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Results of the 1000 Hour Rotary Microfilter Endurance Test

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11/16/10

EM Waste Processing Technical Exchange 2010

SpinTek filtration

EM Office of Environmental Management
safety ❖ performance ❖ cleanup ❖ closure

SpinTek filtration

SpinTek Rotary Microfilter

1 - 25 filter disks

~11 inch diameter

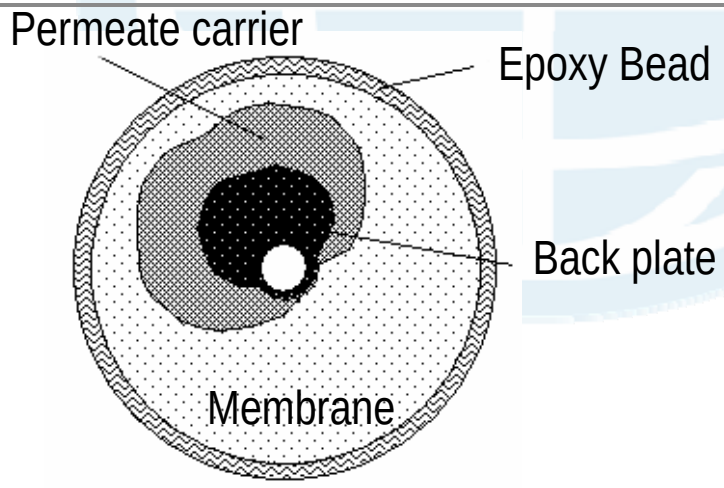
~1 sq ft filter media per disk

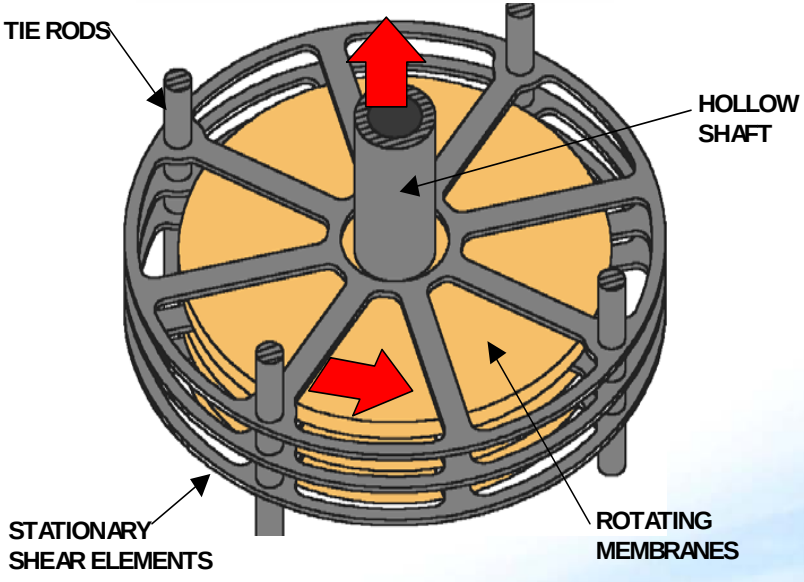
1170 rpm

60 ft/s tip speed

Turbulence promoters / baffles above and below disks increase shear at the membrane surface and reduce cake buildup

40 psi pressure drop across filter



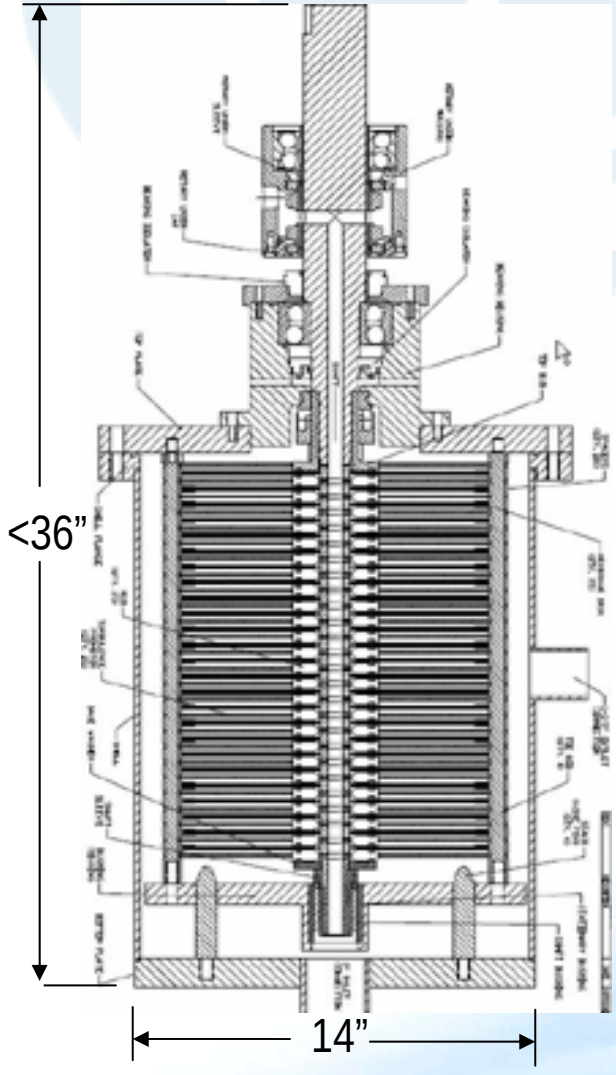


SpinTek filtration

Design of the 2nd Generation 25-Disk Rotary Filter

Improvements:

