It’s Only Muddy Water, So Why is it So Hard to Dispose of?
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Contact Link for Latest Information and OSU Fact Sheet

Email: Info@DitchWitch.com

Mention: HDD Mud Residue Disposal Research Information and Provide an Email Address

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But....
Research Provides Some Real Time Data and Measured Results for Disposal Options
1. Survey: Current Mud Disposal Methods and Info
2. Mud Sample Analysis Nationwide
3. Research Of Mud Disposal on Bare & Vegetated Soils
4. Conclusions, Is Land Application Safe and Viable?
5. Prescription for Land Application of Mud Residue
Key Survey Points

Question: Rank How Big of an Issue Mud Disposal is (10 = Major Issue)

- Job Site: 38%
- Dump Site: 19%
- Field or Lot: 24%
- Contractor Property: 21%

Question: Describe What your Usual "Fluid Disposal" Activity Looks Like?
**Key Survey Points**

**Question: How much Mud do you Dispose of per week?**

- **< 2.5**: 36%
- **2.5 - 5**: 27%
- **5 - 10**: 14%
- **10 - 20**: 14%
- **> 20**: 9%

**Mud Disposal 1000s Gal / Week**

**Question: Do you utilize a Reclaimer?**

- **No Reclaimer**: 60%
- **Add Reclaimer**: 27%
- **Use Reclaimer**: 13%
Example:

- Disposing of 8000 Gallons/Wk
- $27/Ton Disposal Fee (or $0.45/gal)
- 60 Mile Round Trip for Disposal
- Assume Mud Reuse Rate is 10:1
Example of Disposing of 8000 Gallons/Wk @ $0.45/gal

<table>
<thead>
<tr>
<th>Est. Disposal Fees using Conventional Mud Mixing</th>
<th>Est. Disposal Fees using Mud Cleaner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>312,000</strong> Tot Mud Gal/yr Disposed</td>
<td><strong>134,160</strong> Tot Gal/yr Disposed, incl soil cuttings</td>
</tr>
<tr>
<td><strong>24,960</strong> Total Miles Driven/yr</td>
<td><strong>10,733</strong> Total Miles Driven/yr</td>
</tr>
<tr>
<td><strong>1,129</strong> Disposal labor hrs + 1 hr per trip</td>
<td><strong>486</strong> Disposal hrs + 1 hr per trip</td>
</tr>
<tr>
<td><strong>347</strong> Number of Batches Mixed/yr</td>
<td><strong>35</strong> Number of Batches Mixed/yr</td>
</tr>
<tr>
<td><strong>$278,000</strong> Tot Equip Cost (FM25+2Vac+2Trucks)</td>
<td><strong>$205,000</strong> Tot Equip Cost (MR90+Vac+Truck)</td>
</tr>
<tr>
<td><strong>$14,560</strong> Tot Mud Cost per Year (Labor + Additives)</td>
<td><strong>$1,456</strong> Tot Mud Cost per Year (Labor + Additives)</td>
</tr>
<tr>
<td><strong>$22,583</strong> Tot Labor Cost for Disposal</td>
<td><strong>$9,711</strong> Tot Labor Cost for Disposal</td>
</tr>
<tr>
<td><strong>$140,400</strong> Disposal Fees $/Year</td>
<td><strong>$60,372</strong> Disposal Fees $/Year</td>
</tr>
<tr>
<td><strong>$28,080</strong> Vehicle Op Cost for Disposal</td>
<td><strong>$12,074</strong> Vehicle Op Cost</td>
</tr>
<tr>
<td><strong>$92,667</strong> Equip Cost (1/3 each yr)</td>
<td><strong>$67,650</strong> Equip Cost (1/3 each yr)</td>
</tr>
</tbody>
</table>

**$298,290** Yearly Disposal & Operating Cost

**$151,263** Yearly Disposal & Operating Cost
Everyone Says it’s Harmless, So
Why is it so Hard to Dispose of “Muddy Water”? 

