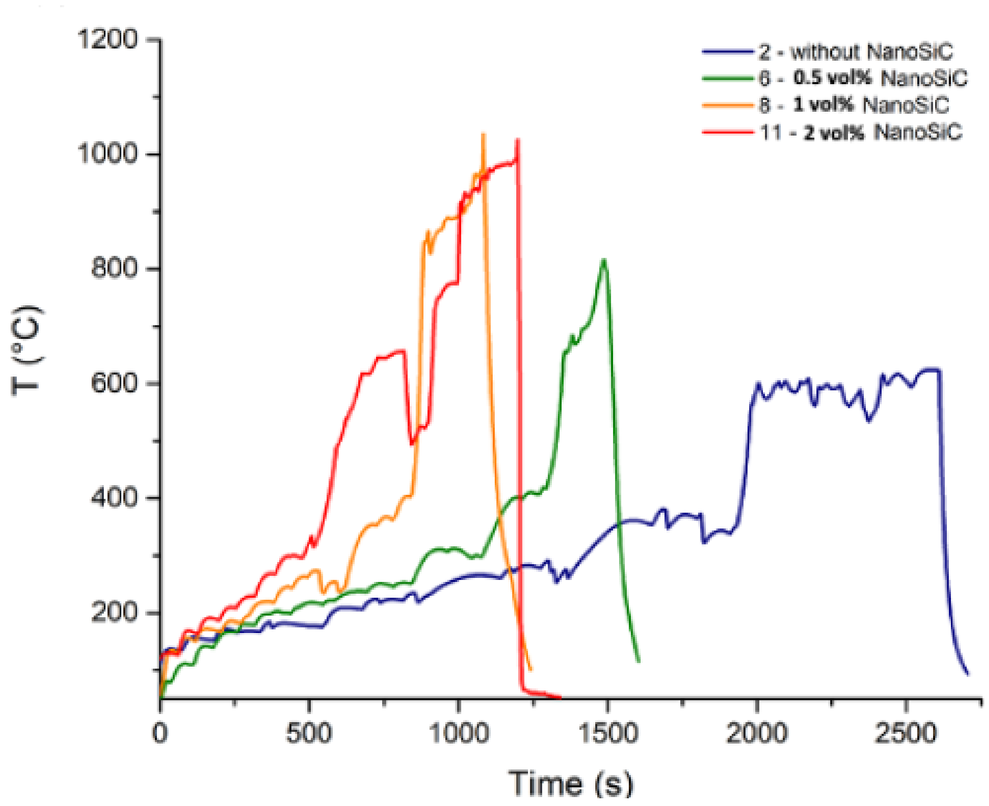
- 19 European organisations, 3 international partners and an Expert Review Group contributed to the 3-year-long programme.
- Specifically designed collaborative experimental campaigns were coupled with interpretative modelling. Integration of novel insights into repository-relevant temporal and spatial scale predictive models.
- Knowledge management, dissemination, training, and mobility.

4. Selected achievements and breakthroughs

4.1. Microwave sealing of bulk SiO_2-Al_2O_3 ceramics

➢ The final sealing of the canister is one of the most critical challenges facing the use of ceramic materials.

✓ A technological breakthrough was achieved by incorporating nano-SiC powder into the SiO_2-Al_2O_3 ceramic, which significantly increased their coupling with microwaved allowing local heating and sealing.



4.2. Corrosion under irradiation

➢ Identify critical parameters in irradiation-corrosion interactions by systematically analysing the effects of wide ranges of dose rate and total dose:

✓ Cu corrosion exhibits a positive dose rate dependence even at low rates.

✓ Steel corrosion exhibits a weak dose rate dependence, with no measurable influence below 10 Gy hr^{-1}.

4.3. Microbial effects

➢ Understand the influence of irradiation and temperature on microbially-induced corrosion:

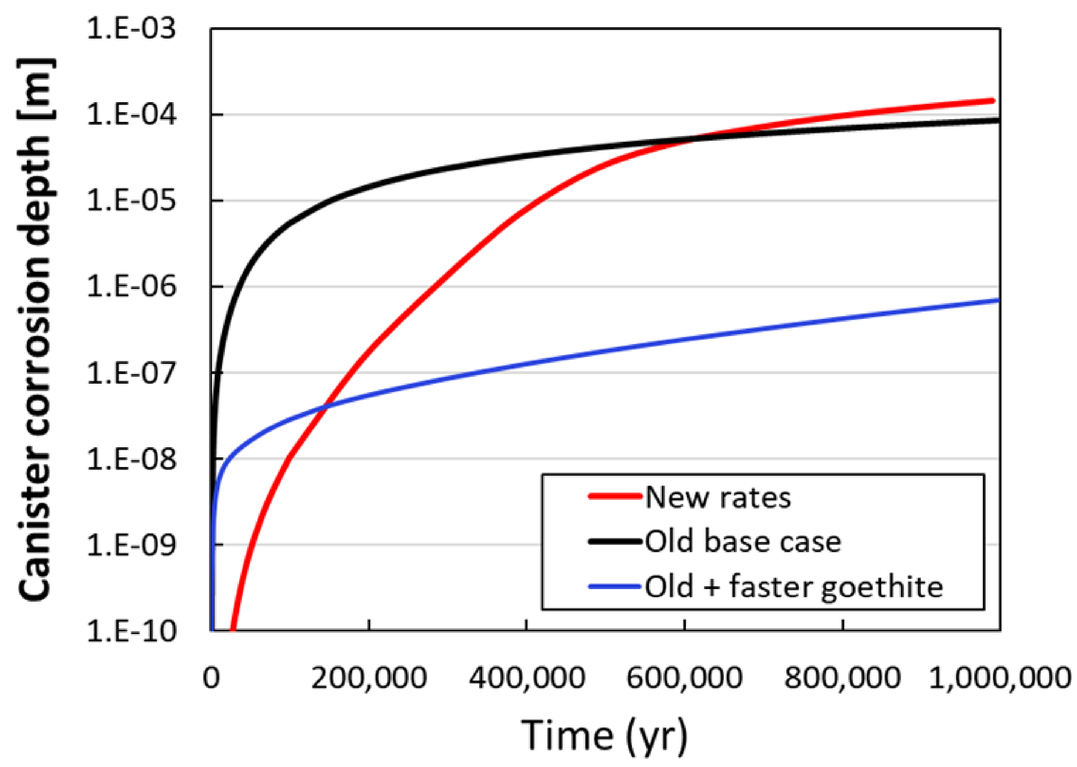
✓ The effect of irradiation typically depends on total dose and the species. Some species survived after 1yr of high dose rates.

✓ Complete sterilisation of bentonite after 1yr at ≥90°C.

4.4. Predictive modelling

➢ Further develop models by incorporating new knowledge from the experimental activities of the work package:

✓ New models show increased realism and lead to more robust and accurate predictions



5. Conclusions

- Addressed fundamental scientific questions, and performed applied, repository-relevant research
- Focused on the usefulness and applicability of outcomes for repository implementation
- Supported the formation a European canister materials community
- Benefited from the active participation of End Users and international experts.

6. Acknowledgements

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