- Improved cooling to the internal journal bearing
- Improved mating of stack to filter tank
- Reduce vibration
- Use of commercial non-contact air seal
- Reduced internal restrictions



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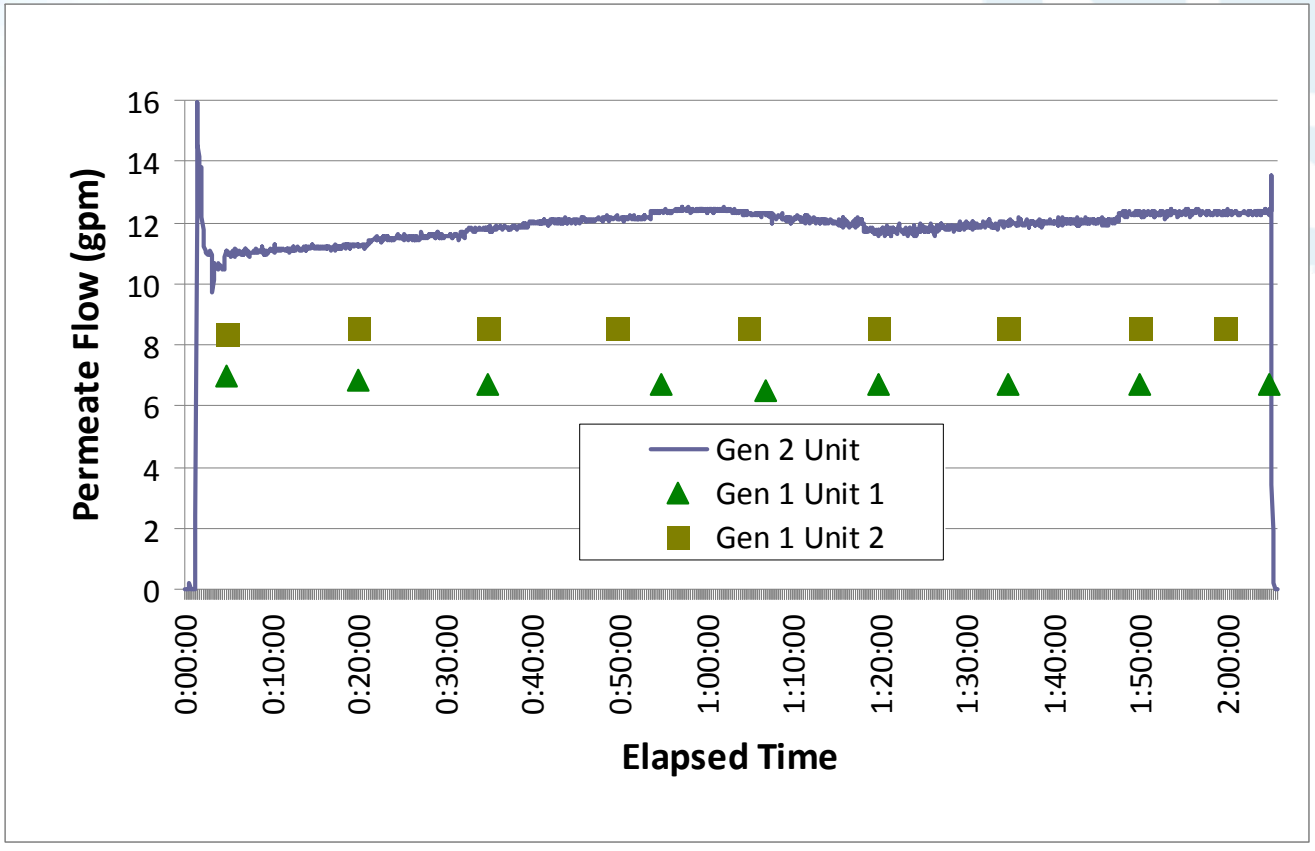
Acceptance Test - Clean Water Flux



The Gen 2 filter demonstrated ~50% improvement in clean water flux over the Gen 1 filters

