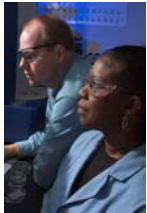


Yield Stress Reduction of DWPF Melter Feed Slurries



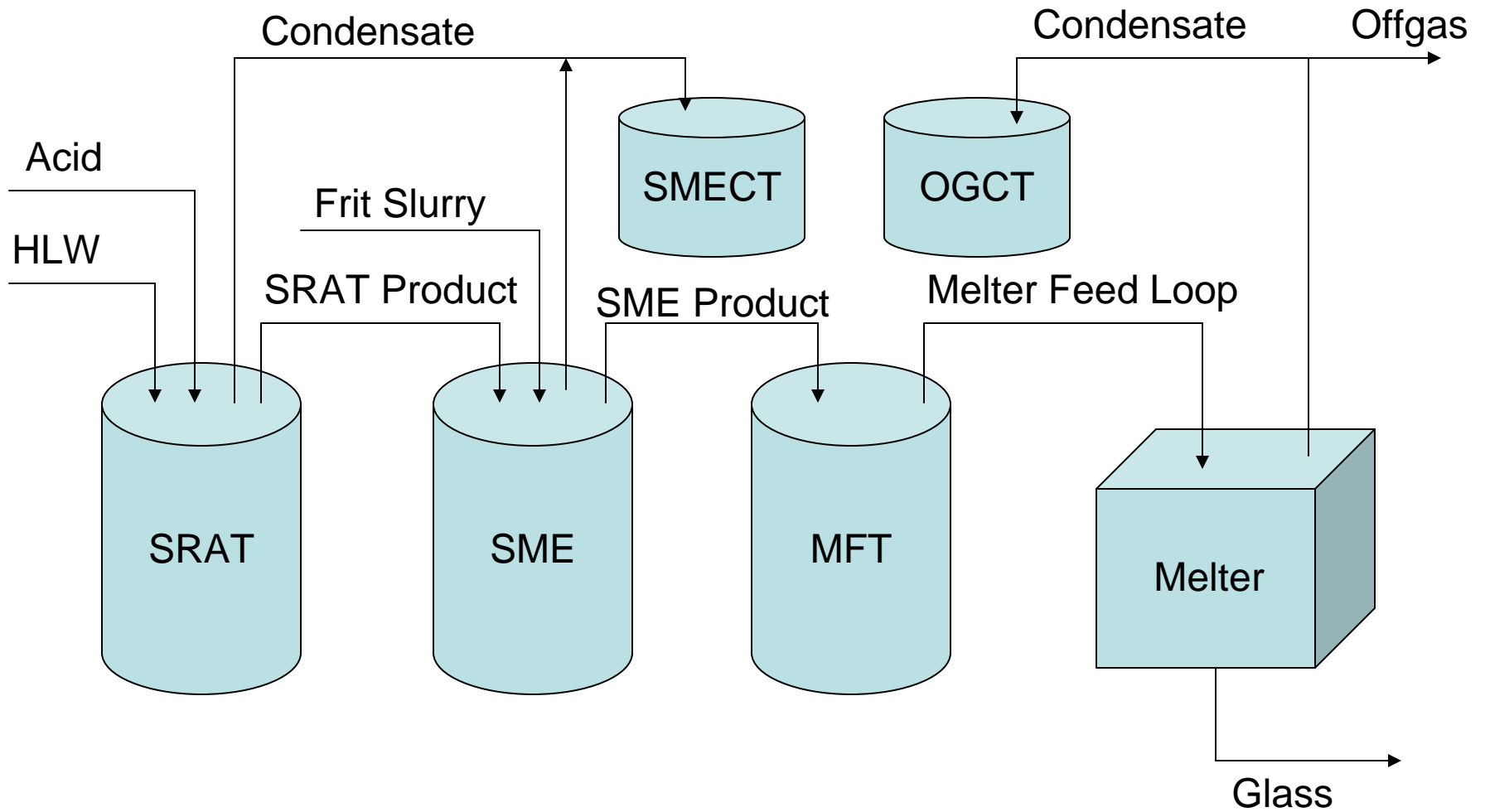
We Put Science To Work

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April 23, 2007

Objective

- Increase throughput at the Defense Waste Processing Facility by increasing solids content of melter feed
 - Joule-heated melter, slurry-fed
 - Facility is converting liquid High Level Waste (HLW) to glass
 - Solids content of feed is limited by yield stress of feed slurry
 - Slurry modeled as a Bingham Plastic

