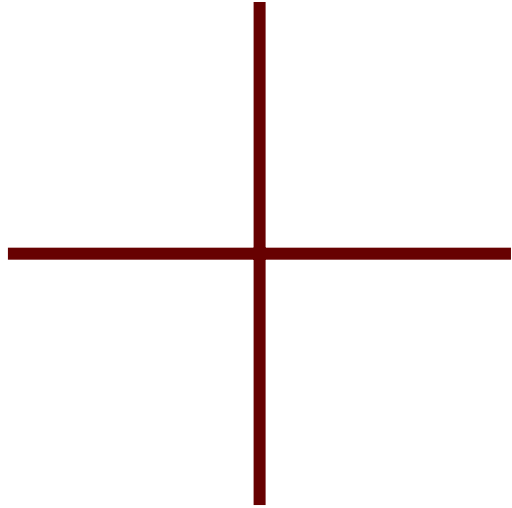


# Filtration of Modified Monosodium Titanate Slurries



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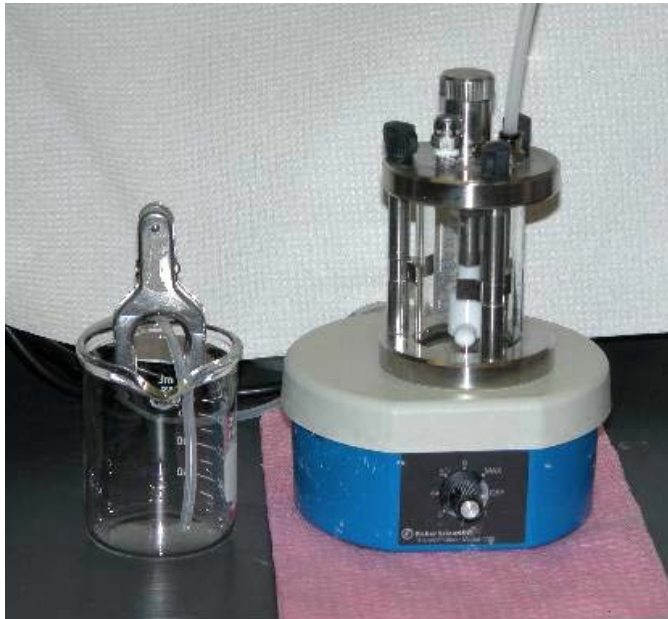
Michael Poirier and Samuel Fink  
April 23, 2007

# Background

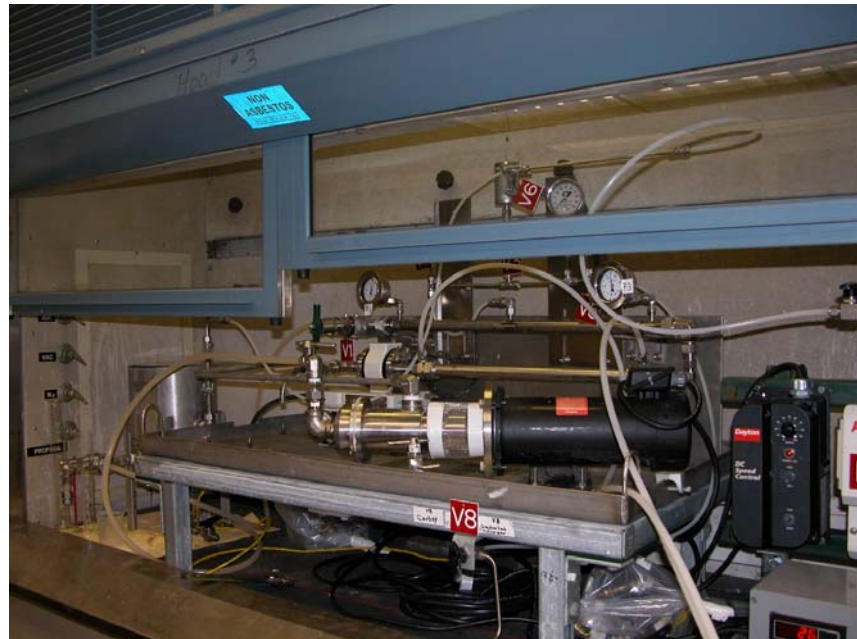
- SRS High Level Waste solutions require separation of  $^{90}\text{Sr}$  and alpha-emitting radionuclides ( $^{238,239,240}\text{Pu}$ ,  $^{237}\text{Np}$ ) before disposing as low activity wastes
- Baseline SRS process uses batch contact with monosodium titanate (MST) followed by crossflow filtration to separate solids
- Plutonium removal is rate limiting step in treatment process
- MST significantly influences downstream operations
  - Solids handling and filtration
  - Ti content in glass
- Developed improved sorbent for separation of strontium and actinides
  - increased capacity (reduce solids quantity)
  - increased kinetics (reduce contact time)
- Need to determine impact of modified MST on filtration process