SpinTek filtration

1000 Hour Test

Conducted at the vendor's facility

Sludge washing test

SRS Sludge Batch 6 recipe

- Slow settling
- Low mean particle size

3 sludge loadings – 5, 10, 15 wt %

Automated operation

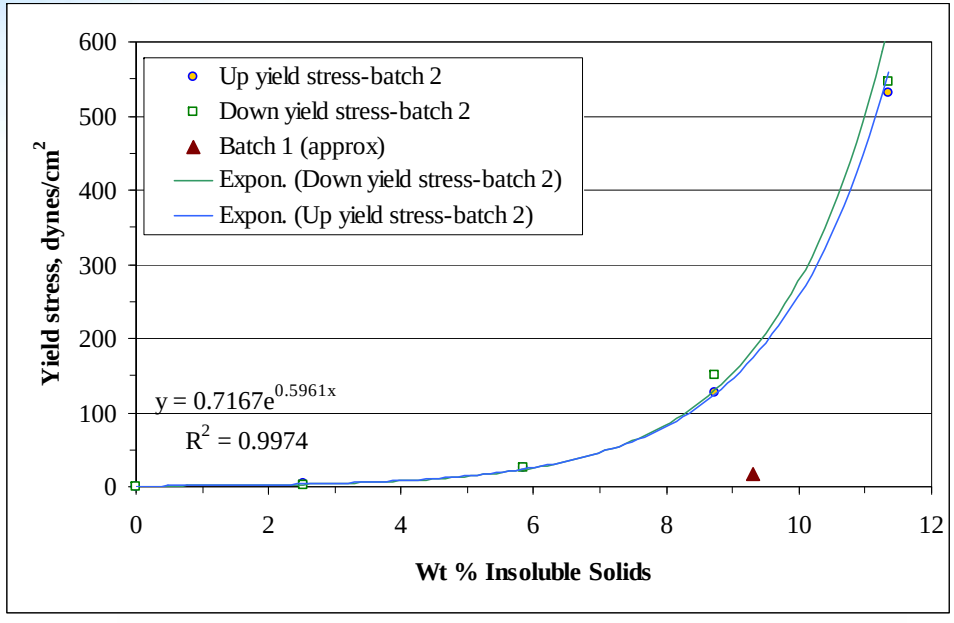
After 1000 hours complete, sludge washed to <1M Na (initially 5.6M)

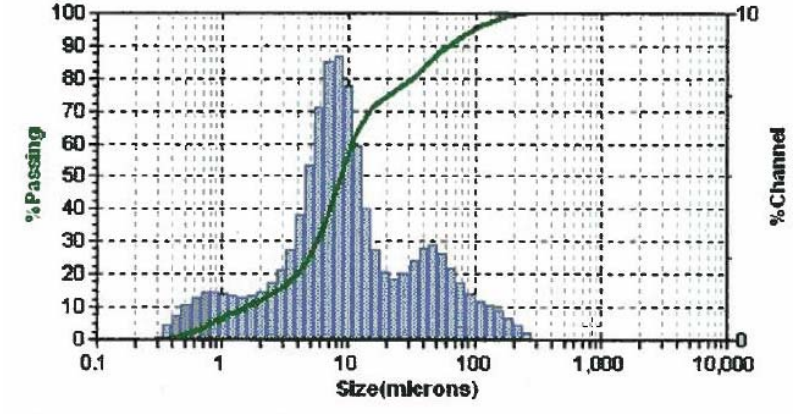
Testing completed in October 2010

SpinTek filtration

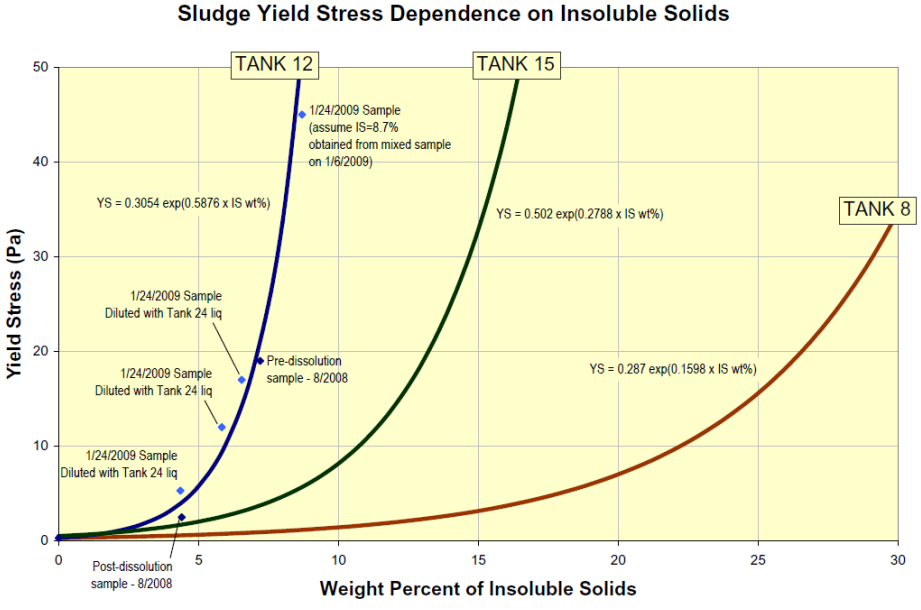
Preliminary Results of SRS Sludge Simulant Properties

