Decreasing the Environmental Impact of Treating Slurry Waste Onsite by Mechanical Separation

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Agenda

- BOS Solutions Overview
- Equipment Overview
  - Centrifuges
- Dewatering Overview
- Case Study 1 – Mobile Site
  - Goals
  - Site Layout
  - Results
- Case Study 2 – Permanent Site
  - Goals
  - Site Layout
  - Results
- Product Development
- Conclusions

*The most dangerous phrase in language is “we’ve always done it this way”*
Solids and Liquid Separation, Benefiting the Environment

Core business is to separate suspended solids from a liquid phase to comply with varying objectives.
- Typically, to remove the solid from a liquid phase as a dry product to reuse the liquid phase (water, drilling fluid)
- Waste reduction, separating waste into two streams can produce manageable waste content and reduced volumes

Industry Applications
- Oil and gas drilling rigs and HDD pipeline construction
- Construction waste – Jet Grouting, Foundation Piling, Slurry Wall foundations, etc.
- Pond dredging, and reclamation
- Daylighting / hydrovac waste reduction
Equipment
Mechanical Treatment - Centrifuges

- Fully Variable Drive Centrifuges
  - Main Drive, Back Drive, Pump Drive
- Optimization for whatever slurry type processed
  - Varying solids content, particle diameter, particle density, fluid density and fluid viscosity
Centrifuge – Stokes’ Law

\[ V_s = \frac{gD_s^2(\rho_s - \rho_L)}{18\mu} \]

Where:
- \( V_s \) = terminal, or settling, velocity (m/s)
- \( g \) = acceleration of gravity (m/s\(^2\))
- \( \rho_s \) = density of the solid (kg/m\(^3\))
- \( \rho_L \) = density of the liquid (kg/m\(^3\))
- \( D_s \) = diameter of the solid (m)
- \( \mu \) = viscosity of the liquid (Poise)
BOS III Tank

- All-In-One 12’x43’ Footprint
- BOS Tank (III)
  - 9 Cell Tank
  - Polymer Tanks x 2
  - Heated Pumphouse
  - Hydraulically Lifted Stand
  - Self Cleaning
  - Gun Line and Suction in each cell
- Can hold 2 BOS 40 Centrifuges
Dewatering
Dewatering – Slurry Waste Reduction
Mobile Site Solution – Pipeline Construction Slurry Waste

 Traditional method of handling waste production
  • Transport waste to a disposal facility or spray-fields in Hydrovac trucks or capture slurry waste in large sumps on site

 BOS method
  • Receive and process the slurry waste at or near project site
  • Benefits
    • Reduce waste volume by producing a dry stackable solid
    • Produce a clear water for reuse when applicable
    • Reduce transportation and disposal costs
      • Solids waste hauled in end dump truck
Site Layout

**Sump A & B not shown**
Site Layout

- 400 BBL Tank
- 400 BBL Tank
- 400 BBL Tank
- Dual Shale Shakers
- Premix Tank
- Shale Bin
- BOS III Tank with 2 BOS 40 Centrifuges
- 175kW Generator

**Sump A**

- Slurry
- Solids
- Clean Water

**Sump B not shown**
Clear Water Results
Dry Solids Results
Performance Results

- Processed 2,445 m³s of hydrovac slurry waste (15,380 bbls)
  - 7 active HDD rigs
- Reduced waste volume by 32%
- Recovered 772.5 m³s of water for reuse (4,860 bbls)
- Produced 3,951 tonnes of dry stackable waste
  - Paint filter pass solids
Environmental Impact

By processing the waste at a mobile site instead of a Spray filed resulted in the following benefits:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Total Distance Reduced Going to BOS Site VS Sprayfield (km)</td>
<td>9,835</td>
</tr>
<tr>
<td>Added: Distance to Haul Solids to Landfill (km)</td>
<td>3,784</td>
</tr>
<tr>
<td>Added: Distance to Haul Clean Water to Crossing site (km)</td>
<td>2,123</td>
</tr>
<tr>
<td><strong>Total Distance Reduced (km)</strong></td>
<td><strong>3,928</strong></td>
</tr>
<tr>
<td>Total Time Reduced Going to BOS site VS Sprayfield (hrs)</td>
<td>348</td>
</tr>
<tr>
<td>Added: Time to Haul Solids to Landfill (hrs)</td>
<td>43</td>
</tr>
<tr>
<td>Added: Time to Haul Clean Water to Crossing Site (hrs)</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total Saved Time (hours)</strong></td>
<td><strong>276</strong></td>
</tr>
</tbody>
</table>
| Trucking Mileage Reduced                                        | 3,928  | Km
| Fuel Savings                                                    | 3,093  | L
| **Greenhouse Gas Emission Reductions**                           | **8,289** | kg CO₂
Key Findings

Quality of Recovered Water
• Passed microtox
• TSS: 22 mg/L
• EC range: 3 – 4 dS/m
• pH range: 7-8

Onsite Pump Off disposal investigated
• Recovered Water passed criteria but the location was too close to the city ditch system so the receiving soil was never tested
• Application Rate: 1,000 m³ / h
Central Site – Permanent Solutions

- Site accepting all types of hydrovac slurry waste

- Traditional disposal options
  - Landspray
  - Drying / decanting pads
  - Facility

- BOS System – dewater slurry waste to:
  - Produce a dry stackable solid
    - End dump transport to landfill for backfill
  - Produce a clear water
    - Reusable or sanitary sewer discharge
Central Site – Permanent Solutions

- Large dump pad designed to handle 5 vacuum trucks unloading at once

- Separation equipment housed in building for protection from weather

- Debris / branches / large organics initially sink, removed by hoe and slotted bucket

- Slurry and large solids (gravel size) are pumped to separation equipment.
Central Site – Separation Equipment

BOS III Tank and Centrifuges for Dewatering

Shaker tank and stacked shakers

Centrifuge for solids removal
Central Site – Separation Equipment

1. Slurry pumped to shaker, large solids removed
2. Effluent pumped to centrifuge, fine solids removed
3. Lighter fluid transferred to holding tank
4. Pumped to dual centrifuges for dewatering. Dry solids discharged in to bin
5. Clean water reused or disposed of
Central Site – Results

- Trucks per Day: 70-75
- Volume per Day: 700 m³
- Trucks per Week: 400
- Volume per Week: 4,000 m³
- Waste Reduction: 46%

Increased Equipment and Schedule:
  - Daily Operating Hours: 18
  - Days per Week: 5 or 6
Waste Reduction Comparison

Before – Slurry Waste

BOS Solutions – Dry Solids
Conclusions

• Reduction or elimination of vacuum truck utilization on large scale projects
  • Reducing greenhouse gas emissions – 2 kg of CO2 / km driven
  • Reducing public and site personnel risk
  • On average, reducing waste volume by 30-45%

• Reduction in fresh water usage
  • Reusable water removed from waste product
  • Reducing fresh water hauling to site
  • On average, recovering 1,100 m3s per project

• Value add
  • 20-35% cost savings on trucking and waste disposal bills, drilling fluid recycling, etc.
Product Development

- Fully mobile on trailer with no transportation restrictions

Benefits
- Can handle high solids content material being moved by bucket (loader or track hoe)
- Incorporates all separation types
- Immediate rig up and use
- Can be utilized for:
  - Spill response
  - Variable volumes processing
  - Easily associate additional services (oil/water separation)
Questions?