Continuous Sludge Leaching

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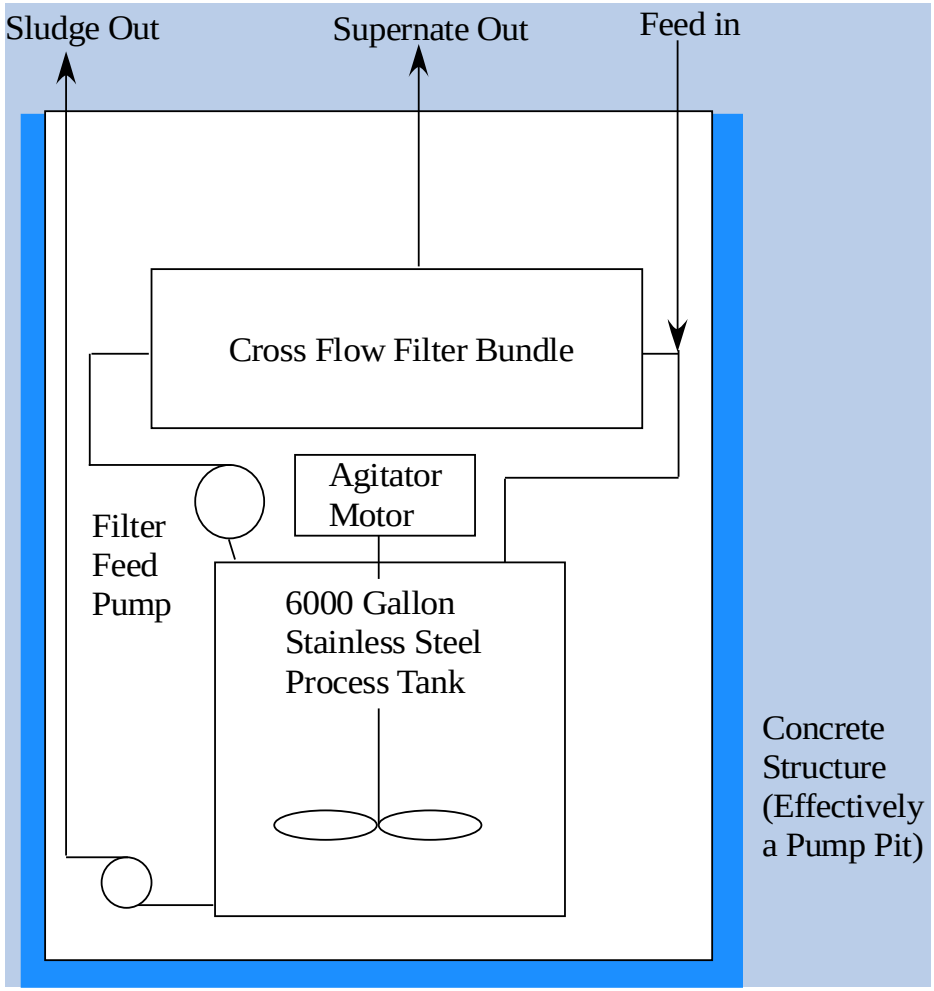
What is CSL?

- Process diagram
- Full scale equipment description
- Pilot scale equipment description
- Actual waste basis
- Bench scale simulant demonstration
- Process optimization

Process diagram



Full scale equipment description

- 3000 gallon reactor vessel
- ~ 100 sq ft of filter area
  - Single 100 tube bundle
- Processes 200 kg/h of S/SX waste
- Produces 150 kg/h of leached slurry
- Removes 90% of the aluminum
- Achieves 60% reduction in mass of insoluble solids
- Produces 3000 kg/h of leachate
- 100 h reactor residence time

