

Development of a Mechanical Based System for Dry Retrieval of Single-Shell Tank Waste at Hanford

Presented: May 1, 2013
to the U.S. Department of Energy
by Ximena Prugue
DOE Fellow, Research Assistant

*Worlds
Ahead*



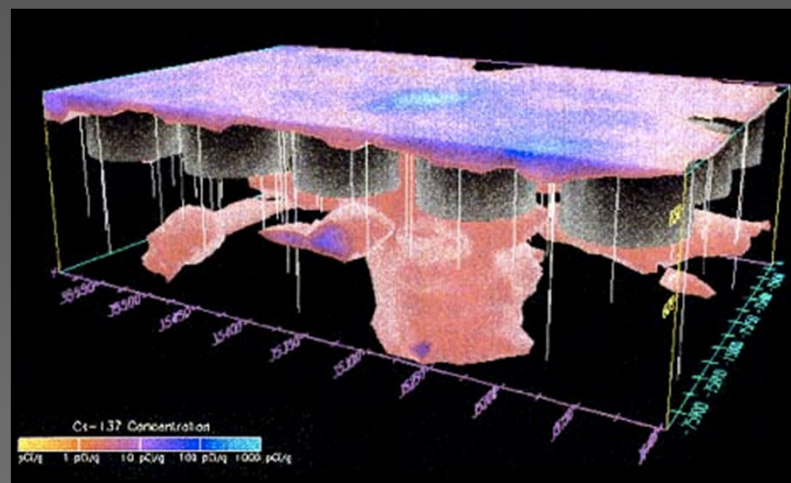
Background

- **DOE Fellow:** Ximena Prugue
- **Degree:** Bachelors of Science
- **Major:** Mechanical Engineering
- **Research Interests:**
 - Robotics and Energy Systems
 - Renewable Energy





Introduction



- Current retrieval methods for sludge and saltcake require significant amounts of water for retrieval (> 55,000 gal)
- Using large amounts of water makes it increasingly difficult to allocate space in the receiving double-shell tanks
- Several methods have also reached their “limits of technology” before reaching the residual waste volume goal of 30 ft³ for 200 series tanks and 360 ft³ for 100 series tanks



Problematic Tanks

- Need to address retrieval technologies for problematic tanks
- For 67 leaking SSTs, little or no water can be added to dislodge or mobilize waste without exacerbating the leak
- Several tanks contain air-lift circulators where an arm-based retrieval would not be possible
- There are sixteen 200-series tanks with a 20-ft diameter where an arm-based system could not be deployed
- Utilize existing risers to reduce risk of contamination
- ***No dry retrieval methods currently available***



Figure 1: Air-Lift Circulators in AX tanks at Hanford



History of SST Retrieval

Tank	Primary Waste Type	Retrieval Technology(ies) Deployed	Nominal Volume of Residual Waste (ft ³)
C-103	Sludge	Modified Sluicing	338
C-104	Sludge	Modified Sluicing, HWD	630
C-106	Sludge	Past Practice Sluicing, AD	370
C-108	Sludge	Modified Sluicing	1029
C-109	Sludge	Modified Sluicing	1150
C-110	Sludge	Modified Sluicing	2299
S-102	Saltcake	Modified Sluicing	4171
S-112	Saltcake	Modified Sluicing, RWL, CA	319
C-201	Sludge	Vacuum Retrieval	19
C-202	Sludge	Vacuum Retrieval	20
C-203	Sludge	Vacuum Retrieval	19
C-204	Sludge	Vacuum Retrieval	18



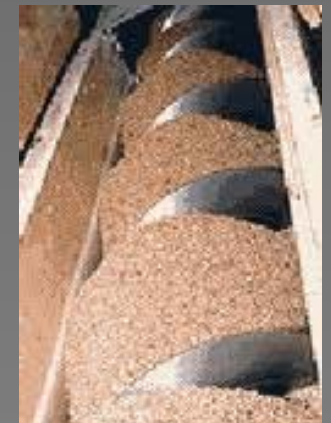
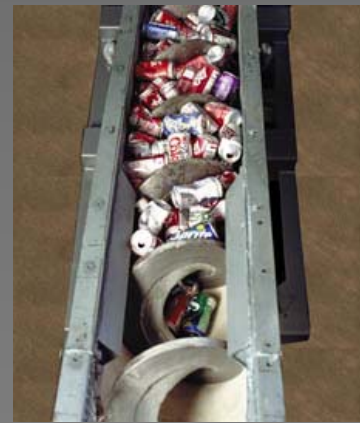
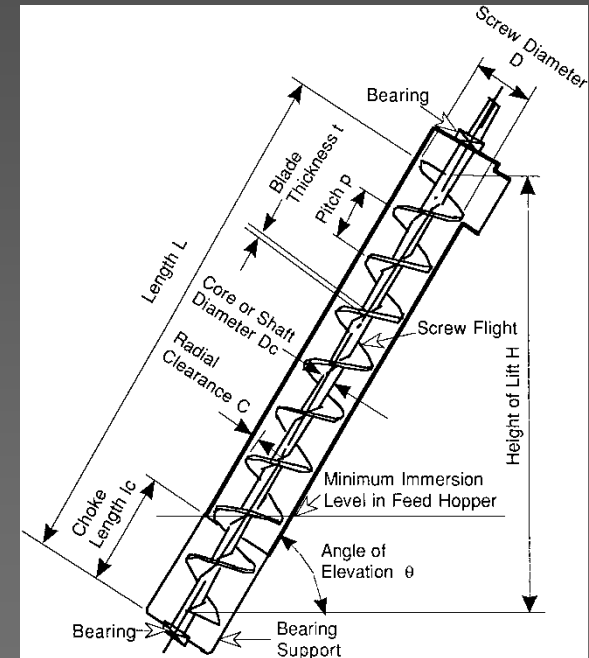
Scope of Work