Simulant





Actual Waste



Note: 10 dyne/cm^2 = 1 pascal

Simulant properties as-received
Yield Stress 54.6 Pa
Consistency 17.8 cP

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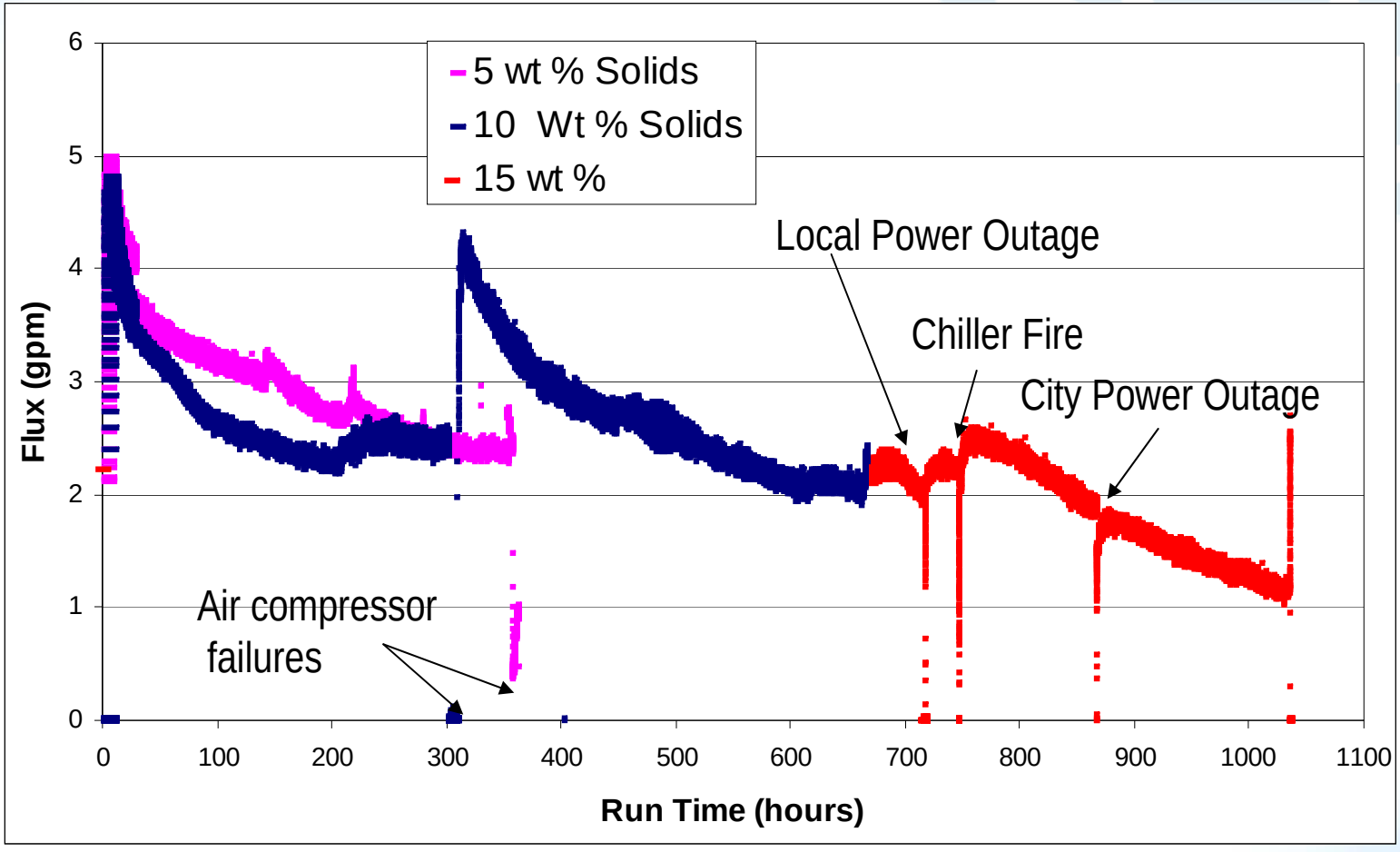
Journal Issue

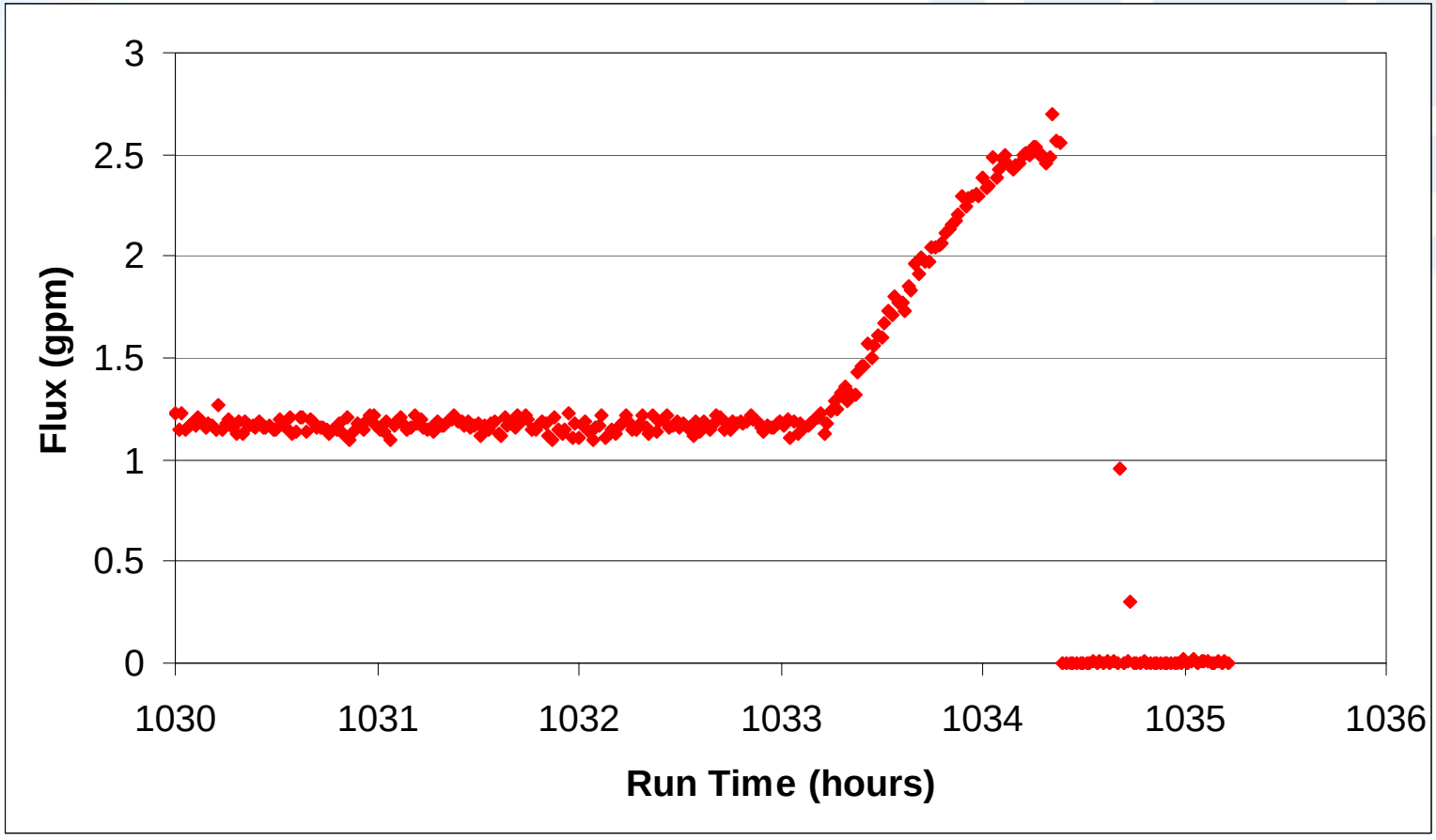
- On two occasions, the filter stack was inspected during test shutdowns revealed chips in the silicon carbide journal bearing.
  - There was no operational evidence that the chips occurred
- Chips were located at stress risers (keyway and pin hole)
- Changed material from Silicon Carbide on Silicon Carbide to Stellite on Nitronic 60