DWPF Flowsheet

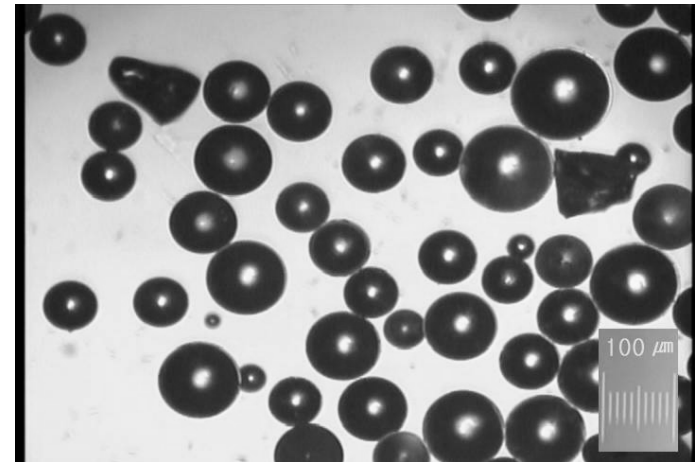
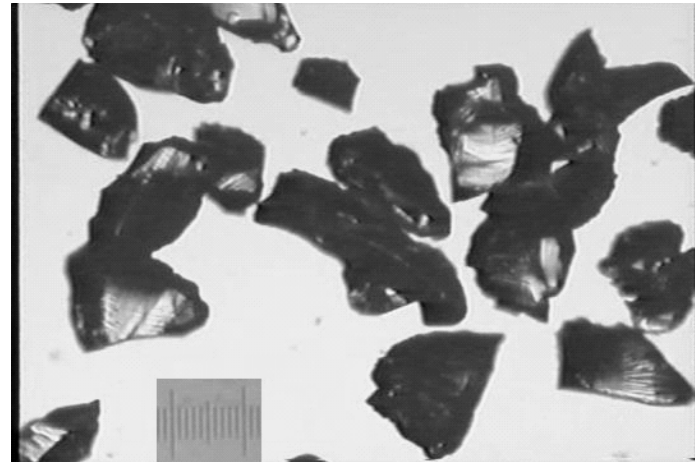


Preliminary Evaluations for Yield Stress Reduction

- Focused on chemical additives to alter properties of sludge solids
 - Dolapix CE64 and Disperse-Ayd W28 identified as candidates
 - Neither additive was consistently effective
 - Yield stress reduced 5 to 40%
 - Relatively large doses required (~3000 ppm)
- Focus shifted to modifying frit particles
 - Waste loading ~ 35%
 - Frit accounts for ~60% of solids in slurry

