TWMA

Drilling Waste Treatment - taking the solution to location
Process Flow

Diagram showing the flow of materials through a process with labels for Control Unit, Engine, Mill, Oil Condenser, Cyclone, Heat Exchanger, Steam Condenser, Rotary Valve, Screw Conveyor, Recovered Powder, Recovered Oil, Recovered Water, and Cuttings From Feed.
TCC-RotoMill Offshore
Typical Offshore Layout
Processing Sites
TCC-RotoTruck
TCC-RotoTruck

Video
Case Study – Wyoming

Current Disposal Costs

- Diesel Oil Based Drilling Wastes generated: 430.61 ton
- Costs for encapsulation per Well: $90,223.00
- Recovered Oil from Wastes: 0 bbls
- Net Cost per ton: $209.52
TCC RotoTruck Project Costs

• Oil Based Drilling Wastes Processed: 430.61 ton
• TCC RotoTruck Processing Costs, $430.61 x $175.00: $75,356.73
• Plus Diesel used to Power Unit: $17,395.00
• Plus Mobilization/ Demobilization: $4,000.00
• Recovered Oil from Drilling Wastes: 349.50 bbls
• Less Recovered Oil Value @ $147.00 per bbls: $51,376.50
• Net Cost to process Drilling Wastes: $45,375.26
• Net Cost per ton: $105.37
Project Saving

Net Current Cost per ton: $209.52
Net TCC-RotoTruck Cost per ton: $105.37
Savings per ton: $104.15
Savings Per typical well: $44,848.03
Wyoming Oil and Gas Conservation Commission

- Pit treatment company must get annual approval from the WOGCC

- TPH limit of 1,000 mg/kg – 10,000 mg/kg depending on sensitivity of site.
  - Most sites get 10,000 mg/kg limit.

- SAR limit of 12 if spreading on surface – no SAR limit if buried 3’ below surface

- Pre-treatment notification to WOGCC. Follow-up report and analyses within 60 days.
Wyoming Oil and Gas Conservation Commission

- If treating wastes must do Wyoming Leachate Test Procedure:
  - TPH leachability limit of \( \leq 10 \text{ mg/l} \)
  - TDS leachability limit of \( \leq 5,000 \text{ mg/l} \) if spread on surface
  - SAR limit of 12 if spread on surface
  - Commercial treatment sites fall under the jurisdiction of the Wyoming DEQ
Pre Treatment Analytical Results

<table>
<thead>
<tr>
<th>Well Location</th>
<th>Date</th>
<th>Sample date</th>
<th>Leachate – TDS (mg/L)</th>
<th>Leachate – TPH – Organics (mg/L)</th>
<th>Total Petroleum Hydrocarbon – Organics (mg/kg)</th>
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</thead>
<tbody>
<tr>
<td>Wyoming</td>
<td>2010</td>
<td>5/19/10</td>
<td>4150</td>
<td>124</td>
<td>158,045</td>
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<td>Oil and Gas Conservation Commission Limits (&quot;Guideline for Closure of Unlined Production Pits&quot;, 12/10/02)</td>
<td>5000</td>
<td>10</td>
<td>1000\textsuperscript{A}, 10000\textsuperscript{B}</td>
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</tbody>
</table>

‘A’ – Limit for Critical Areas defined by the “Guideline for Closure of Unlined Production Pits”, 12/10/023.  
‘B’ – Limit for Non-Critical Areas established, following WOGCC “Guideline for Closure of Unlined Production Pits”, 12/10/02
Post Treatment Analytical Data

### Typical Recovered Materials Wyoming - OBM

<table>
<thead>
<tr>
<th>Well Location</th>
<th>Date Processed</th>
<th>Sample date</th>
<th>Sodium Adsorption Ratio (SAR)</th>
<th>Leachate – TDS (mg/L)</th>
<th>Leachate – TPH – Organics (mg/L)</th>
<th>Total Petroleum Hydrocarbon – Organics (mg/kg)</th>
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</thead>
<tbody>
<tr>
<td>Wyoming</td>
<td>2010</td>
<td>6/7/10</td>
<td>9.7</td>
<td>954</td>
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<tr>
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<tr>
<td>Wyoming</td>
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<td>18.2</td>
<td>4040</td>
<td>&lt;0.5</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>
| Oil and Gas Conservation Commission Limits  
("Guideline for Closure of Unlined Production Pits", 12/10/02) | | | 12 | 5000 | 10 | 1000^A, 10000^B |

^A – Limit for Critical Areas defined by the “Guideline for Closure of Unlined Production Pits”, 12/10/023.

