20th AfWA International Congress and Exhibition 2020
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SAWDUST AS A FILTERING MEDIA IN SLUDGE DRYING BEDS

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GAVA JOB SSAZI PIUS

INTRODUCTION

- Demographic trends world over indicate increase in population.

- This means an ever-increasing pressure on available resources hence an increase in generated waste volumes.

- Faecal sludge from wastewater is among wastes generated in large quantities, posing challenges in relation to its management leading to both environmental pollution and public health threats.

- The large sludge volumes generated require innovative mass and volume reduction treatment techniques.

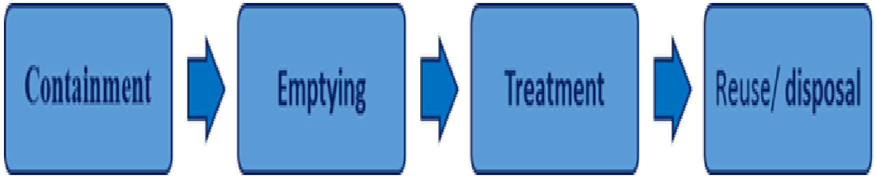
- Treatment technique employed varies depending on quality of raw sewage received**(Yeqing, et al., 2013**).

SLUDGE MANAGEMENT

- According to EPA in the U.S., sewage sludge is the solid, semi-solid, or liquid residue formed after domestic sewage treatment.
- Faecal sludge (FS) is obtained from onsite sanitation technologies, and delivered to treatment facilities by cesspool trucks, ugavacs, etc. but not through sewer lines as illustrated.

CONTINUATION OF SLUDGE MANAGEMENT

- Formed after faecal sanitation chain (storage, collection, transportation and treatment). Comprises of of excreta and black water, with or without greywater.



Faecal sludge management chain

- Has variable composition, quantity and concentration. Composition is of a solid and liquid fraction (**Garg & Neeraj, 2009**, **Yeqing, et al., 2013**)

SLUDGE TREATMENT

- Pathogens mostly found in faecal matter.

- Wastewater treatment process concentrates pathogens in sludge. Therefore, sludge handling is of utmost importance (**Andreoli et al, 2007**).

- Main sludge treatment objectives prior to transport, disposal and or use are attainment of volume reduction and property alteration using Digestion, thickening, stabilisation, drying and dewatering techniques.

CONTINUATION OF SLUDGE MANAGEMENT

- The unplanted drying bed technique was used for this study since Lubigi Sewage Treatment Plant (LSTP), was the geographical scope.
- Employs natural drying techniques of evaporation and percolation, driven by the area's temperature and humidity (**Strande et al, 2014**).

- **Sludge drying in unplanted covered sludge drying beds at LSTP, Kampala, Uganda**

SAWDUST

- Research studied use of sawdust, a wood dust, (among wood processing by products besides chippings, slabs, off cuts and shavings-**Tiough, 2016**) as a potential sand filter replacement with gravel maintained as the draining medium.
- It's a tiny – sized powdery wood waste in saw milling and wood industries with particle size largely dependent on wood type, saw teeth and intended use.(**Maharani et al, 2010**).

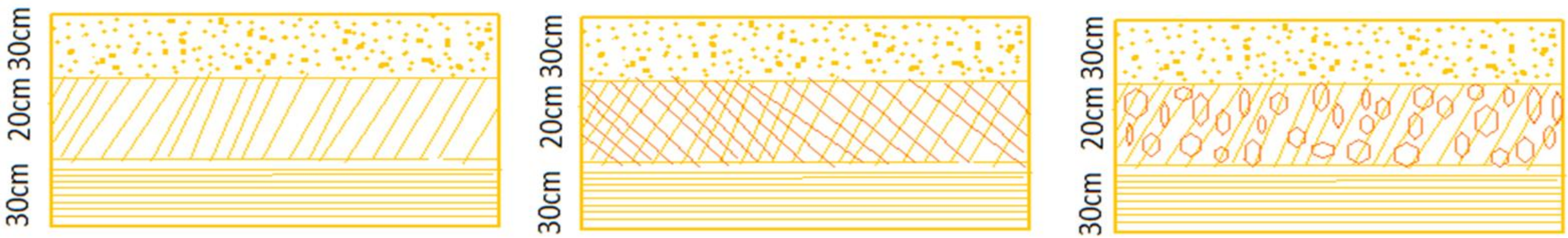
CONTINUATION OF SLUDGE MANAGEMENT

- Many Industries exist in Uganda from which it can be obtained. Its absorptive, abrasive, bulky, fibrous, nonconductive and granular properties endear it for use (**Forest product laboratory, 1969**).

- **Fine Sawdust filtering media in the drying bed**

MATERIALS AND METHODS

❖ Set up of model beds of 1m^3 volume capacity with 1m^2 effective drying area covered with tarpaulin structure. The study was carried out in the wet and dry seasons (2 cycles) with similar arrangement as shown below.



Sand Profile   Fine saw dust profile   Course saw dust profile

Key

CONTINUATION OF MATERIALS AND METHODS

- The research was conducted during both the dry and wet seasons, first and second cycle respectively.
- Model beds had course and fine aggregates as a support base, with sand, coarse sawdust and fine sawdust as the filtering layers in both cycles
- Beds comprised of raised plinth wall (1m) from ground surface with supporting layer of gravel (fine and coarse) with depth of 30cm and sizes ranging from 5-10mm and 10-19mm. This was placed on under drains comprising of a PVC pipe.

Sludge drying beds constructed for research

- The sand-sawdust mixture serving as a filtering media, was placed on the gravel at a depth of 20cm. The sand was washed and dirt free, having an effective size of 0.2-0.6mm with a uniformity coefficient of 2.833.