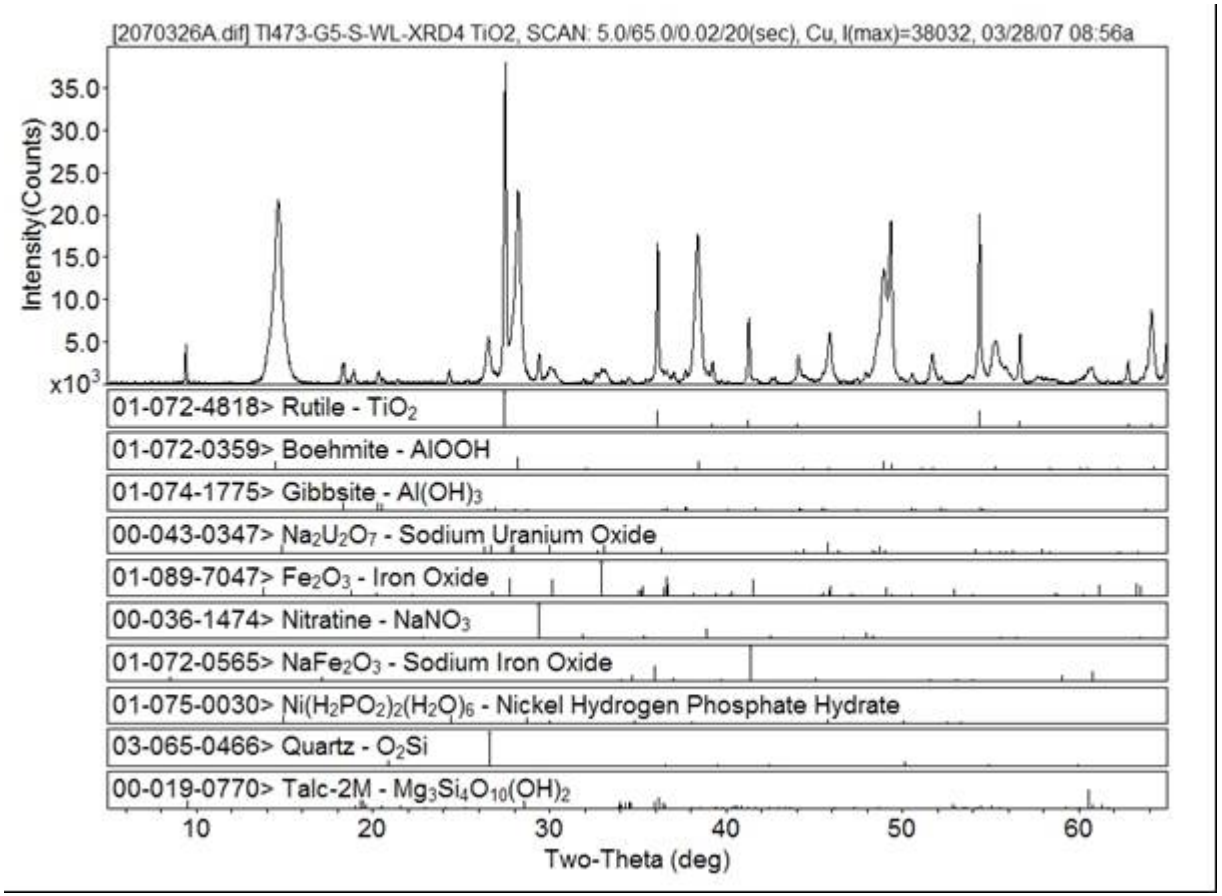
Pilot scale equipment description

- 100 gallon reactor vessel
- 3 sq ft of filter area (3 tube bundle)
- Processes 6 kg/h of simulated waste at 15 wt%
- Produces 5 kg/h of leached slurry at 15 wt%

Actual waste basis : REDOX waste

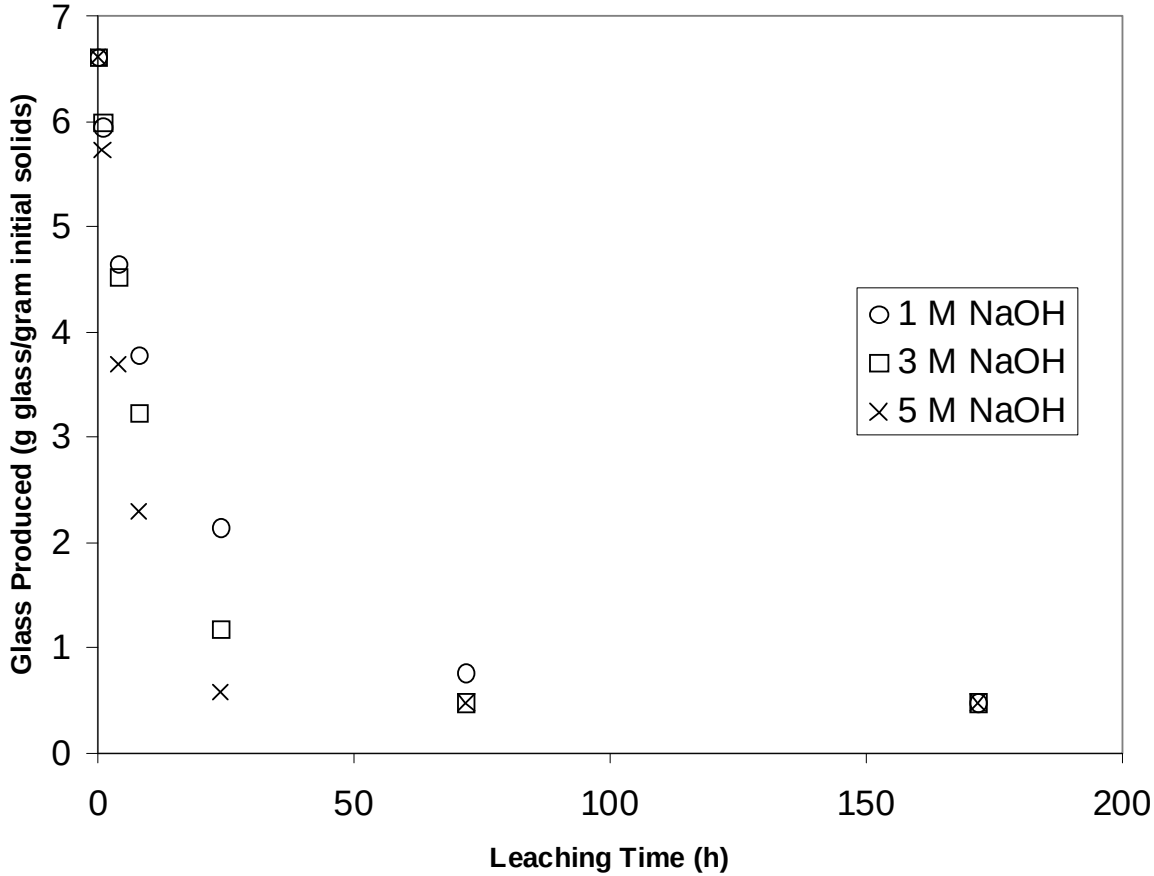
- REDOX waste is 90% boehmite and 10% gibbsite