^B – Limit for Non-Critical Areas established, following WOGCC “Guideline for Closure of Unlined Production Pits”, 12/10/02

Recovered Water was used to rewet the Recovered Powder which was buried and covered on location in accordance with BLM Regulations. Recovered Oil was reused in the Drilling Fluid.
Texas Rail Road Commission Clean-up Standards

Onsite/On-lease Burial Oil Based Cuttings

- Bury 3’ below surface

- TPH limit of \( \leq 1\% \) (10,000 mg/kg)

- EC limit of \( \leq 4 \text{ mmhos/cm} \) or background if background > 4 mmhos/cm

- pH limit of \( \geq 6 - \leq 10 \text{ s.u.} \)

- Benzene \( \leq 0.05 \text{ mg/kg} \)
Texas Rail Road Commission Clean-up Standards

Onsite or offsite Land Treatment of Oily Waste

• Spread on surface or incorporate into top few inches of soil profile

• TPH limit of ≤ 1% (10,000 mg/kg).

• EC limit of ≤ 4 mmhos/cm or background if background > 4 mmhos/cm

• pH limit of ≥ 6 - ≤ 10 s.u.
Texas Rail Road Commission
Clean-up Standards

Onsite and Offsite land farming of water based drilling fluids

• Chlorides must be less than 3,000 mg/kg

• Onsite land farming does not need a minor permit

• Offsite land farming does need a minor permit issued to the oil and gas operator
Centralized Treatment Plants - *(same operator but wastes are from multiple leases)* & Commercial Treatment Plants *(multiple operators from multiple leases)*

- TPH limit of \( \leq 1\% \) (10,000 mg/kg)
- EC limit of \( \leq 4\) mmhos/cm or background if background \( > 4\) mmhos/cm
- pH limit of \( \geq 6 - \leq 10\) s.u.
- Total TOX
- TCLP metals and benzene.
Onsite land spreading or burial in pit

- Water based and oil based systems – cuttings must be removed from pit and dried (water based) or treated (oil based)

- Returned to pit or land spread must meet limits in **Table 910-1:**
  - TPH limit of ≤500 mg/kg
  - BTEX limits
  - PAH (polyaromatic hydrocarbons) limits
  - EC <4 mmohs/cm, pH 6.0 – 9.0 s.u., SAR 12.5, metals limits, including very low Arsenic limit
Colorado Oil and Gas Conservation Commission

- Arsenic limit of 0.39 mg/kg. Average background level is 11 mg/kg. If can prove below background – can get background limit

- Limits developed by Dept. of Health not COGCC

- In cropland or 100 year floodplain, must close pit within 3 months after drilling completed

- In non-cropland, must close within 6 months.
Non-commercial Centralized Treatment Facilities can be permitted under Rule 908

• For a single operator – cannot take wastes from 3rd party, except as part of a unitized area or joint operating agreement
North Dakota Industrial Commission
Oil and Gas Division

- Currently, reserve pits are only allowed in non-sensitive areas (non-shallow groundwater)

- Starting April 2012, all mud systems will be required to be closed loop – no reserve pits

- If in a non-sensitive area, dry or treated cuttings may be disposed of onsite in a lined (minimum of 16 mil liner) pit, buried 4’ below surface

- North Dakota does not have any pit closure limits or testing requirements.
Oil and Gas Division has jurisdiction of drilling wastes generated, treated, or disposed onsite if for a single well or a well spacing unit.

Central Location Treatment Sites
- Well spacing unit can include 1 – 6 wells depending on the size of the spacing unit. Cannot exceed 6 wells/spacing unit or 1280 acres.
- Totally under the jurisdiction of the Oil and Gas Division.
North Dakota Health Division

- North Dakota Health Department – Division of Solid Waste has jurisdiction for any wastes moved offsite

- Any offsite disposal areas must be permitted as a landfill

- If a central location receives wastes from multiple spacing units, it will be considered a **commercial site**. State currently has 4 permitted commercial sites.
A central commercial site would need a Waste Treatment Plant Permit from the Oil and Gas Division and a Landfill Permit from the Health Division.

Division of Health will set clean-up standards for at least TPH and Benzene.

Could set TPH limit of 500 mg/kg to 50,000 mg/kg and benzene limit of 10 – 50 mg/kg, depending on site and liner system.

If good liner system may not include TPH limit and benzene limit set as high as 50 mg/kg.
State Regulations Things to Remember

• Pit closure regulations and closure standards vary from state to state and even from site to site within the same state

• Offsite and commercial disposal operations take additional special permitting actions

• When proposing a project, engage with state regulatory agencies along with service provider early on

• Determine site conditions and treatment/disposal options. Get agency buy in prior to starting a treatment/disposal project
Summary

TCC-RotoMill/ TCC-RotoTruck

- TWMA Processed Cuttings since 1993 with this technology
- Footprint of Offshore TCC-RotoMill 688 ft²
- Footprint of TCC-RotoTruck two 45ft Trailers
- Highly Mobile with quick set up times
- Recovered oil unaffected by process
- Recovered powder less than 1%, typically less than 0.1%