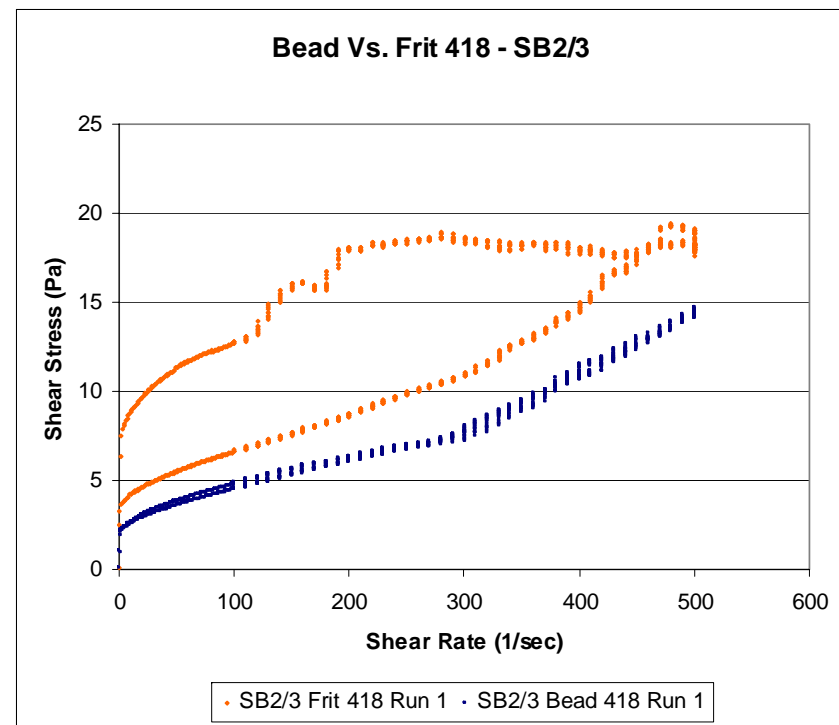
DWPF Glass Former (Frit) Addition

- Alex Nikolov (IIT) proposed changing from frit to beads
 - DWPF process currently uses irregularly shaped frit as the glass former
 - Selected and sized based on ability to sandblast a poured SS canister
 - Beads failed to adequately decon canisters
 - Desire to have one frit for the process frit addition and the decon frit process
 - Benefits of beading the frit likely outweigh the costs of two separate frit types



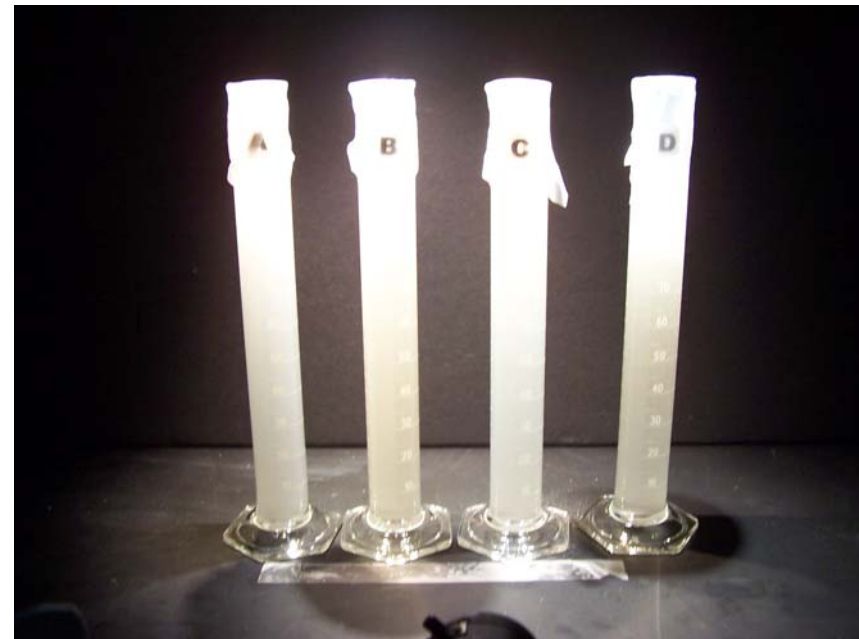
Preliminary Results

- Yield stress reduced 20 to 40% by switching to beads with same particle size as frit (-80/+200 mesh)
- Issues identified with implementation
 - Settling rate
 - Impact on homogeneity of melter feed
 - Process and glass acceptability determined by SME product sample
 - Melt rate
 - Decreased surface area could impact melting behavior
 - Benefits as solids loading increased
 - Impact on frit addition system



Settling Rate

- Objective of testing was to select a particle size range for beads that equals the settling rate of current process frit
 - Xanthan Gum used as physical simulant
 - Settling rate in graduated cylinders recorded with time lapse videography and solids analysis
 - Bead particle size of -100/+200 mesh selected