- ▶ Evaluate existing methods for dry retrieval of solid waste from SSTs and report potential process improvements
 - Using the **least** amount of water
 - Retrieve the **most** amount of waste
 - In the most **efficient** manner
- ▶ Complete SST retrieval by 2040
- ▶ Optimize DST space
- ▶ Reduce environmental risk, especially for assumed leaking tanks



Screw Conveyor

- Ideally suited to handle a wide variety of materials and variable flow rate better than a pneumatic based system
- Lengths of over 50 m (~164 ft) are possible using only a single drive
- Entirely enclosed allowing fully contained waste transfer without any emissions or spillages
- Can be operated remotely
- Versatile and easily maintained with few moving parts





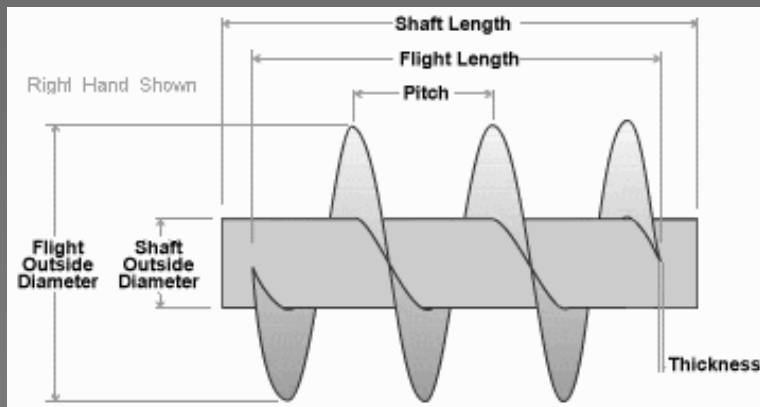
Design Parameters

Screw Capacity Factors:

- Particle Size
- Bulk Density
- Particle Shape

Screw Design Factors:

- Clearance between screw and shaft
- Free Length of the Intake



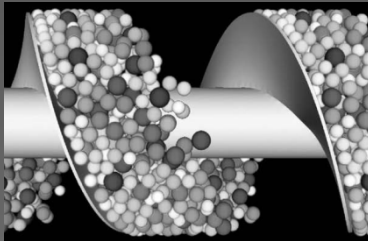
Methods to determine free-flowing properties of material:

- Hausner ratio = TD / AD
- Angle of repose



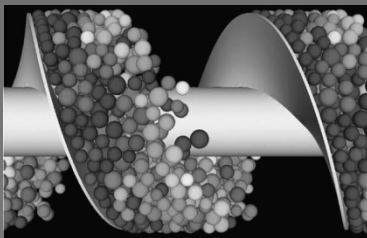
Empirical Methods - DEM

Particle Distribution



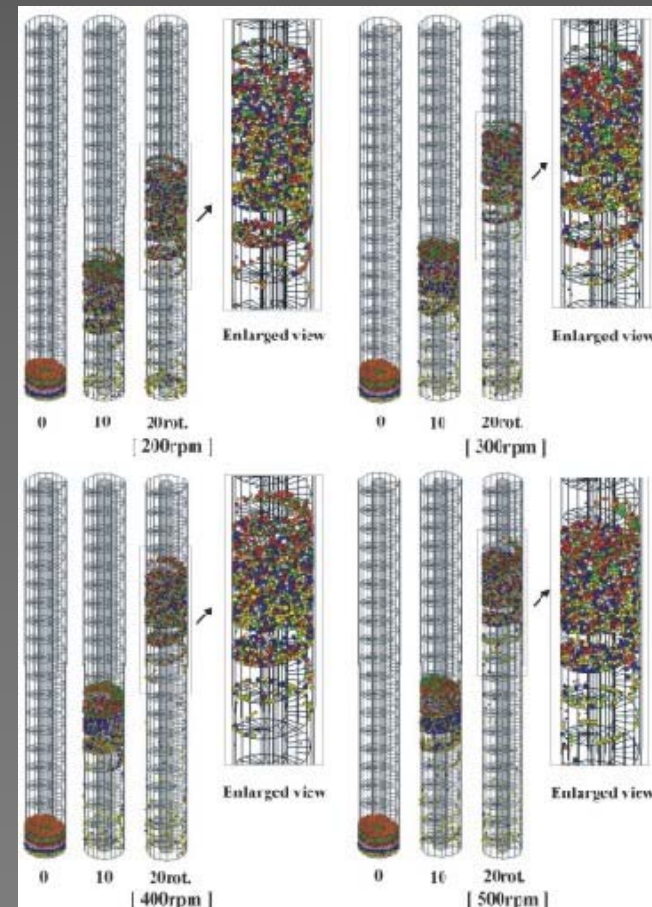
Particles are colored by diameter:
 smaller ones are light grey and
 larger ones are dark grey.