# Testing

Performed tests with stirred cell and bench-scale crossflow filter  
Filter media was  $0.1 \mu$  Mott sintered stainless steel



Stirred Cell



Crossflow Filter

# Testing (cont.)

- Feed
  - 5.6 M sodium salt solution
  - MST or modified MST
  - Some tests added simulated sludge to the feed

Species	Concentration (M)
Na (M)	5.6
K (M)	0.015
Cs (M)	0.00014
OH (M)	1.91
NO <sub>3</sub> (M)	2.14
NO <sub>2</sub> (M)	0.52
AlO <sub>2</sub> (M)	0.31
CO <sub>3</sub> (M)	0.16
SO <sub>4</sub> (M)	0.15
Cl (M)	0.025
F (M)	0.032
PO <sub>4</sub> (M)	0.01
C <sub>2</sub> O <sub>4</sub> (M)	0.004
SiO <sub>3</sub> (M)	0.004
MoO <sub>4</sub> (M)	0.0002

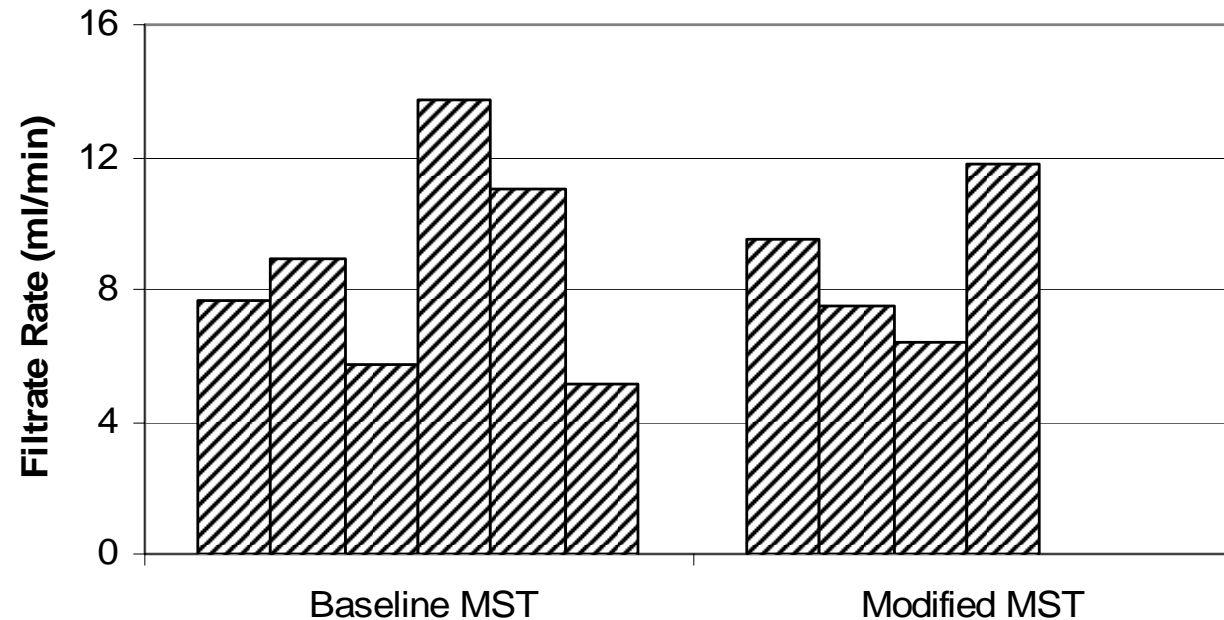
# Stirred Cell Tests

- Placed 60 ml of test solution in a vessel and added sufficient MST (baseline or modified) to the vessel to create a 0.06 wt % MST slurry
- Placed a clean 0.1 micron Mott sintered stainless steel filter disk into stirred cell
- Added MST slurry to stirred cell, closed stirred cell, applied 30 psi pressure, and recorded cell volume as a function of time
- Flushed stirred cell with inhibited water, and removed filter disk
- Cleaned filter disks by soaking in 1 M nitric acid, deionized water, and 1 M sodium hydroxide