Impact of Particle Size on Yield Stress

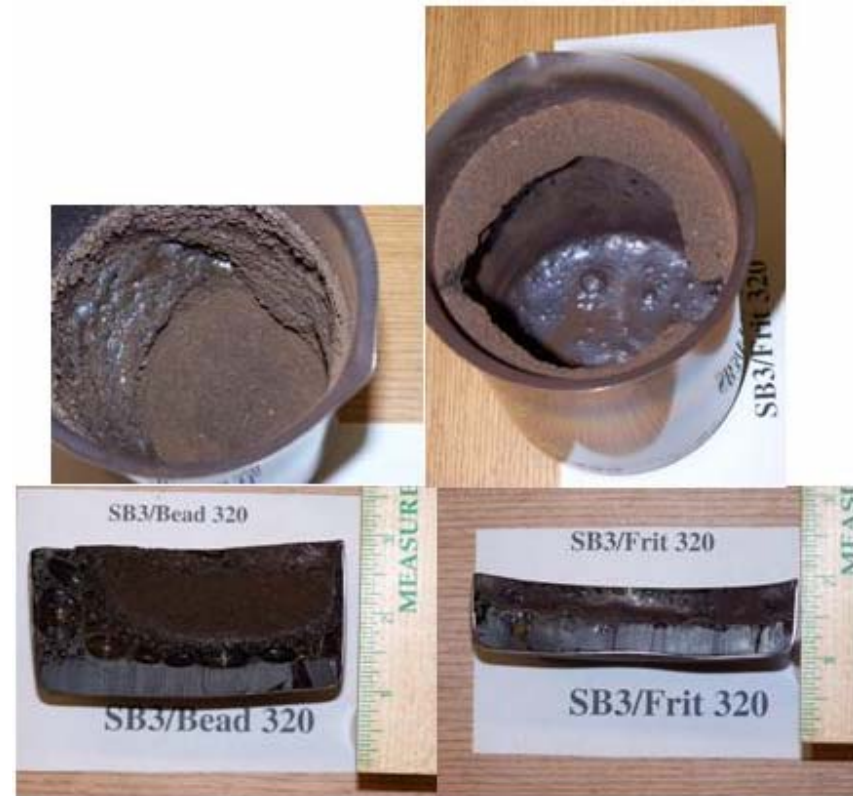
- Impact of smaller particle size for beads on rheological properties of melter feed evaluated
- No significant impact found by reducing particle size of beads
 - Significant impacts noted in past studies using frits

Frit/Bead	Yield Stress (Pa)	Consistency (cP)	* % Reduction in Yield Stress /Consistency
Frit 320	3.26	20.53	N.A.
Beads (-140)	2.64	16.05	23 / 28
Beads (-100+140)	2.51	15.27	30 / 34
Beads (-70+100)	2.61	12.88	25 / 59

* Relative to Frit 320 SME product

Melt Rate

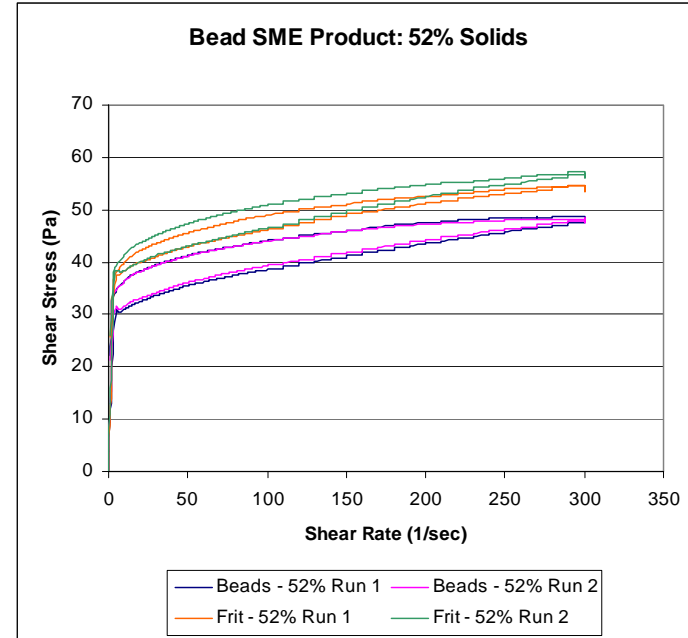
- Melt rate was essentially the same for beads as frit in a dry-fed test
 - 0.45 versus 0.47
- Differences were noted in melting behavior
- Slurry-fed melt rate testing to be conducted prior to implementation