Mud Sample Survey and Analysis
Mud Sample Survey

56 Samples
28 States
Mud Sample Analysis

• Solids Content
  - Dry sample weight divided by wet weight

• Electrical Conductivity (Dissolved Solids)

• pH (Acid/Base)
# Mud Sample Analysis

## EC (µS/cm), pH, and Solids Content

<table>
<thead>
<tr>
<th></th>
<th>Electrical Conductivity</th>
<th>pH</th>
<th>Solids Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1181.4</td>
<td>Mean</td>
<td>7.37</td>
</tr>
<tr>
<td>Median</td>
<td>925.7</td>
<td>Median</td>
<td>7.48</td>
</tr>
<tr>
<td>Minimum</td>
<td>118.1</td>
<td>Minimum</td>
<td>4.69</td>
</tr>
<tr>
<td>Maximum</td>
<td>3950.0</td>
<td>Maximum</td>
<td>9.95</td>
</tr>
</tbody>
</table>

**Threshold for Saline Soils > 4000**

**Most Soils Range from 4.5 – 8.5**
## Mud Sample Analysis

### EPA 3050B Solids Digestion

<table>
<thead>
<tr>
<th>Metal</th>
<th>Typical Levels in Soil (mg/Kg)</th>
<th>Number of Samples Above Range Of Typical Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>6 - 80</td>
<td>5</td>
</tr>
<tr>
<td>Manganese</td>
<td>80 - 1300</td>
<td>1</td>
</tr>
<tr>
<td>Zinc</td>
<td>17 - 125</td>
<td>1</td>
</tr>
<tr>
<td>Nickel</td>
<td>4 - 55</td>
<td>0</td>
</tr>
<tr>
<td>Arsenic</td>
<td>4 - 9</td>
<td>0</td>
</tr>
<tr>
<td>Chromium</td>
<td>7 - 221</td>
<td>0</td>
</tr>
<tr>
<td>Cobalt</td>
<td>1 - 22</td>
<td>0</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.06 - 1.1</td>
<td>0</td>
</tr>
<tr>
<td>Lead</td>
<td>10 - 84</td>
<td>0</td>
</tr>
</tbody>
</table>

Mud Sample Analysis
Liquid Portion: EPA Criteria for Aquatic Life

So you might not want to use if for your Aquarium.
But nothing in this data indicates its unsafe for land application.
Mud Sample Analysis

Liquid Portion: Sodium Adsorption Ratio

So you might not want to use it for your Geraniums. Nothing in this data indicates it is unsafe for land application.
Mud Sample Analysis
Total Metals in Solid Portion

% of Max of EPA 503 Biosolids Land Application Threshold

100% of 56 Samples (28 States) were well below EPA 503 Max Threshold
All could safely be land applied
Mud Sample Analysis
Plant Available Nutrients

Percent of Agronomic Optimum (for turfgrass)

Potassium
Phosphorus
Magnesium
Calcium

Mean %
Median %
Min %
Max %
Nation Wide Mud Sample Survey

The “Big Picture”

Potting Soil vs. 100% could be used as Soil Amendment
HDD Residual (Mud) Land Application Studies

Two field studies

1. Vegetated Bermuda Pasture or Hayfield (Cover)

2. Bare plots with all Vegetation Removed (Bare)
Covered Plots

Mud Residue Applied at rates of: 0, 10, 20, 30, 40 & 50 Tons/Acre of Solids portion

50 T/Ac Plot Immediately after application
Covered Plots

Row of plots after Application
50 Tons/Acre Plot in foreground

Days later after a rain
Covered Plots: Biomass after 120 days

- Means appears to indicate an increase in Biomass with application of mud.
- But Statistical analysis shows no significant difference at 95% Conf Level.
Bare Plots

Plots Scraped Clean and Leveled

Uniformly Seeded with Bermuda Grass
Bare Plots

Mud Applied at rates of: 0, 10, 20, 30, 40 & 50 T/Ac

50 T/Ac Solids, in Foreground
Bare Plots

120 Days After Application, No Irrigation
Bare Plots: Day 60

- 10 T/Ac produced significantly higher cover than control and other rates
- 50 T/Ac was significantly lower than control
Conclusions for Land Application Studies

1. Sample Days 0, 7, 30, and 90
   - No significant chemical change in the soil for all rates on both covered and bare plots