# Crossflow Filter Tests

- Placed ~ 8 L of simulated salt solution in the feed tank
- Added simulated SRS Sludge and monosodium titanate to produce the target solids composition
- Operated the filter at the target conditions for 60 minutes and recorded filtrate rate gravimetrically
- After 60 minutes, changed filter operating conditions, backpulsed filter, and started recording data
- Nominal temperature 23 °C
- Axial velocity 6 – 12 ft/s
- Transmembrane pressure (TMP) 30 – 50 psi
- Feed
  - 0.06, 0.29, 1.29, 5.0 wt % solids
  - MST only, modified MST only, sludge + MST, sludge + modified MST

# Results – Stirred Cell

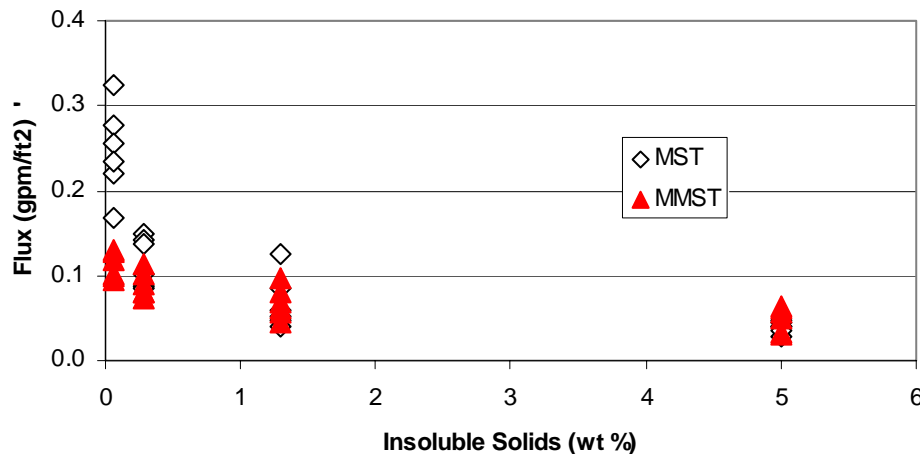


Average filtrate rate with the baseline MST was  $8.7 \pm 3.3$  ml/min

Average filtrate rate with the modified MST was  $8.8 \pm 2.4$  ml/min

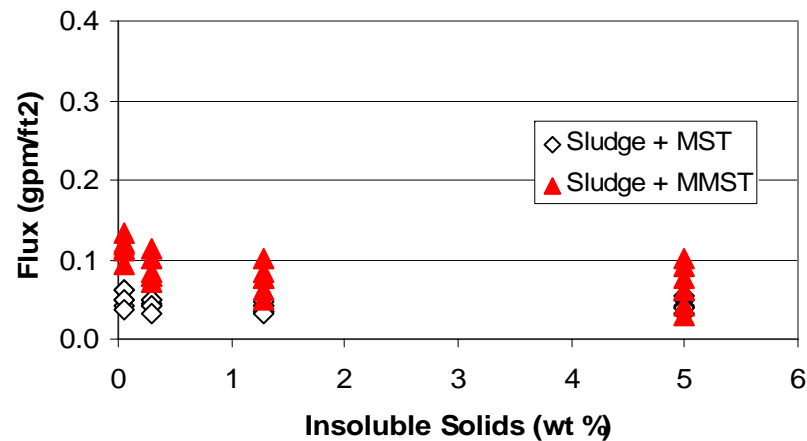
Filtrate did not show any solids for either feed material

# Results - Crossflow



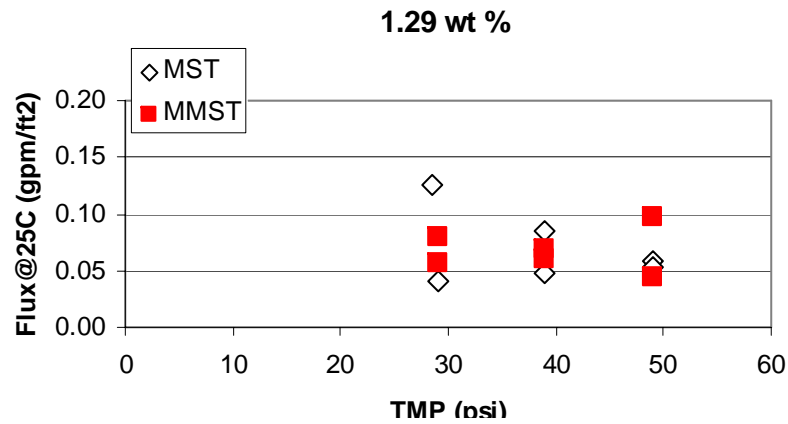
- Baseline MST shows higher flux (1.3 – 2X) than modified MST at low solids loadings (0.06 and 0.29 wt %)
- It shows approximately the same flux at higher solids loadings (1.29 and 5.0 wt %)
- Modified MST has larger median particle size (~ 10  $\mu$ ) than baseline MST (~ 3.5  $\mu$ )
- Modified MST has a broader particle size distribution (1 – 20  $\mu$ ) than baseline (1 – 8  $\mu$ )
- As solids loading increases, more particle-particle interaction occur, which leads to increased particle degradation of larger modified MST particles and narrowing of particle size distribution
- Filtrate samples did not show any solids

