

Pilot Scale Testing in Support of K-65 Waste Retrieval and Treatment at the Fernald Site



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**Hanford Pilot Plant
Lessons Learned
Meeting**

Pilot Testing for the Retrieval and Treatment of K-65 Waste at the Fernald Site

- **The Fernald Site near Cincinnati had 10,000 tons of uranium mill tailings (K-65 waste) stored in two 80-ft diameter by 36-ft tall silos.**
- **The waste was removed by slurry mining, concentrated in a clarifier and then grouted for disposal**
- **Slurry test loops at ORNL and Digital Instrumentation and Analysis Laboratory (DIAL) were used to evaluate pumping requirements and abrasion.**
- **The full-scale pumping and sluicing equipment was initially tested at TPG, Inc., where it was fabricated, and then installed on a test stand at Fernald to develop procedures and train operators.**

Silo at Fernald – Before Installation of Modules



Test Stand at TPG



The sluicing nozzles push surrogate to the slurry pump, which transfers the slurry to the receiving tank.

The surrogate was limestone sand of various size ranges, to match the particle size distribution of the K-65 waste.

Slurry Pump and Test Stand at TPG



Balancing water levels and sluicing spray locations was critical in moving surrogate slurry without losing pump flow.

Water levels too high and spray location too far from pump kept pump running, but did not move surrogate.

Pump never plugged at TPG.

Test Stand Building at the Fernald Closure Site





A metal test stand (70-ft long, 15-ft wide and 8-ft high), containing ground limestone sand as a K-65 waste surrogate, was used to represent the silos. The actual slurry pump and sluicing nozzles were mounted on the test stand building.

Surrogate slurry was pumped up to the top of the building (~20 ft) and then over to a tank.

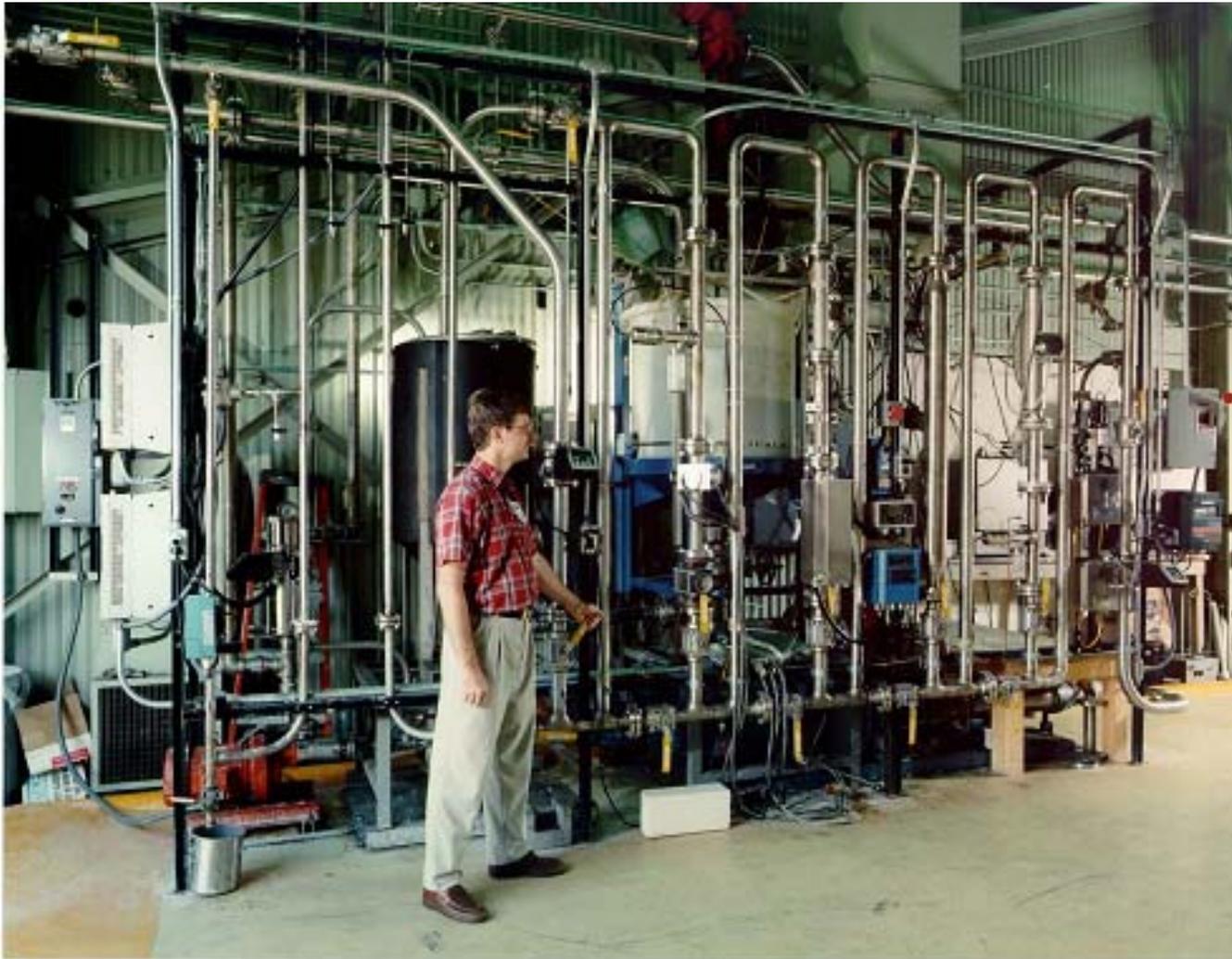
If pump loses suction and is left running, the discharge line will plug with solids.

