

ICET Test #2: Test Conditions and Observations (TSP and 100% Fibrous Insulation)

Test Conditions

The general conditions, approach, and requirements for the ICET program are contained within the test plan that governs this test series (Adams Accession # ML051100357). All tests are being conducted in an environment that represents expected containment pool conditions during recirculation. The initial chemical environment contains 2800 mg/L of boron, 100 mg/L of hydrochloric acid (HCl), and 0.7 mg/L of lithium hydroxide (LiOH). Tests are conducted for 30 days at a constant temperature of 60°C (140°F). The materials tested within this environment include representative amounts of submerged and unsubmerged aluminum, copper, concrete, zinc, carbon steel and insulation samples. Representative amounts of concrete dust and latent debris are also added to the test solution. Tests consist of an initial 4-hour spray phase to simulate containment spray interaction with the unsubmerged samples. Water is circulated through the bottom portion of the test chamber during the entire test to achieve representative flow rates over the submerged specimens.

The primary differences among the ICET tests are the buffering agent and the insulation materials. Test #2 incorporated a tri-sodium phosphate (TSP) buffering agent and 100% fibrous insulation. The TSP was injected into the recirculation line starting at 30 minutes after the initiation of sprays. The TSP injection was completed by the end of the 4-hour spray phase. After the spray phase, and during the first week of testing, the test solution pH averaged 7.2. There was a slight increase in the average pH during the second week to a value of 7.3. The pH remained constant over the final two weeks of the test. This 30-day test was initiated on February 5, 2005, and was completed on March 7, 2005.

Important Test Observations

Several products were evaluated for the presence of chemical effects in these tests: the test solution, fibrous insulation samples, test chamber sediment, and sample coupons. There were chemical by-products found in the fibrous insulation samples and sediment which should be considered when addressing possible chemical effects implications as part of the generic letter (GL) 2004-02 evaluation. The test observations relevant to each product form are described as follows:

Water Samples

No chemical by-products were visible in the daily water samples at the test temperature of 140°F or upon cooling to room temperature. Additionally, no precipitates or by-products have become visible as the samples have set at room temperature since the end of the test. A sharp rise in water sample turbidity occurred after four hours which coincided with the complete introduction of TSP. The maximum turbidity value at both test and room temperature was reached after one day of testing. This maximum measured value was 20 NTU when the test solution was at 140°F. After this point in the test, turbidity gradually declined to a level of 1 NTU by the sixth day of the test. Turbidity remained constant until the end of the test.

The total suspended solids (TSS) values exhibited similar trends. The total suspended solids were maximum (36.2 mg/L) at the end of the 4-hour spray cycle. After the first 24 hours of the test, the TSS sample dropped to 27.5 mg/L and continued to decrease to 10 mg/L by day 5 of the test. The TSS concentration was constant at this point until the end of the test. Measurements of water sample particulate sizes indicated that 80 - 90% of the particulates were between 50 to 100 μm during the first two days of testing. Measurements of weekly samples thereafter indicated that the bulk of the particulates were between 1 to 25 μm . Kinematic viscosity measurements at 140°F and room temperature were constant during the entire test. Strain rate viscosity measurement indicated that the water samples exhibit Newtonian behavior.

The most prevalent chemical additions to the initial chamber chemical composition (i.e, boron, LiOH, and HCl) included silica and sodium. The silica concentration at the beginning of the test was approximately 0 mg/L, then increased nearly linearly to a value 85 mg/L by day 19 of the test. After this point, the silica concentration remained constant through the end of the test. The initial sodium concentration (after TSP injection) averaged approximately 900 mg/L during the entire test, but the sodium concentration measurements fluctuated between values of 700 mg/L and 1000 mg/L during the course of the test. In contrast to ICET test #1, no substantial aluminum was present in solution.

Fibrous Insulation Materials

Fibrous insulation materials were evaluated after days 4, 16 and 30 of the test. There was evidence of chemical deposits in the day 4 fiberglass sample. The amount of the deposits increased with test time. After the test, these deposits, in contrast to ICET test #1, were dispersed throughout the insulation sample blankets and were not preferentially deposited near the surface. The deposits also had a much different morphology than in test #1. The fibers were not as encrusted as in test #1, and the deposits often appeared near the intersection of several fibers.

Sediment

There was a quantity of sediment found on the test chamber floor in addition to the latent debris and concrete dust quantities added just before the onset of testing. There were also chemical by-products visible in the sediment that appear to originate from metallic sample corrosion within the test chamber. Corrosion products formed on some of the metallic sample coupons were dislodged and settled within the test chamber.

Sample Coupons

There was a copper layer evident on the submerged aluminum samples. This copper layer may have resulted from heavy metal corrosion of aluminum by copper ions. Otherwise, no unexpected sample corrosion products were readily apparent. The samples were weighed after drying and no cleaning was performed prior to weighing. There was not significant weight loss or gain from any of the samples for these tests.

A more complete data report for ICET test #2, containing additional observations, is currently being prepared and will be made publicly available once it has been completed.