# Results – Crossflow (cont.)

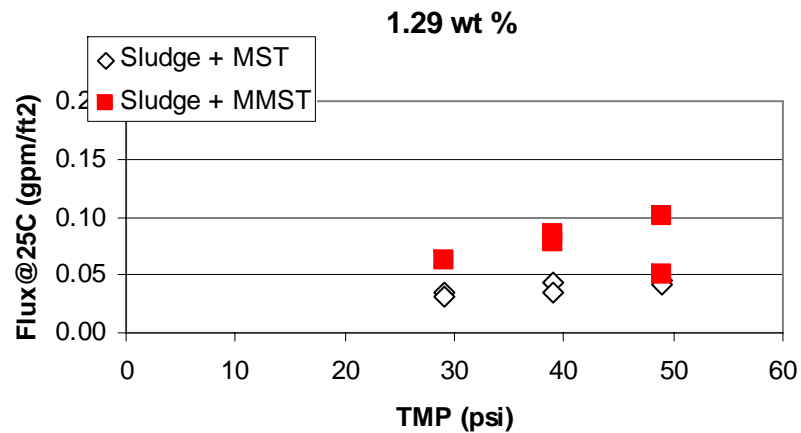


- Modified MST-sludge slurries show higher flux than baseline MST-sludge slurries at all solids loadings (1.5 – 2X)
- Interaction between sludge and MST changes properties of filter cake
- Modified MST-sludge cake more permeable than baseline MST-sludge filter cake
- Filtrate samples collected did not show any solids

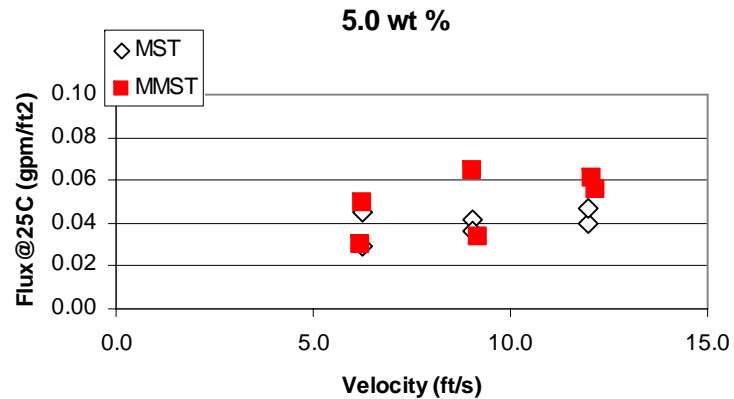
# Results – Crossflow (cont.)



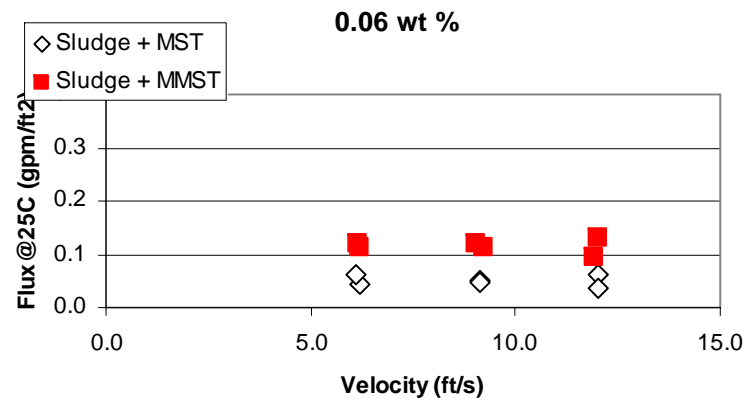
- TMP did not have a significant effect on filter flux



# Results – Crossflow (cont.)



- Axial velocity did not have a significant effect on filter flux



# Conclusions

- With MST-only slurries, the baseline MST produced higher flux than the modified MST at lower solids loadings, and comparable flux at higher solids loadings
- With sludge-MST slurries, the modified MST produced higher flux than the baseline MST at all solids loadings
- 0.1  $\mu$  filters removed the solids particles from all feed slurries tested

# Acknowledgements

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