SpinTek filtration

Flux Data for 1000 Hour Test

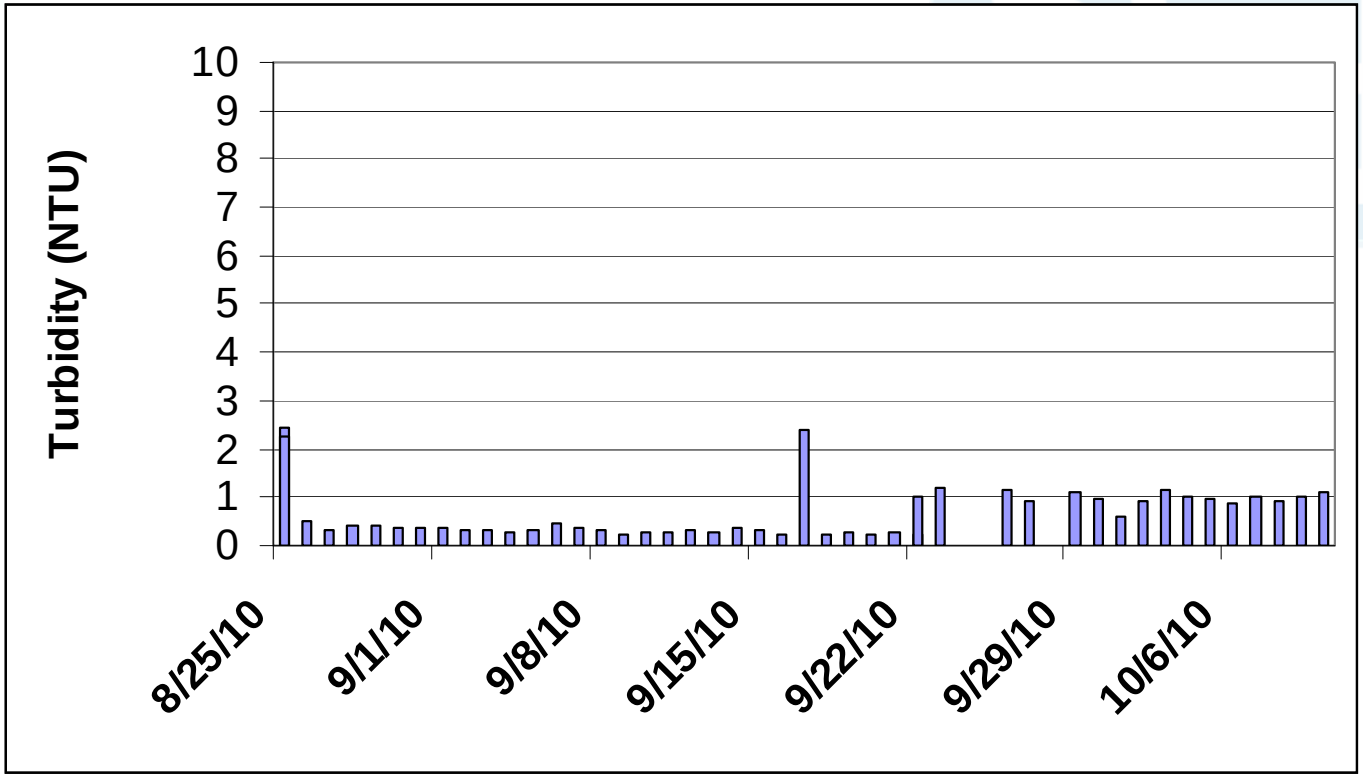


Sludge Washing



Wash water (inhibited water) is added at the same rate as filtrate is removed

Filtrate Clarity



All filtrate samples less than 2.5 NTU

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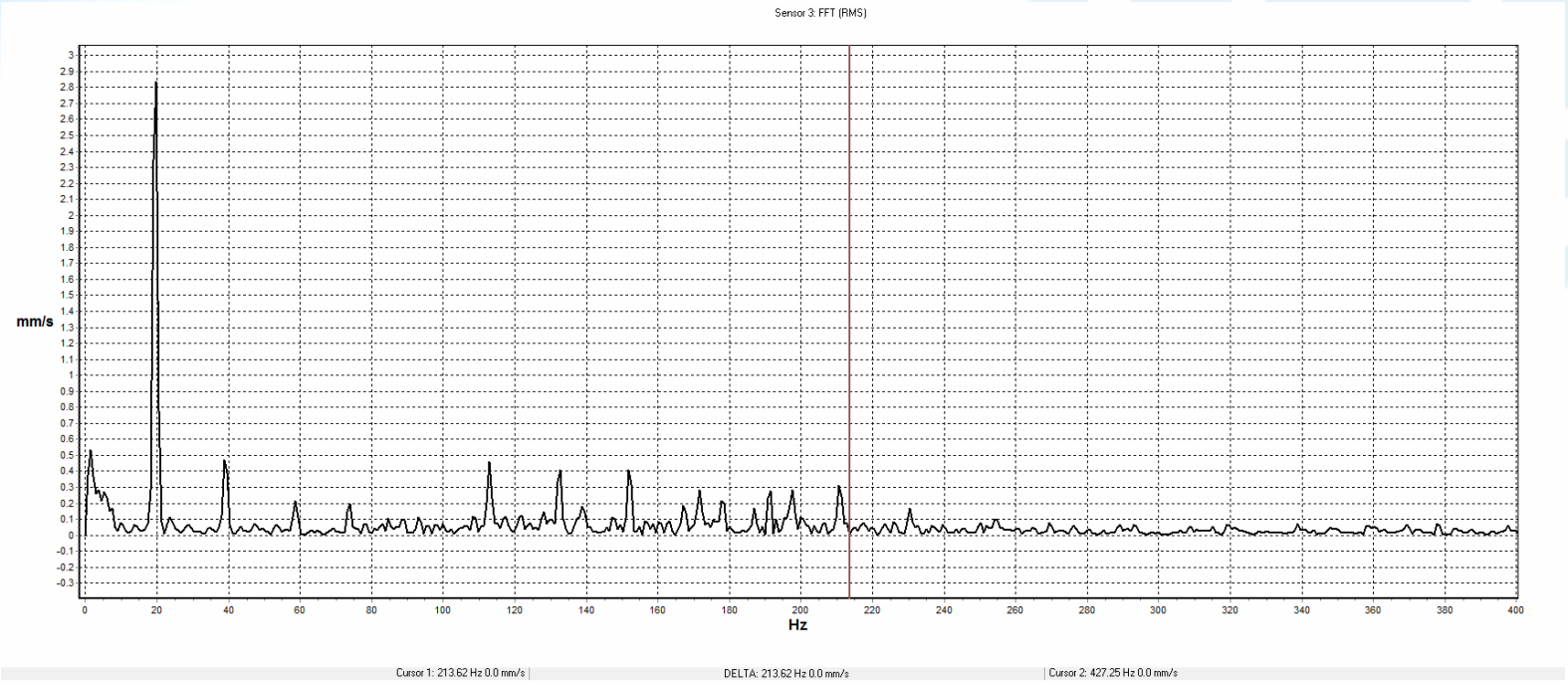