Slurry Test Loops Were Operated at ORNL, using surrogates, and at DIAL, using surrogates and actual K-65 solids

These tests supported the design of the treatment facility

- **Determine minimum flow velocities to keep solids suspended**
- **Determine pressure drops at various velocities**
- **Measure abrasion in piping components**
- **Determine the accuracy and dependability of instruments for flow rate, pressure, solids concentration, density and radium concentration.**
- **Determine the dependability of various pumps.**

An Existing Slurry Test Loop at ORNL Was Modified for Testing the K-65 Surrogate Slurries



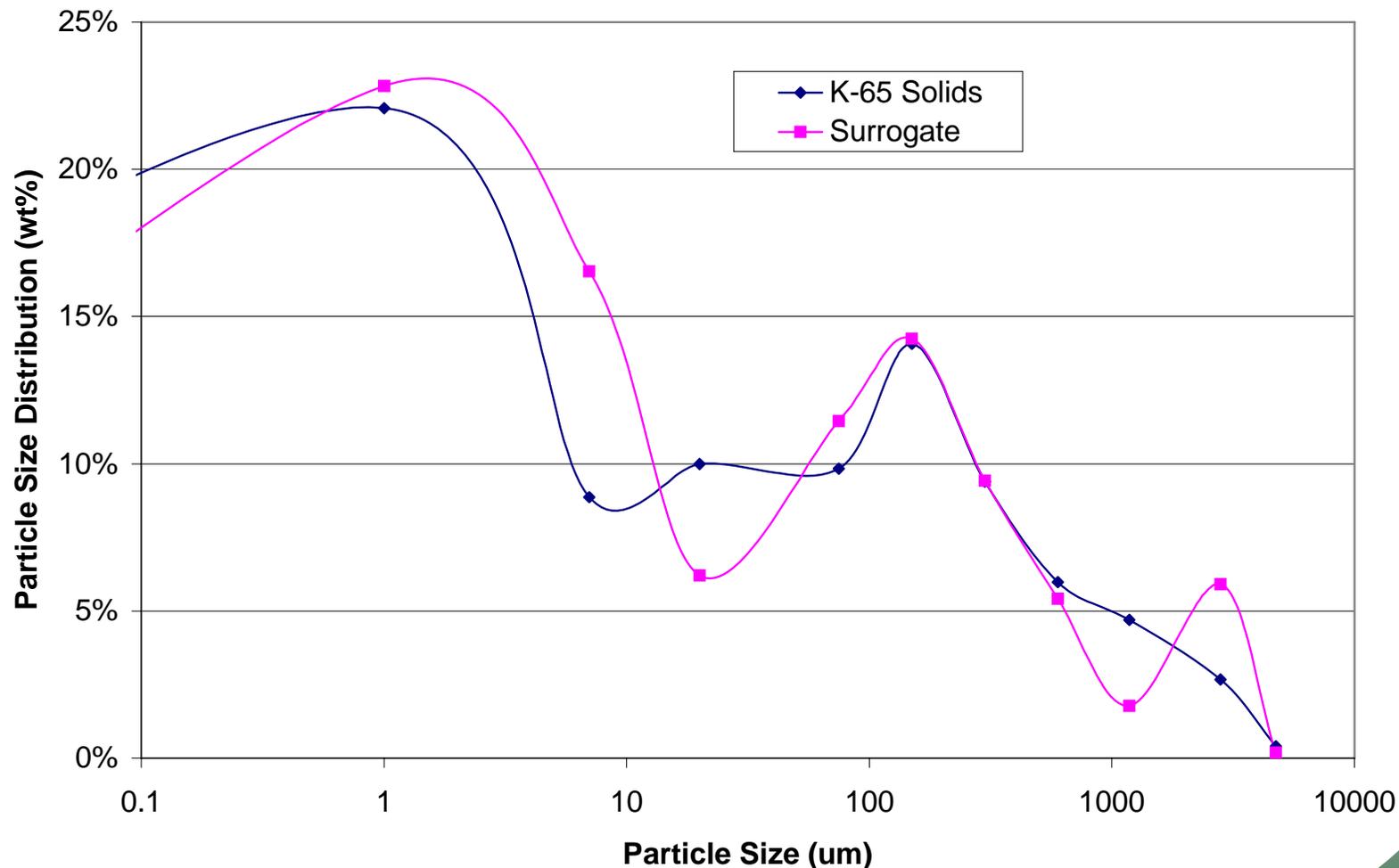
Surrogate materials were chosen to match abrasive properties of K-65 waste, while minimizing toxicity and cost

Composition of K-65 waste and surrogate			
Component	Mohs Hardness	K-65 (wt%)	Surrogate (wt%)
SiO₂	7	69.0	97.0
Al₂O₃	9	4.0	3.0
PbO	5	12.0	
Fe₂O₃	6	5.5	
BaO	5	5.5	
CaO	3	4.0	

Abrasion test using magnetic stirrer with Fe-Ni cylindrical magnet and 15% slurry of K-65 waste and surrogate showed similar weight loss. Standard test for abrasiveness of slurries (ASTM Method G75-95) requires specialized equipment and is not commercially available for radioactive materials.

Surrogate was composed of silica sand and silica flour to match particle size distribution, plus alumina

Particle Size Comparison of K-65 Waste and Surrogate



The Coriolis meter, which was the baseline instrument for density and suspended solids, showed abrasion which seriously affected the readings



A pinch valve, which was the baseline flow control valve, caused a high-speed jet that eroded the downstream pipe



Erosion caused by pinch valve in test loop



Results of Pump Testing

The rotary-lobe pump, which was the baseline for pumping the concentrated slurry, showed severe erosion. The backup progressive-cavity pump also showed severe erosion. A hardened centrifugal pump worked well.



Accomplishments From the Test Loops

- **A flow velocity of 5 ft/sec prevented settling of solids.**
- **Hardened centrifugal pumps were chosen for all slurry pumps in the treatment facility.**
- **Standard piping and elbows worked well, as long as there were no restrictions in the slurry flow path.**
- **A microwave densitometer worked well for measuring solids concentration.**
- **All of the pumps and instruments selected from the surrogate tests performed well in the treatment facility.**
- **The K-65 waste was successfully treated and shipped off-site and the Fernald site has been turned into a park.**