GSI-191 Chemical Effects

Strainer Testing Plans for Chemical Effects

April 18, 2007

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Outline

- Brief Overview of Testing
- Description of Testing
- Other Testing Activities
- Conduct of Testing
- Test Schedule

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Alion Chemical Effects Head Loss Tests

1. Prototype Array Testing
   - WCAP-16530 Precipitates
   - Added to tank just like non-chemical debris
2. 30 Day Chemical Effects Head Loss Testing
   - Large scale (screen geometry 2 ft2)
   - Small scale (flat plate 0.14 ft2)
   - ICET type test with screen to measure head loss
3. Bench top Leaching/Corrosion/Precipitate Testing
   - Integrated Environment for 30 Days

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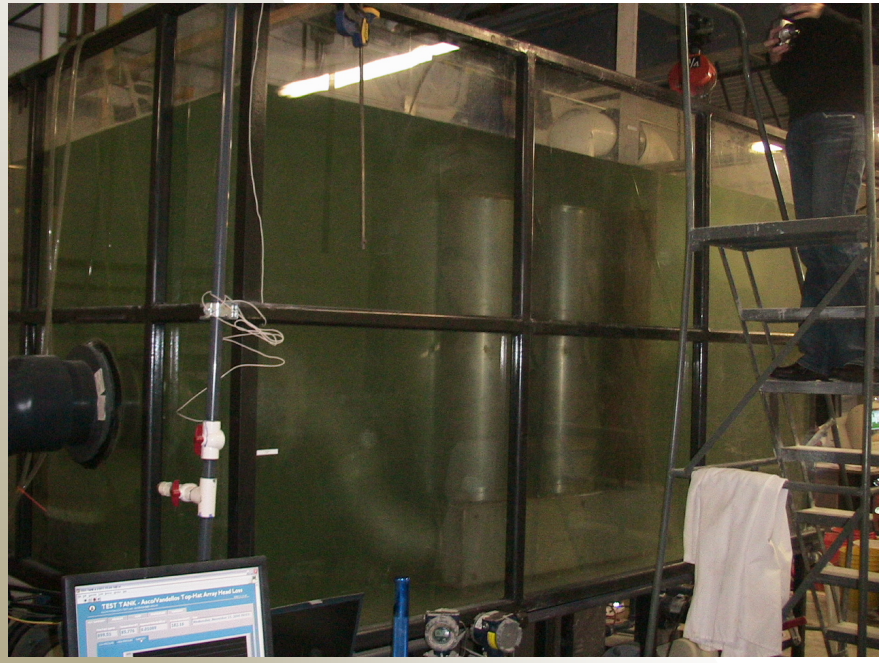
Description of Testing – Facilities Prototype Testing

Before Debris Add



After Debris Add

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Prototype Array Testing

- Debris quantities scaled to chemical prototype screen area – approach velocities consistent with full screen
- Chemical precipitants are developed from the WCAP chemical particulate generator (no surrogates) and settling rates validated
- Chemical precipitates generated using WCAP in tap water
- Generating all 3 chemical precipitants – not assuming sodium aluminum silicate is similar to aluminum oxyhydroxide