Rutile added as an internal standard



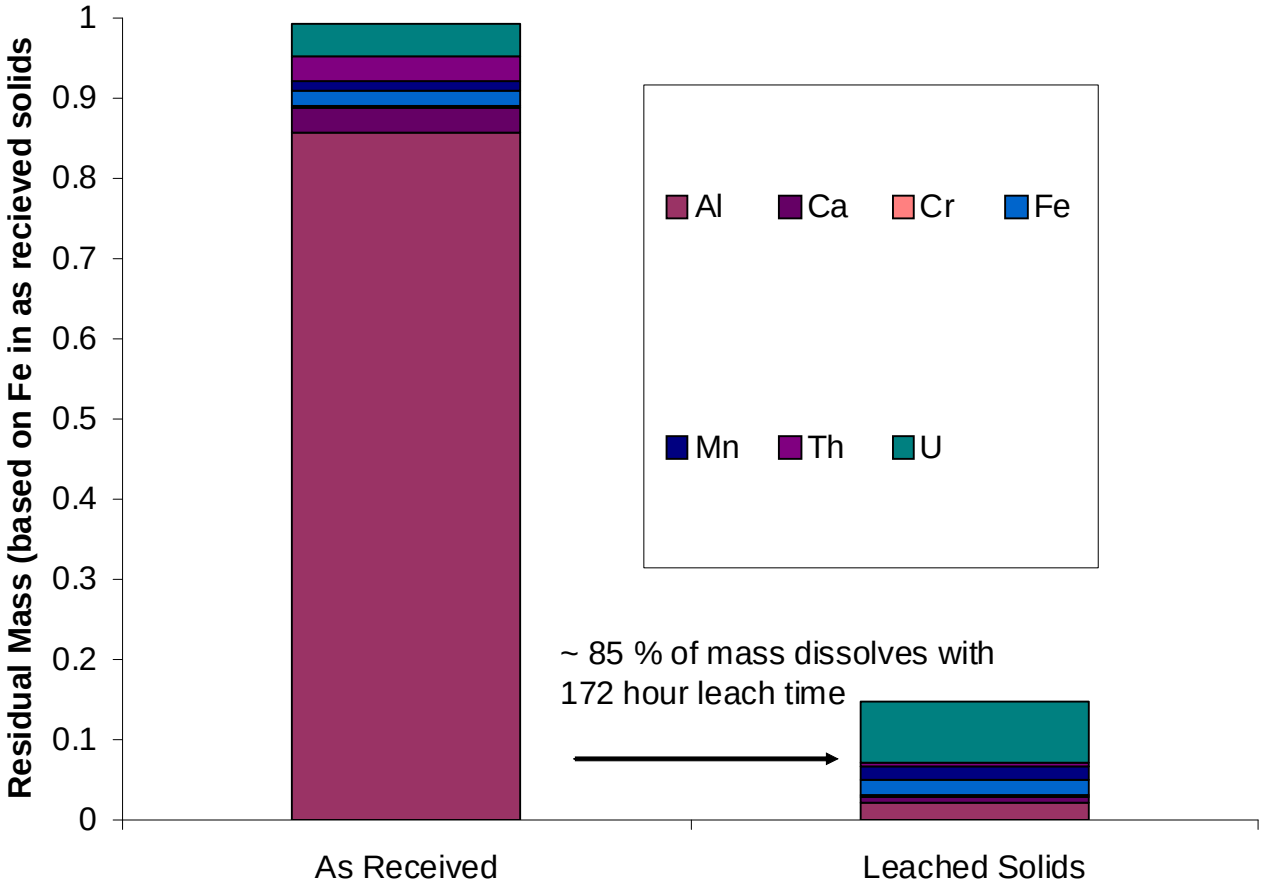
Actual waste basis: batch reaction performance

- Al eliminated as the waste loading constraining component by leaching in 5 M NaOH at 100°C for 24 h in very dilute caustic
  - U becomes the next limiting component