Sample Vibration Measurement



Typical vibration

3.31 mm/s @20 hz at rotary joint

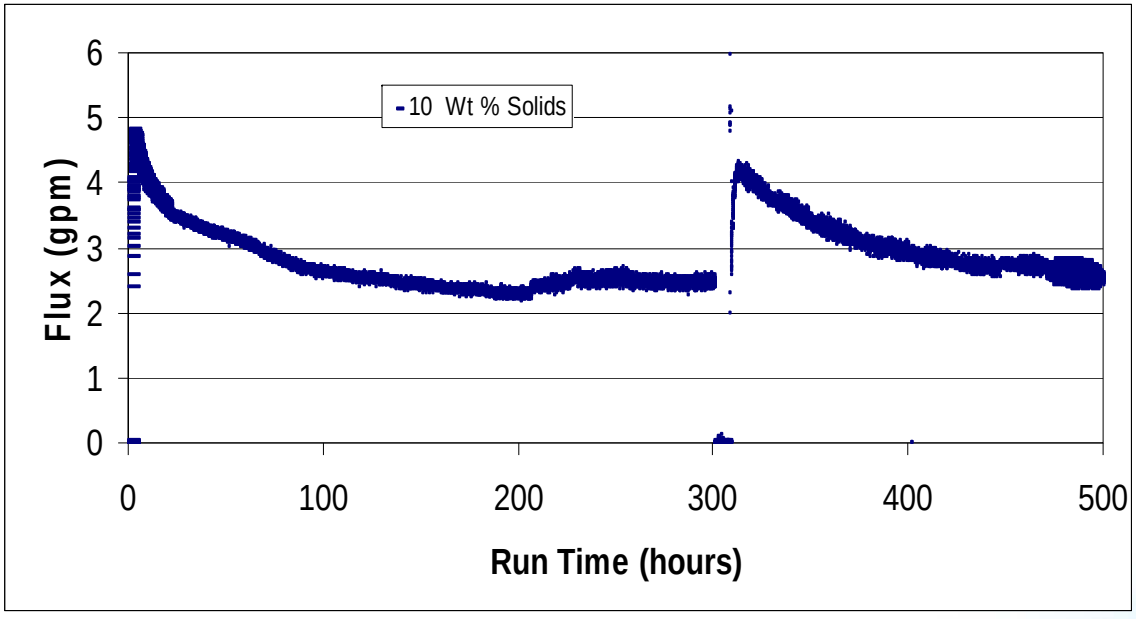
1.77 mm/s@20 hz at main bearing

In-Situ Cleaning

During the test, the air compressor from the support system failed resulting in the filter shutting down.