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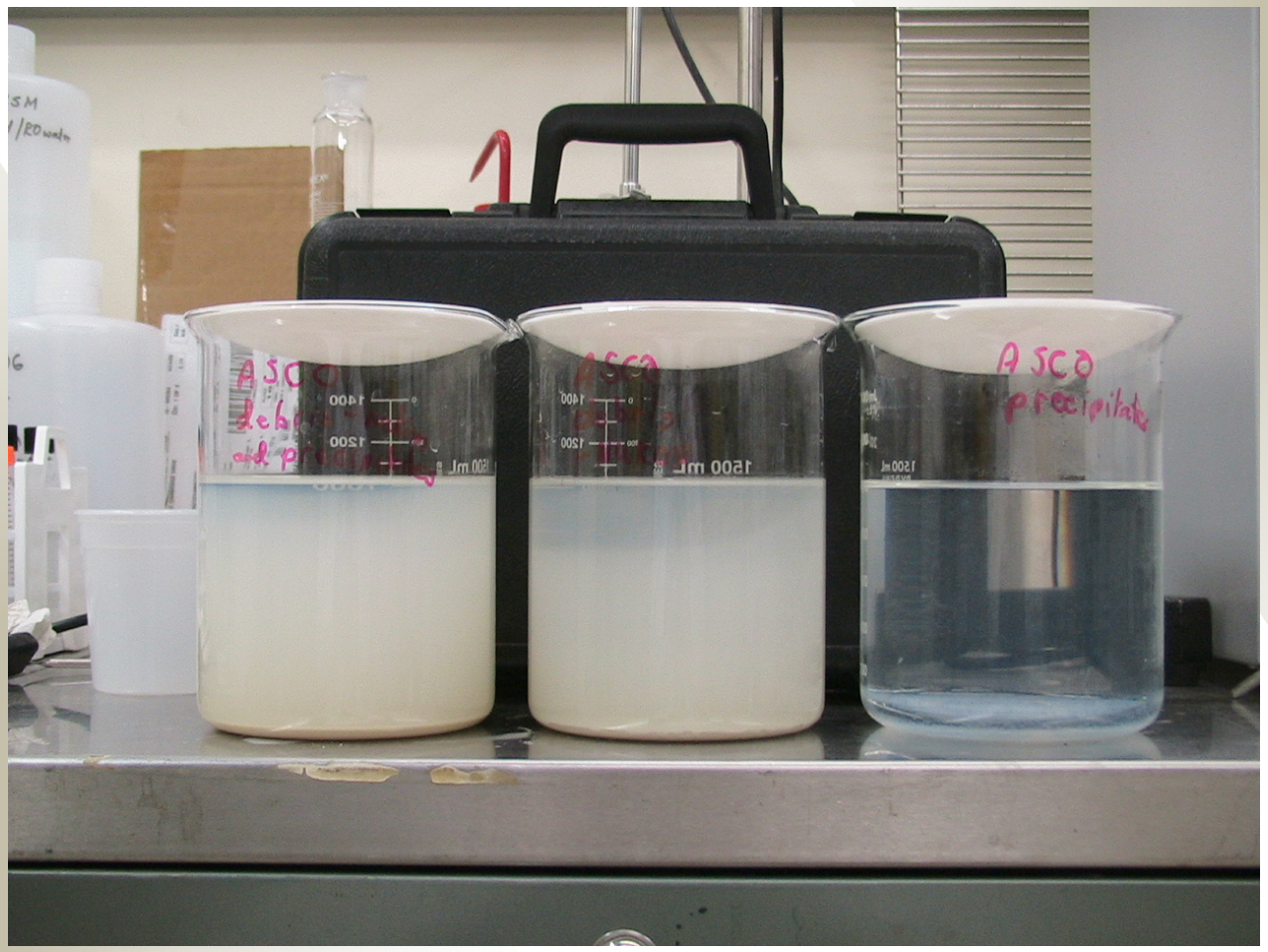
Sample Precipitate – WCAP-16530



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Prototype Testing Challenges

- WCAP-16530 model can predict significant quantities of chemical precipitates.
- WCAP method of precipitate manufacture creates a gelatinous debris to add to the mixture which can be problematic when combined with a complete debris bed.
- Difficult to credit settling of WCAP surrogates since precipitates do not necessarily precipitate from the solution but from within the debris bed as well.
- Prototype testing with debris and WCAP precipitates can be successful if large percentage of open screen available

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30 Day Integrated Chemical Effects Testing

- Perform a refined chemical head loss test to integrate the three (3) concerns (corrosion, precipitation and head loss)
  - Replicate post-accident environment with scaled volume and chemistry of coolant and materials in recirculation loop
  - Control flow and temperature time history (200 deg to 120 deg)
  - Measure head loss through plant specific debris bed over 30 day mission time.

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30 Day Chemical Test Facilities

- Large Scale Chemical Reactor (500 liter) –
  - Recirculation Pool and Spray
  - Temperature Range (ambient to 200 deg F)
  - Screen Area ~ 2 ft^2
- Small Scale Chemical Reactor (55 liter) –
  - Recirculation Pool only, no spray
  - Temperature Range (ambient to 200 deg F)
  - Screen Area – 0.14 ft^2
  - Quantity 6 side by side (parallel experiments)