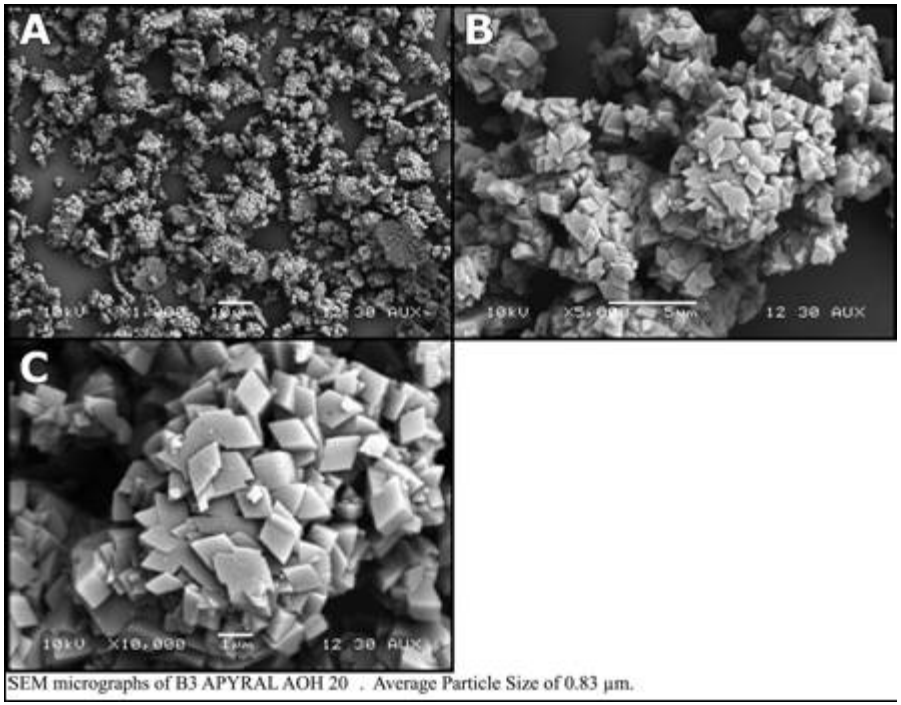


Actual waste: REDOX waste leaching results

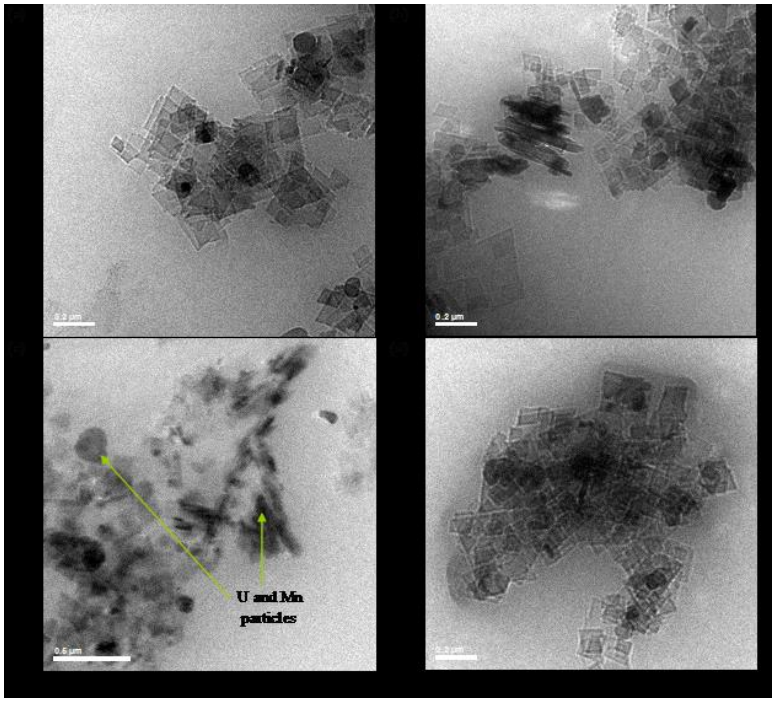
- 98% dissolution of Al
- Residual solids primarily U



Simulant demonstration: actual waste crystals are 2-3 times smaller than simulant crystals