Benefits of Beads at Higher Solids Loading

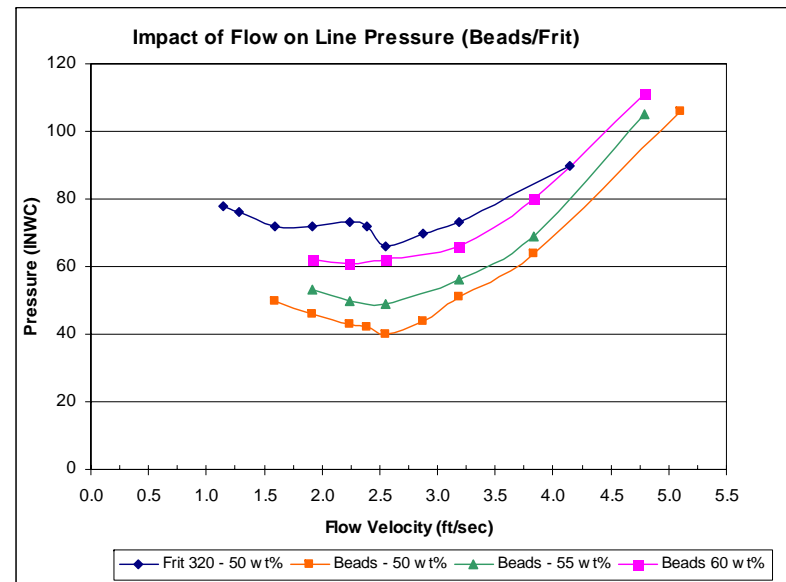
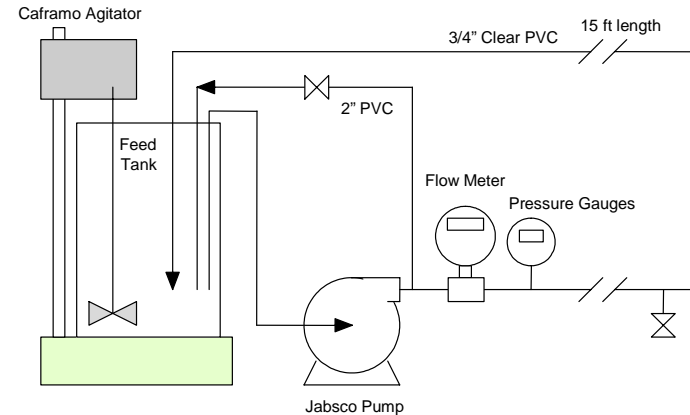
- Beads evaluated at 45% and 52% total solids versus frit
- SB2-Frit 320 system
 - Challenging system for DWPF
- Impact of beads was more significant as solids content increased

	BEADS		FRIT	
Up Curve	45%	52%	45%	52%
Yield Stress	14.7	34.0	13.2	41.1
Consistency	18.9	48.2	27.3	52.2
	BEADS		FRIT	
Down Curve	45%	52%	45%	52%
Yield Stress	15.0	41.0	16.8	46.1
Consistency	50.7	29.9	45.8	36.3



Impact on Frit Addition System

- Preliminary tests completed with simple flow loop
 - Frit/water system
- Pressure inflection occurred at same flow rates
 - Solids settling noted visually at inflection points
- Back pressure lower for beads than frit
- Flow loop could be stopped and restarted with beads
 - Not possible with frit
 - Similar observations noted with agitated vessels



Conclusions

- Beads represent a significant process improvement versus frit for the DWPF process
 - Lower yield stress
 - Melter feed
 - Frit addition slurry
 - Lower erosion of process equipment
- Additional experimental work planned
 - SME product homogeneity/sampling issues
 - Melt rate during slurry-fed tests
 - Impact of beads on frit addition equipment
 - Individual component evaluation
 - Testing with various ratios of frit to beads
 - Beading processes not 100% efficient
 - 80 to 90% attainment likely
 - Decon frit will remain after implementation of beads