

Project Number: DE-FG03-99SF21891

Project Title: Monitoring the Durability Performance of Concrete in Nuclear Waste Containment

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Technical Progress Report N°1

The project started on August 15, 1999. The first Technical Progress Report covers a one and a half-month period (08/15/99-09/30/99). Following the milestone plan the project started with tasks 1.1 and 3.1.

Task 1.1:

The starting point of task 1.1 is the study of the coupled diffusion-dissolution problem of Calcium Leaching in concrete. With regard to the material test series of the project (task 3.1), we considered the problem as a Stefan problem: a dissolution front defined by a chemical imbalance between the calcium concentration in the concrete pore solution and the one in the solid skeleton (concrete matrix) propagates through the structure. The study of this problem revealed interesting insights into the possibilities of accelerated material testing, under controlled calcium leaching conditions. In particular, we found out, that a well-posed increase of the equilibrium concentration of calcium in the pore solution allows increasing the leaching velocity (i.e., front propagation) 100 to 400 times. In other words, a one-day laboratory test on a physical cement material system can represent 100 to 400 days of real-life calcium leaching in concrete containment.

Task 3.1:

Task 3.1 is devoted to material testing under controlled chemical degradation conditions. The period covered by this report was marked to a great extent by a bibliographical research on the state-of-the-art of natural and accelerated calcium leaching in cementitious materials. Special emphasis was given to a comprehensive chemical understanding of the leaching processes, exploring the chemical frontiers of accelerated testing (interaction with task 1.1). The very understanding of the complex chemical reactions during accelerated testing allows us to design a more efficient experimental test method than the ones used today.

With regard to the limited time scale of laboratory test methods, the material tests will be carried out on cement pastes. The advantage of using cement pastes is two-fold: on the one hand, it allows us to focus on the very mechanisms of calcium leaching in cementitious materials; on the other hand, small sample sizes can be used limiting the material volume to be chemically degraded. By end of September, sample preparation for the first test series started. This first test series focus on the influence of sample size and preparation method on reproducibility and uniformity of mechanical results. Once this test series achieved, final sample size and preparation modes will be defined for the leaching experiments.

Milestone plan: The initial milestone plan remains valid; no changes were necessary. A copy of the plan is attached.

Task listing:

No task has been finished yet. Planned completion dates remain unchanged

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