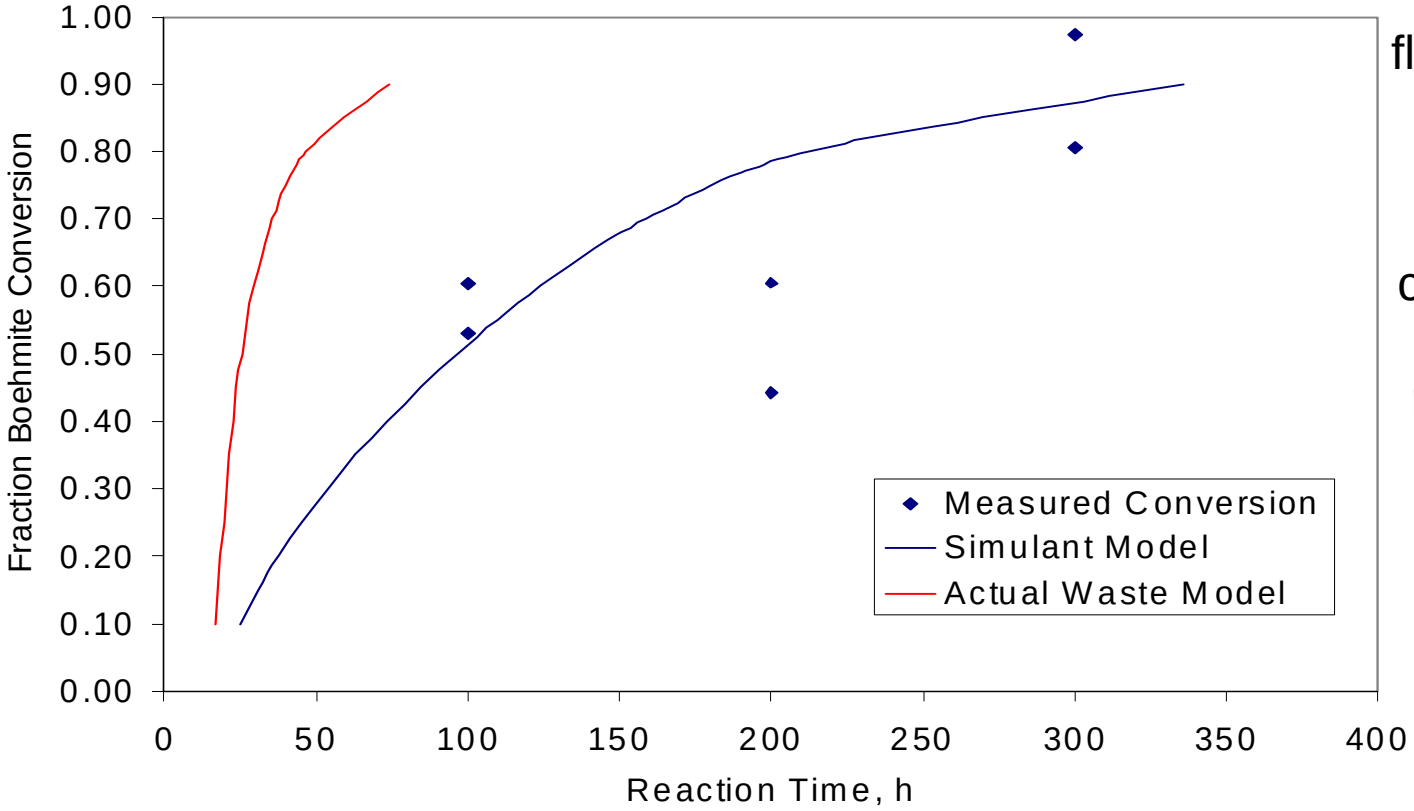


Simulant boehmite



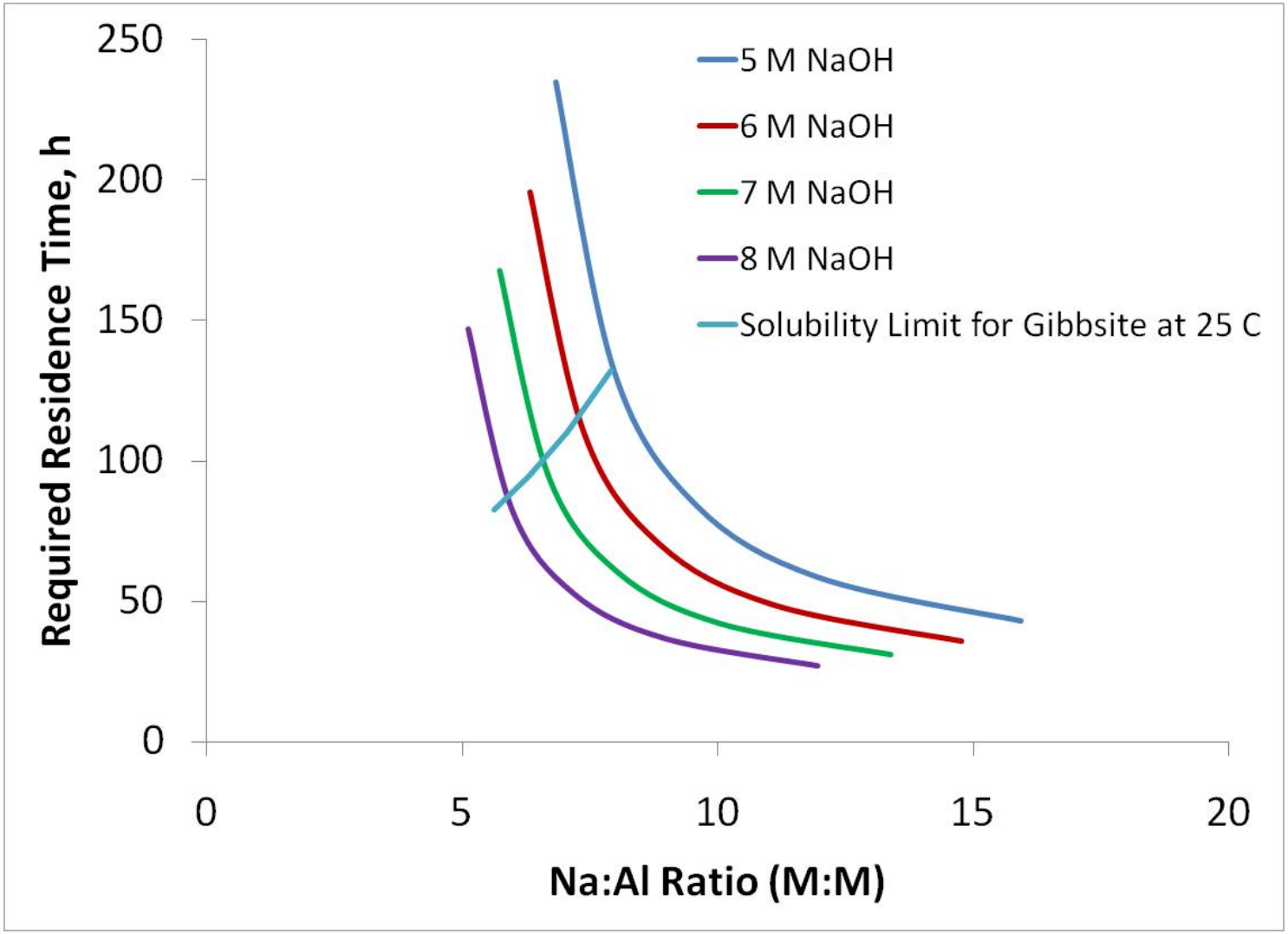
Actual waste boehmite

Bench scale simulant demonstration: boehmite conversion in bench scale CSL tests



Due to the low flows at this scale – there are experimental instabilities that can lead to lower than measured residence times