- **System flushed with DI water**
- **Acid rinse with 80 L of 0.2 M nitric acid.**
- **10 min soak/circulate/10 minute soak**
- **DI water rinse**

The water was drained and the filter was restarted



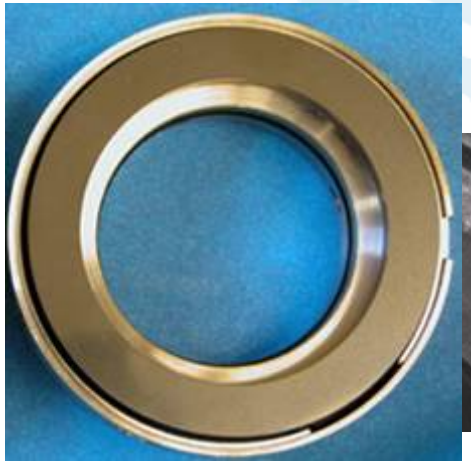
SpinTek filtration

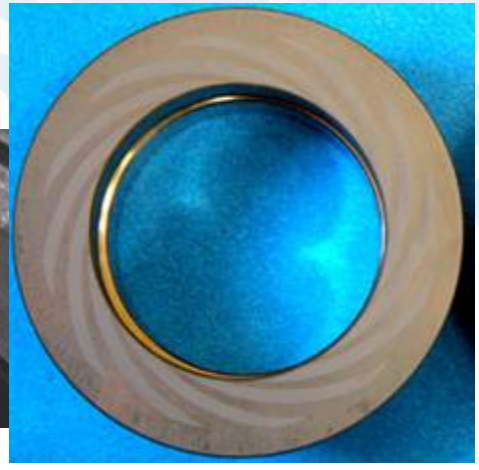
Mechanical Seal

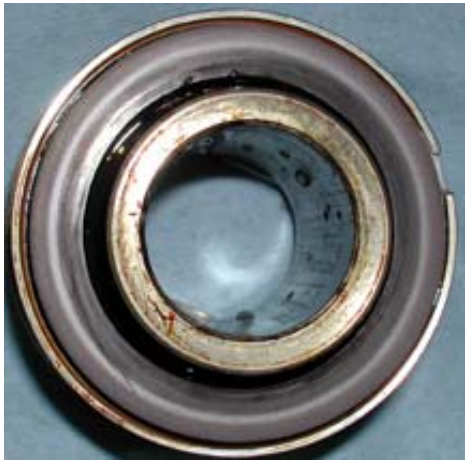
During operation, a primary concern is lifetime of the mechanical seal

Leakage from main shaft mechanical seal is expected to be first indication of wear on rotary filter but will not be the ultimate failure of the filter

Air Seal - new







Air Seal – post testing ~1500 hours

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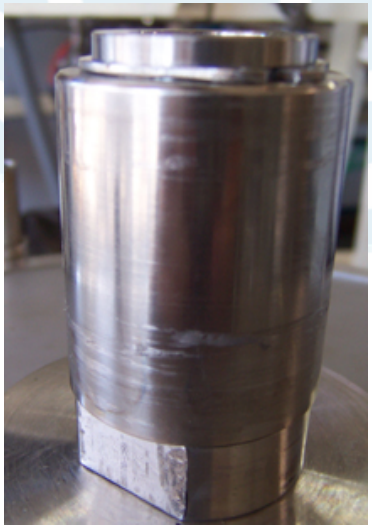
Bushing/Journal Bearing

- **Initial clearance inadequate to support thermal expansion resulted in initial scarring of journal**
- **Tolerances adjusted and no journal issues were found during 1000 hour test**



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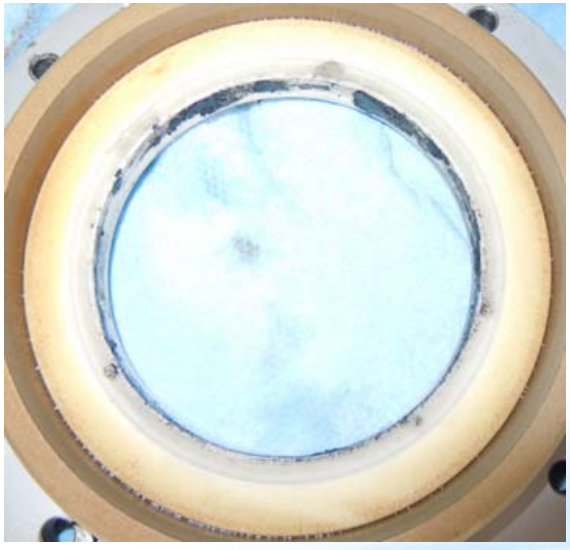
Rotary Joint Wear