2. Yield on covered plots
   - No significant difference in yield for all rates on covered plots
   - Though means seem to indicate an increase in yield w mud

3. Percent cover on bare plots
   - 10 tons per acre significantly higher than control and other rates
   - 50 tons per acre significantly lower than control
   - All other Plots were not significantly different than control
Summary of Research

- Nationwide Sample Analysis - Chemical & Physical Characterization
  1. Solids Portion: No harmful amounts of heavy metals found
  2. All samples fell far below EPA 503 Heavy Metal Criteria for EQ Biosolids.
  3. Water Portion: Cd in some samples was only constituent found above EPA Criteria for Aquatic Life (Note, this is a criteria for surface water).
  4. All samples were Safe for Land Application

- Field Study
  1. No significant difference in biomass yield
  2. No significant chemical change to soil after application
  3. Possibly aids in germination at the lowest rate applied (10 tons/acre)
  4. Possibly hinders germination at the highest rate applied (50 tons/acre)
  5. Safe for Land Application

- Caution: though no indication of excess contamination was found, that does not mean none exist everywhere. Exercise care if drilling at a site that is suspected of being in a contaminated area; have soil or mud tested before disposal.
“Prescription” for Land Application

1. Investigate the jobsite, is the HDD Job site in a known or historical area for contamination?
   - If Yes: Test or Dispose Mud Residue at appropriate dump site.

2. Establish desired application rate of solids 10-50 Tons/Acre
   - Note for watery light muds, heavy application rates can require > 1 inch
   - Vegetated: Do not exceed 50 tons/acre of solids.
   - Bare Plots: Do not apply more than 40 tons/acre to bare soils.
     • Exercise caution for watery muds, they will easily flow across bare soils
“Prescription” for Land Application

Continued:
3. Mix or agitate the tank before application

4. Measure Mud Residue Density in (lb/gal)
   • Mud Balance (lb/gal)
“Prescription” for Land Application

Continued:

5. Knowing that typical soils and rock have density around 22 lb/gal or less, and water is 8.3 lb/gal. You can calculate the Total Volume of Mud Residue required to apply over one acre. Use Equation below or Graphical Method on next page.

- In Equation Below, Insert \textit{Mud Density (lb/gal)} from step 4 and \textit{Desired Solids Application Rate (Tons/Ac)} from step 2.

\[
\text{Tot Gallons Mud Residue} \quad \frac{\text{Acre}}{\text{Acre}} = \frac{\text{Tons}}{\text{Acre}} \times \frac{1250}{\text{Mud Density} \quad \text{(lb/gal)} - 8.3}
\]

- Example, to apply a desired 40 ton/acre of solids with mud density of 12.3 lb/gal.

\[
12,500 \quad \text{Gal/Ac} = \frac{40 \quad \text{Tons}}{\text{Acre}} \times \frac{1250}{12.3 \quad \frac{\text{lb}}{\text{gal}} - 8.3}
\]

Indicates that you would need to apply 12,500 gal/acre of mud residue to apply 40 tons of solid material per acre.
“Prescription” for Land Application

Gallons of Mud Residue to Apply per Acre

1. Measure Mud Residue Density
2. Determine Desired Rate of Solids Application
3. Find Density Value along X-axis
4. Move Vertically up to Desired Rate Curve
5. Move Horizontally Left to Determine the Total Volume to Apply per Acre

Gallons of Mud Residue Applied (gal/acre)

Mud Residue Density (lb/gal)

Desired Rate of Solids Application
- 10 T/Ac
- 20 T/Ac
- 30 T/Ac
- 40 T/Ac
- 50 T/Ac
Application Rate Per Pass

- $210 \text{ ft} \div 10 \text{ ft (App Width)} = 21 \text{ Rows}$

- $12,520 \frac{\text{Gal}}{\text{Ac}} \div 21 \text{ Rows} = 596 \frac{\text{Gal}}{\text{Row}}$

1 Acre = $210 \text{ ft} \times 210 \text{ ft}$
HDD Drilling mud: How the people in the industry see it...
HDD Drilling mud: How the people in the industry see it...
Questions