Process Optimization: increasing Na molarity allows smaller reactor



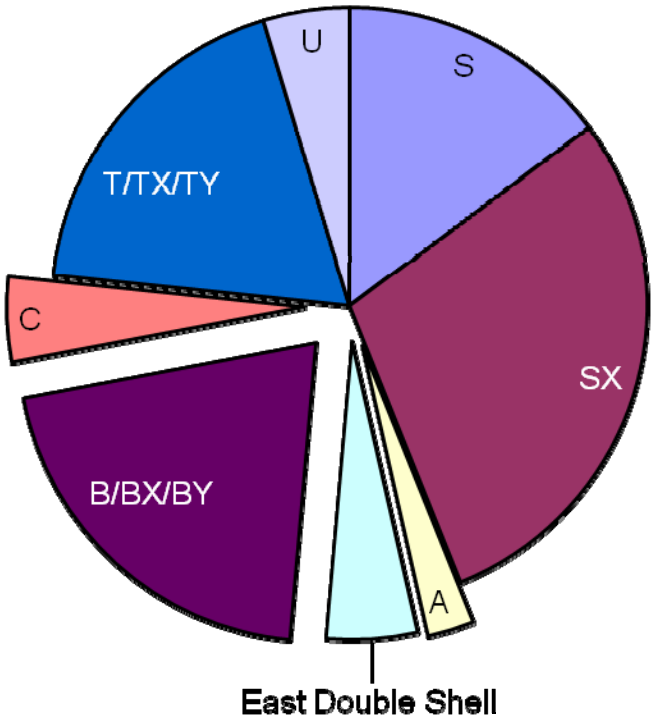
Target 90% Dissolution

Why CSL?

- Allows treatment of boehmite before it is blended with the balance of Al from the tank farms
- Smaller footprint than batch process
- Higher boehmite conversion than batch process
- Coincident chromium removal
- Improved system performance