- **Disassembly and inspection of the rotary joint seals showed no unusual wear**
- **No leakage observed during test**
- **Total operation time over 1500 hours**



SpinTek filtration

Test Summary

Successfully demonstrated:

- **Filtration of a "challenging" SRS simulant up to 15 wt % insoluble solids in a 5.6 M salt simulant**
- **Sludge washing**
- **In-situ acid cleaning with dilute acid**
- **Over 1000 hours of operation on new journal material**
- **Over 1500 hours of operation on all seals**

The filter out lasted:

- **2 air compressors**
- **2 power outages (one planned)**
- **2 chillers**
  - **1 fire**
  - **1 electrical breaker**
- **1 feed pump seal**

Path Forward

- Continue testing to support deployment
  - Multiple units
  - Fines analysis
- Laminated disk
  - Disk designed to withstand reverse flow
    - Allows operation of rotor prior to pump startup minimizing filter cake buildup
    - Allows operation of rotor during chemical cleaning
- New Media Evaluation
  - Higher flux
  - Increased durability
- Develop the design for a larger Filter
  - Increase filter media area 50-100%

SpinTek filtration

Questions?

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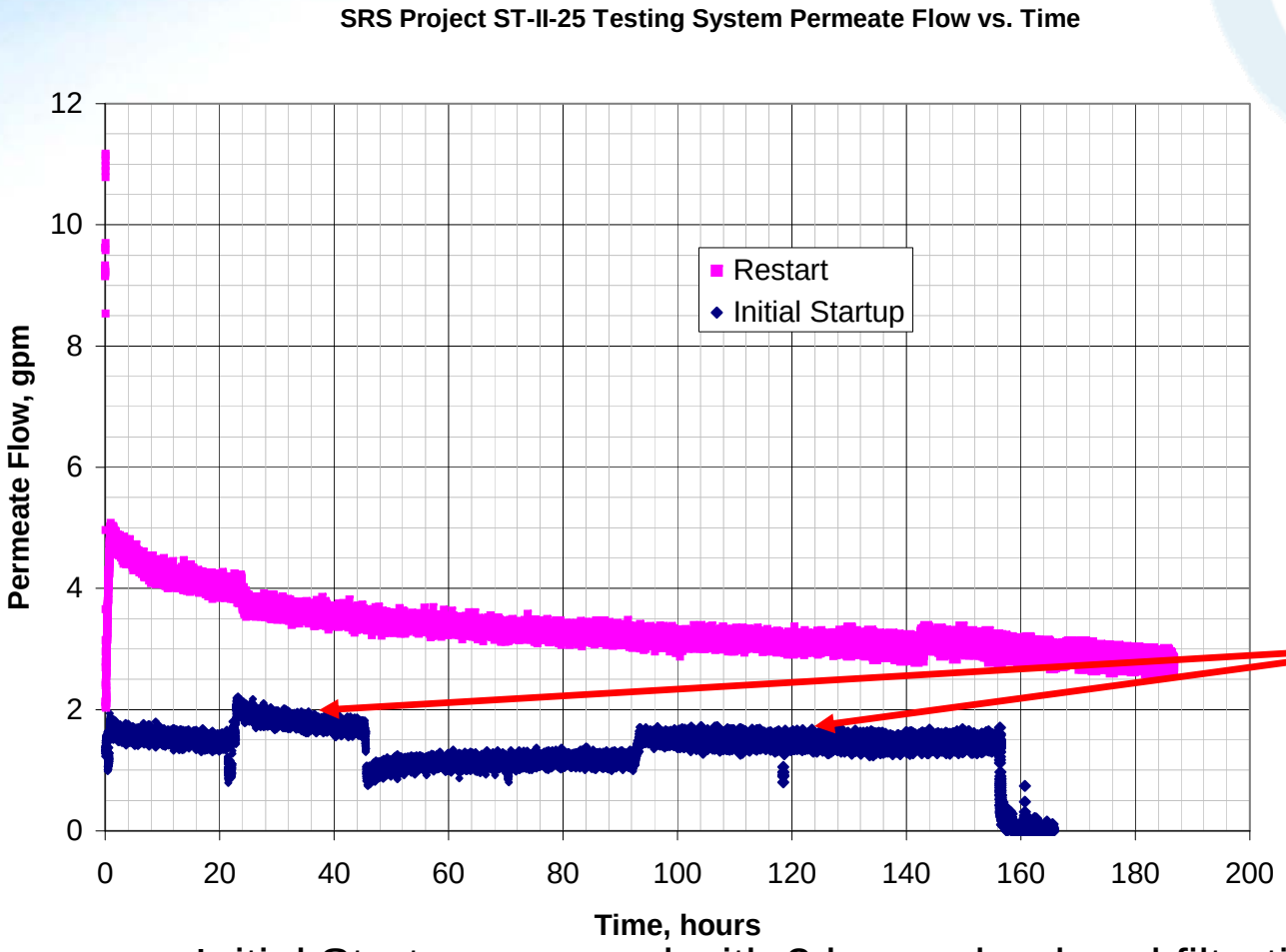
1000 Hour Test Data Comparison



Press drop across membrane = 40 psi unless noted

Press drop across membrane = 50 psi

Initial Startup occurred with 2 hours dead-end filtration prior to rotor start resulting in filter cake buildup

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