Dewatering Pre-Treatment of Faecal Sludge in Urban Slums

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Welcome to UGANDA

KAMPALA – CAPITAL CITY OF UGANDA

POPULATION

UGANDA 30 MILLION
KAMPALA 1.5 MILLION
3.0 MILLION (DAY TIME)

60 % IN SLUMS
Sanitation status – Kampala UGANDA

Over 90% slum dwellers using pit latrines

Pit latrines
- Lined (70%)
- Unlined

70% of the pits are FULL
- Unemptied
Sanitation status – Kampala UGANDA

- Uncollected FS mainly found in Urban slums

- High housing density
- High transportation costs

Housing Density (house structures/km²)
2,200
5,080
1,240

- Limited access to mechanized emptying
Sanitation status – Kampala UGANDA

When pit latrines in slums are full

- Abandoned
- Empty into environment
- Use semi-mechanized technologies

Empty into environment

Manual-aided technologies

65% costs on transportation
Decentralized Management

Reduction of **emptying costs**, increase number of latrines emptied and reduce unsafe disposal into **environment** and related **public Health risks**

- Work done on emptying and more underway

**Treatment – Dewatering**

FS>90% water. Increase of sludge dry solids by 10% decreases in initial sludge volume by over 85%
Understanding **Dewaterability** of faecal sludge from slums

**Pit latrine squat hole**

**Faecal sludge sampler**

Measurement of pH, EC and Temperature

**Lined & Unlined pits**

- Total solids
- Volatile solids
- Sand content
- Crude protein

**Sample preparation**

Dewaterability extent

Dewaterability rate

**Particle size distribution**

**Tool handle**

Cylindrical sludge container

Piston drive rod

Rubber piston

Cover
Understanding Dewaterability of faecal sludge from slums

Dewaterability extent and rate

Solids concentration (lined and unlined)

Particle size distribution

Relating dewaterability extent to FS characteristics

<table>
<thead>
<tr>
<th>FS type</th>
<th>TS</th>
<th>EC</th>
<th>COD</th>
<th>TVS/protein</th>
<th>Sand content</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS from lined pit latrine</td>
<td>0.001</td>
<td>0.030</td>
<td>0.024</td>
<td>-0.459</td>
<td>0.719</td>
</tr>
<tr>
<td>(n=11)</td>
<td>p 0.907</td>
<td>0.590</td>
<td>0.631</td>
<td>0.016*</td>
<td>0.001*</td>
</tr>
<tr>
<td>FS from unlined pit latrine</td>
<td>0.768</td>
<td>0.172</td>
<td>0.156</td>
<td>0.010</td>
<td>0.269</td>
</tr>
<tr>
<td>(n=7)</td>
<td>p 0.004*</td>
<td>0.307</td>
<td>0.333</td>
<td>0.815</td>
<td>0.188</td>
</tr>
</tbody>
</table>
Understanding Dewaterability of faecal sludge from slums

- Increasing size proportions of particles has no effect on dewaterability extent
- High dewaterability in unlined PFS < 1 mm
- Reduction in compressibility to improve porosity/rigidity
- TVS/ crude protein related to low dewaterability extent.
- Reflection of sludge structure which hold water (EPS)
- Modifications by use of physical conditioners
Use of physical conditioners

Sawdust and Charcoal dust used as physical conditioners.

- Availability in slums or vicinity
- Low or no cost
- Enhance end-use potential

FS from lined pit latrines considered
## Use of physical conditioners

### Conditioner dosage and FS characteristics

- **Calorific value (MJ kg\(^{-1}\) dry solids)**
- **Total volatile solids (%TS)**
- **Ash content (%TS)**
- **Crude protein (mg/gTS)**

### Conditioner effect on dewatering extent and rate

- **Conditioner dosage (%TS)**
- **Capillary Suction Time (seconds)**

### Cake moisture Vs crude protein

<table>
<thead>
<tr>
<th>Conditioner</th>
<th>R(^2)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawdust</td>
<td>0.92</td>
<td>0.009</td>
</tr>
<tr>
<td>Charcoal</td>
<td>0.96</td>
<td>0.004</td>
</tr>
</tbody>
</table>

- % cake solids increase
  - Sawdust: 22.9%
  - Charcoal: 35.7%

- Dewatering rate increase
  - Sawdust: 14.3%
  - Charcoal: 15.8%
Use of physical conditioners

Conditioned FS micro-structure (Mg X 100)

Cake porosity improved through pore formation

Leachate production

Raw FS
FS + Sawdust
FS + Charcoal

Linear regression (Cake moisture and leachate volume)

R²  p
Sawdust  0.89  0.000
Charcoal  0.56  0.005

Dewaterability extent governed by;
- absorption in sawdust
- Rigid structure creation
Implications to FSM in urban slums

Summary

- Slum Households
  - Pit latrine emptying
  - Sorting/Screening
  - Solid waste collection/Transfer station

- Faecal sludge
  - Dewatering
    - FS Leachate
      - Nearby Sewer
      - On-site treatment & disposal
    - Dewatered FS solids
      - Energy recovery
      - Composting
      - Landfilling
      - Treatment plant

- Sorted solid wastes
  - Charcoal dust
    - Charcoal outlet
  - Sawdust
    - Timber mill

- Management options

- Requirements
  - Further drying
  - Moisture <10%
  - Conditioner dose >300%
  - Moisture content <60%
  - Space availability in slums
  - No thickening stage
  - Joins drying beds
  - Proximity to slums
DECENTRALIZED FSM IN SLUMS

It’s just the beginning

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