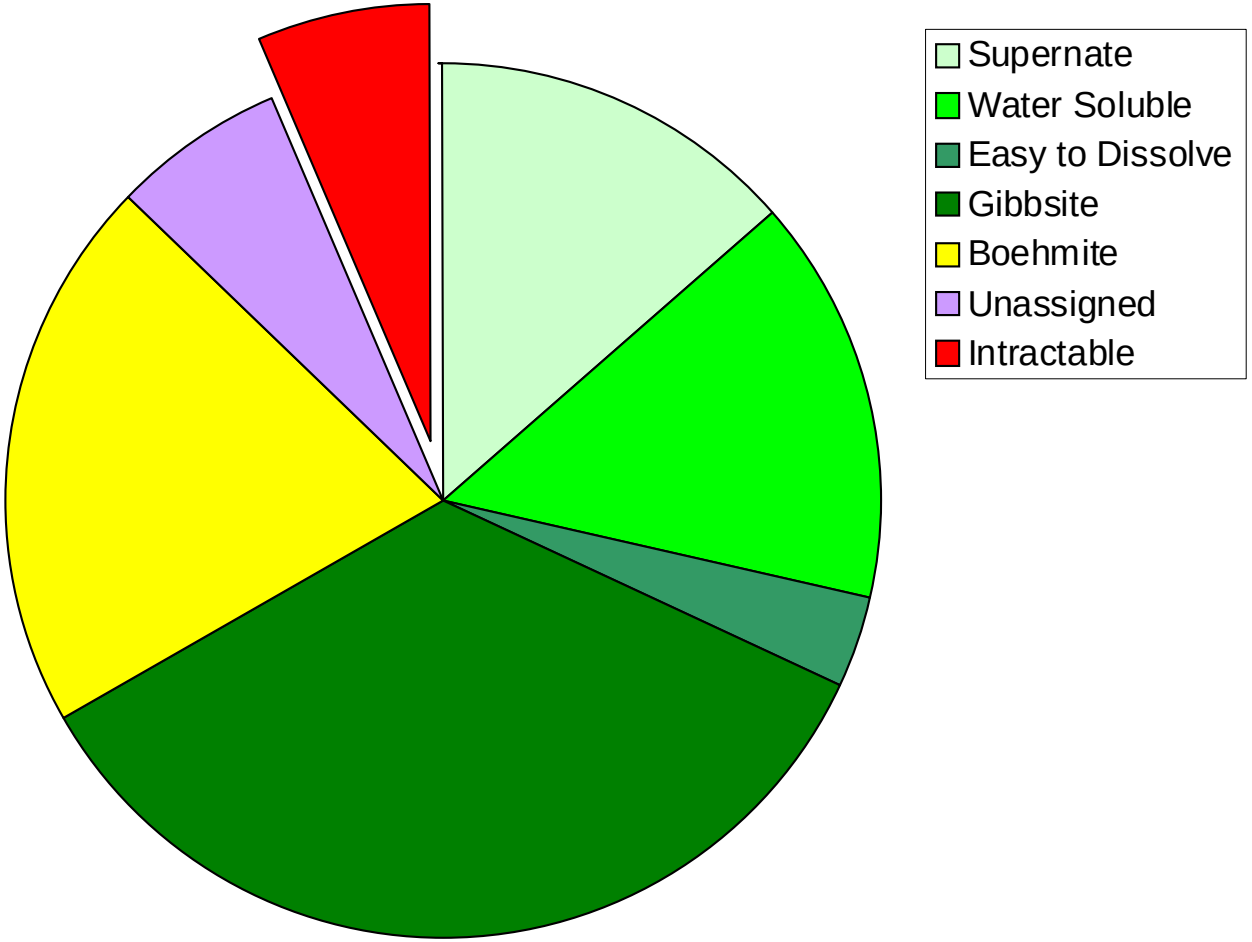
Treatment at the source

- S and SX tank farm contain a large quantity of Al

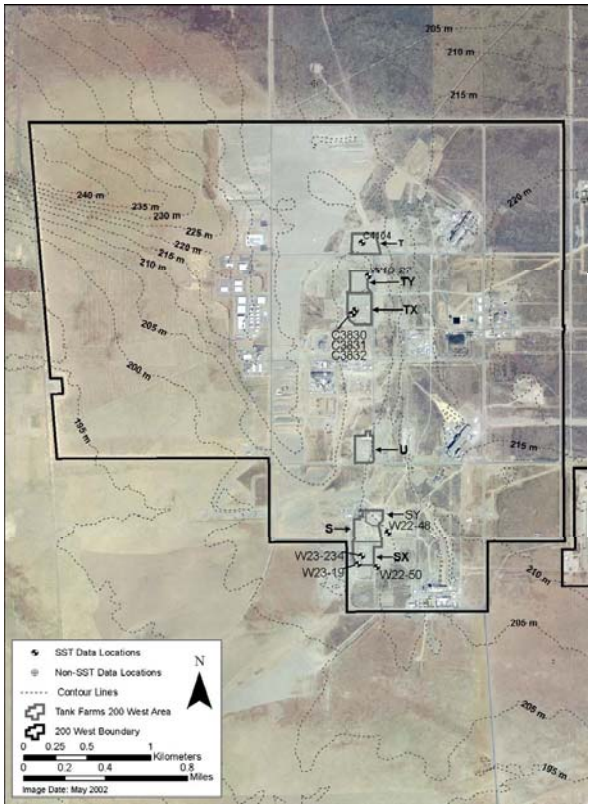


Treatment at the source: Inventory of Al in Hanford HLW

- 28% is water soluble
- 38% is relatively easy to dissolve
- 20% is boehmite
- Only 6% is known to be intractable

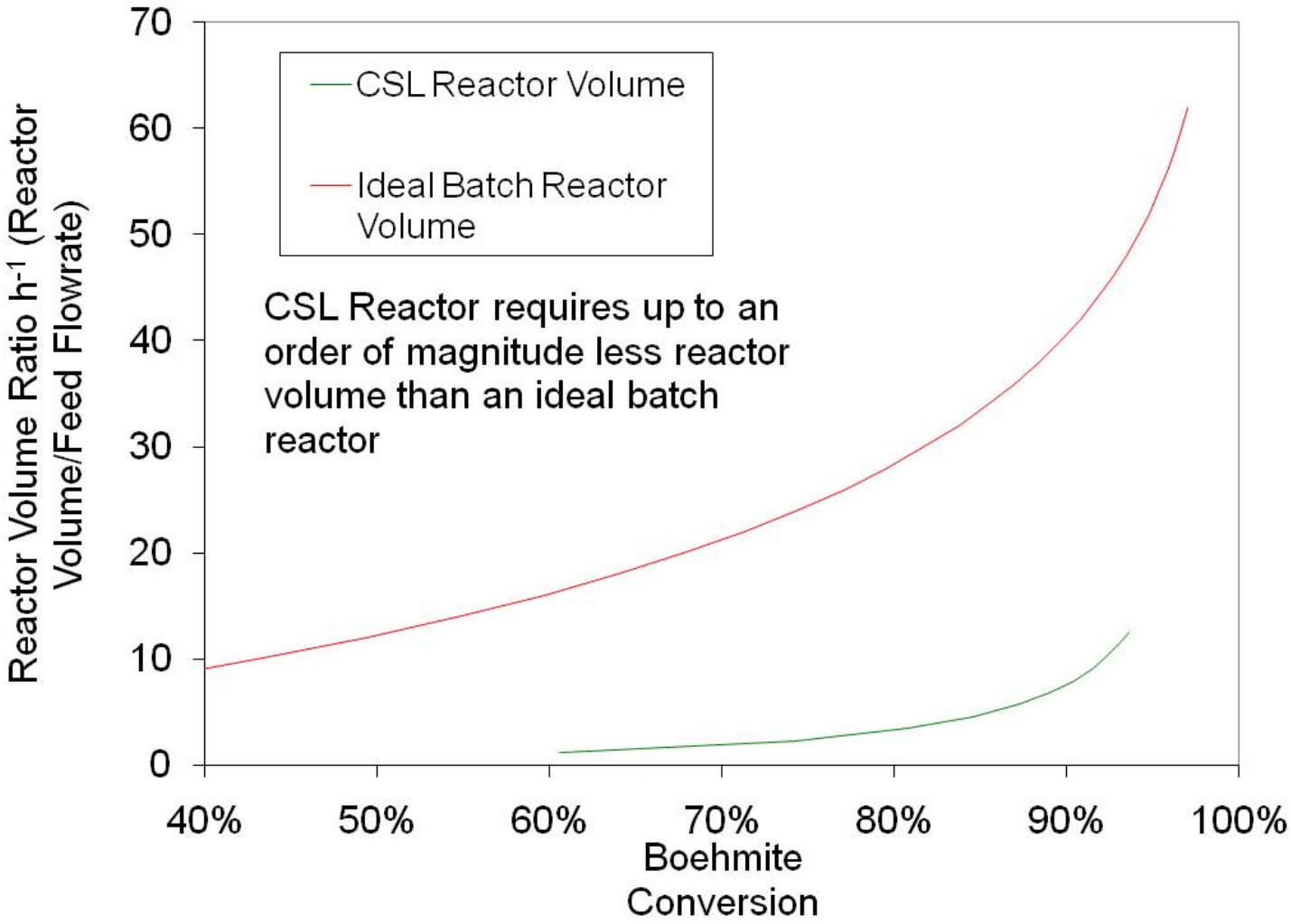


Treatment at the source: nearly all boehmite tanks are in S or SX tank farms in 200 West