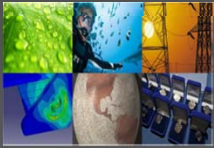
Particle Flow



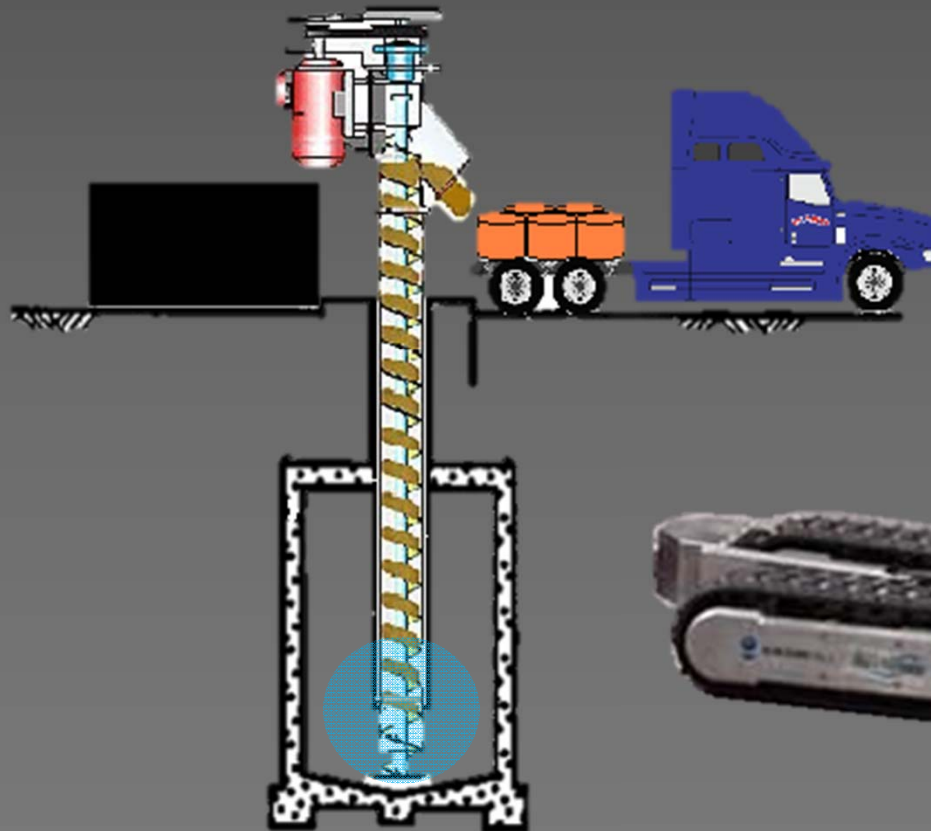
Particles are colored by their
 speed: from light grey to dark
 grey for 0.4 to 0.9 m/s.

Discrete Element Method





Configuration



WIPP





Other Methods in Consideration

PITHOG Robotic
Crawler Dredge



SV60V and SV110V
pumps (SUPAVAC
Canada) can function as a
high lift vacuum and
transfer dry sand and
thick, aggressive sludges.



Outlook

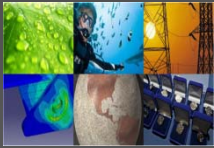
- Determine most accurate moisture distribution data for Hanford waste to be able to simulate waste through vertical conveyor
- Simulate conveyor using empirical methods
- Lab-scale testing



Accomplishments

- Abstract accepted for 15th International Conference on Environmental Remediation and Radioactive Waste Management in Brussels, Belgium this September
- Panelist at 2013 Waste Management Conference
- Third Place poster for in-house poster competition





Internship

- **Location:** Richland, WA
- **Time:**
 - Summer of 2012
- **Research**
 - Mobile Arm Retrieval System (MARS) for single shell tank retrieval