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Large Scale Test Facility

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Small Scale Test Facility

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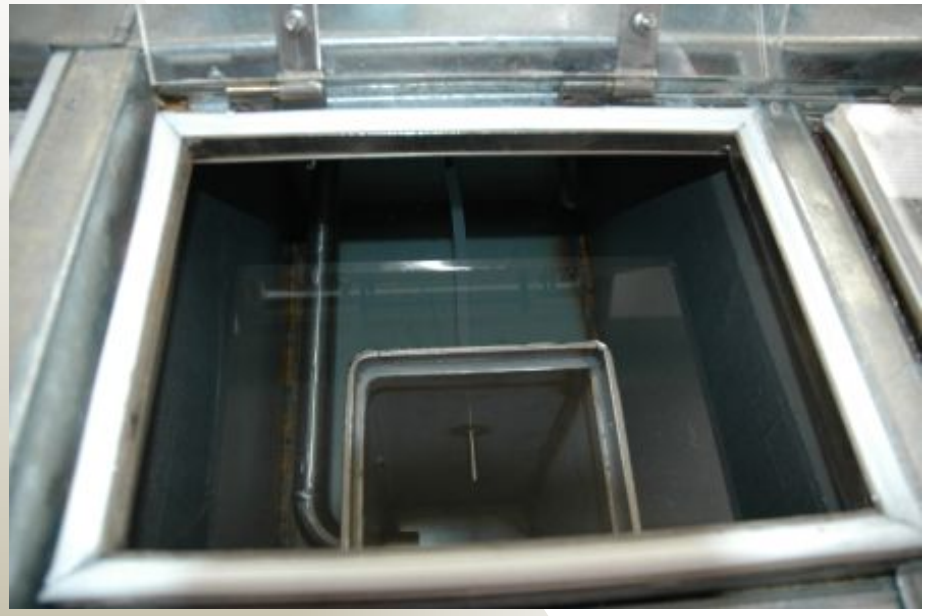
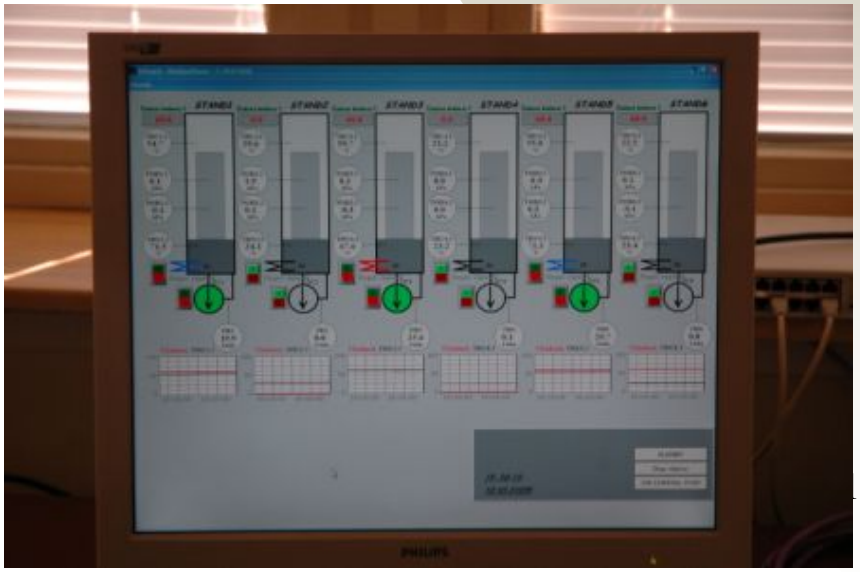
Small Loops



Upper part of the Small Loop



Special software for test control and monitoring

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Test Matrix – May 2007 Testing

Test No	Loop 1	Loop 2	Loop 3	Loop 4	Loop 5	Loop 6
Debris	Fiberglass	Fiberglass	Fiberglass	Mineral Wool	Mineral Wool	Microtherm
Buffer	TSP	TSP	TSP	TSP	TSP	TSP
Time	30 days	30 days	30 days	30 days	30 days	30 days
Temp	Profile	Profile	Profile	Profile	Profile	Profile

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Bench Top Experiments

Purpose of bench top experiments is to gain insight and understanding of the impact a plant specific chemistry has on a plant specific debris bed.

- Identify reactive chemistry, materials and debris beds
- Confirm phosphate inhibition of metals (Al, Zn)
- Investigate dissolution/degradation of fiberglass (Si)
- Investigate dissolution at temperatures greater than 200 deg F
- Confirm locations of precipitate and potential forms
- Address effects of variation in pH on corrosion and solubility

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Bench Top Testing Program

- Status of Integrated Environment Tests
  - 30 Day Testing completed with NUKON+TSP
  - 30 Day Testing completed with Mineral Wool + TSP
  - 30 Day Testing completed with LDFG/Cal-Sil + NaTB
  - Testing includes Zn, Al, Concrete

  - Elevated Temperature Testing in process
  - 24 hour Testing completed with Zr+TSP (300 deg F)
  - 24 hour Testing completed with Zr+NaTB (300 deg F)

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Bench Top Testing Program

- Results are positive for TSP environments with no dissolved Calcium – consistent with NUREG/CR-6913
  - Moving to 30 Day Test Integrated Head Loss Test Program
- Results are positive for NaTB environments, however, slightly more corrosion of metals. Final report and results should be available in May.

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Testing Schedule

- Prototype Testing
  - Harris – in process
  - TMI – in process
  - CR3 – under consideration
- 30 Day Integrated Head Loss Testing
  - SONGS/TMI – in process to be completed in May/June
  - DC Cook – July (Proposal pending)
  - Beaver Valley/IP – June/July (Proposal pending)
  - CR3/HNP/RNP – under consideration

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Testing Schedule

- Bench Top Program
  - Ongoing to address unique conditions and/or materials
  - Ongoing to address uncertainty and variability.

- Test Plans
  - Prototype Test Plans – complete and available to Staff
  - 30 Day Integrated Test Plans – complete and sent to Staff for comments.
  - Bench Top Test Plans – complete and available to Staff

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