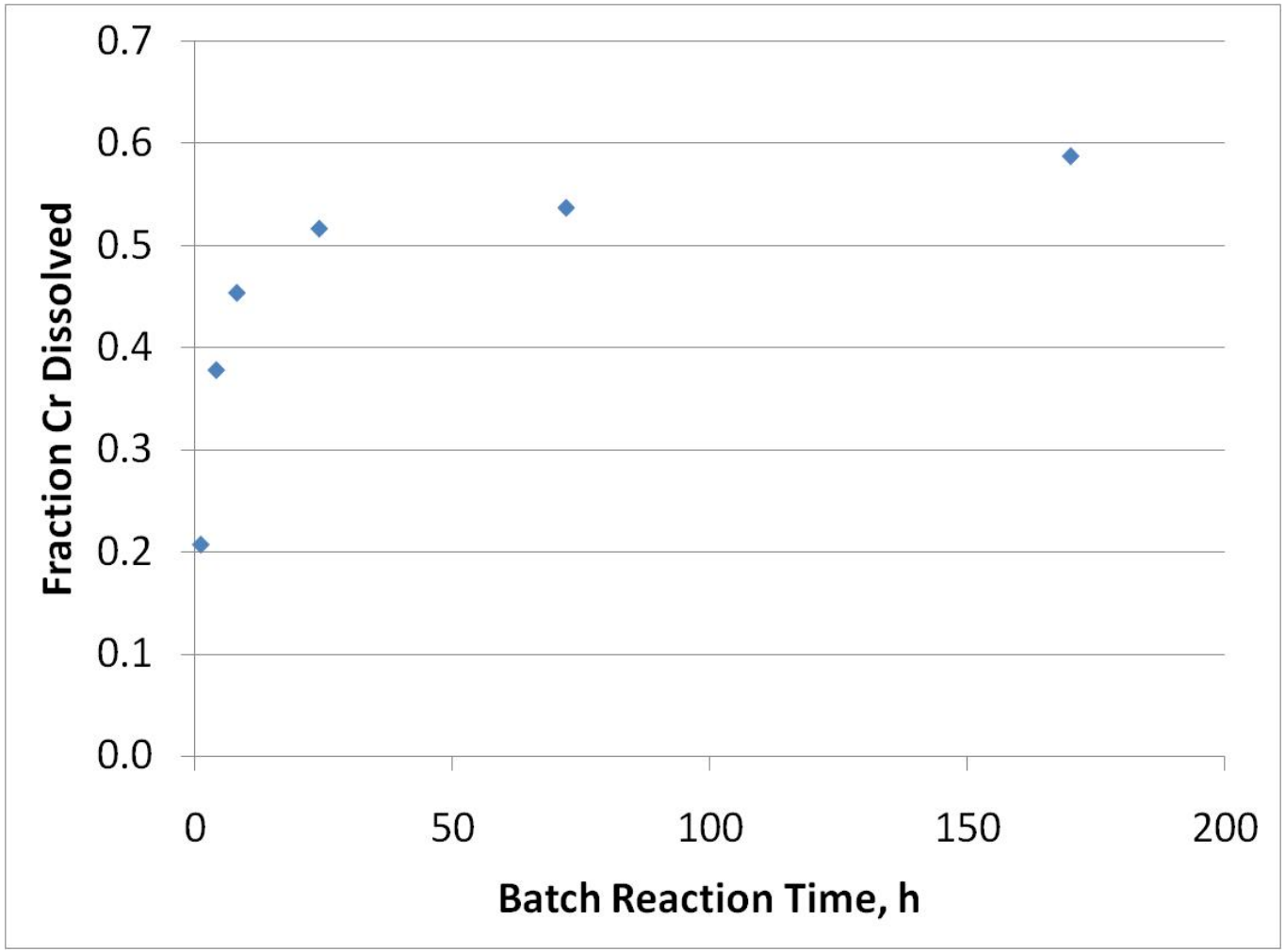


- Map shows aerial view of 200 W tank farms
- S and SX are co-located with SY tank farm
- SY is the only double shell tank farm in 200 W

Smaller footprint – Higher conversion



Coincident chromium removal through air oxidation



Batch results for REDOX waste in 5 M NaOH at 100 C

Improved system performance

- Implementation of CSL would likely reduce the amount of Al in HLW by a factor > 2
  - CSL can effectively remove > 90% of the boehmite
  - Current WTP flowsheet targets < 50% of the boehmite in HLW for dissolution
- CSL produces the most efficient use of caustic
  - Blending gibbsite and boehmite wastes results in more caustic usage to obtain the equivalent boehmite dissolution
- High boehmite waste shown to be rheologically intractable – however leached boehmite waste was shown to be relatively benign

Conclusions

- Implementation of the CSL process removes a significant bottleneck and technical uncertainty from the WTP flowsheet
- The CSL process is the most effective way to achieve ambient pressure dissolution of boehmite
- The CSL process uses caustic more efficiently than the current WTP flowsheet