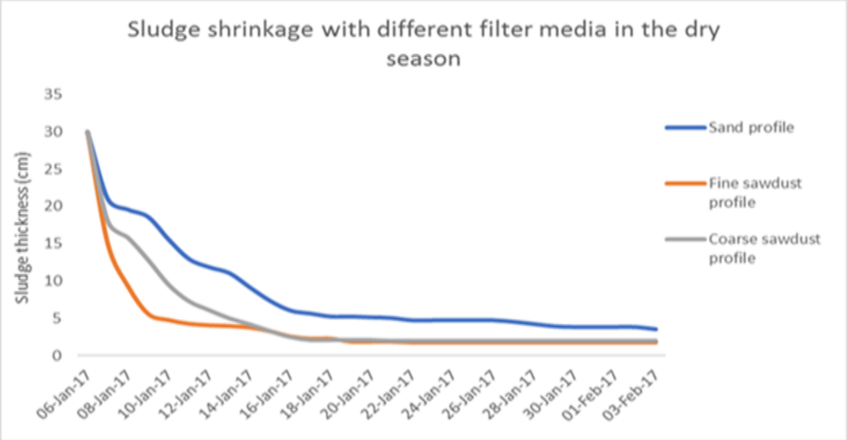
CONTINUATION OF MATERIALS AND METHODS

- Sludge pumped into each bed height 30cm height. Each of the beds was constructed in triplicate and arranged in a randomized block design.
- Sludge depth change was measured after every 24 hours using 2m long tape.
- Sludge depth reduction due to filtration and evaporation determined. Samples from the bed were collected and monitored over 7 days interval for moisture content (MC) and initial total solids. This was done to point when the desired cake's MC at harvesting was achieved.
- Phase changes of the sludge in the beds were monitored and noted i.e. liquid, plastic (ceasing of percolation) and solid phase (with cracks).

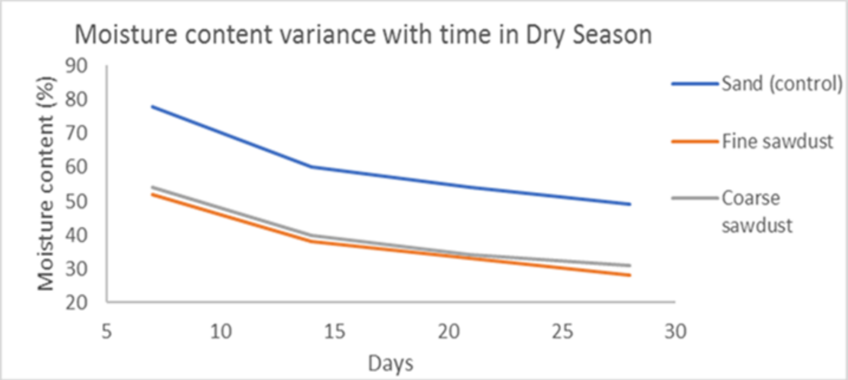
Sludge in the liquid phase

RESULTS & DISCUSSIONS

- Dry season (first cycle)

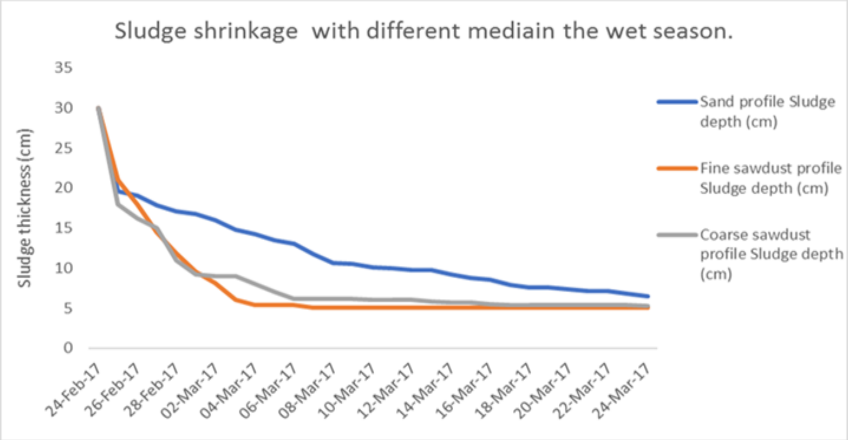


Trend of sludge dewatering process in different filtering media during the dry season.

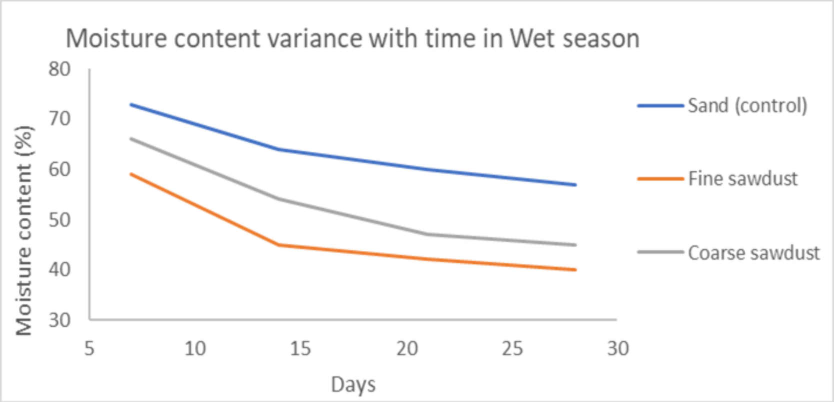


Sludge Moisture content variation in dry season

- Wet season (second cycle)



Trend of sludge dewatering process in different filtering media during the wet season.



Sludge moisture content variation in wet season

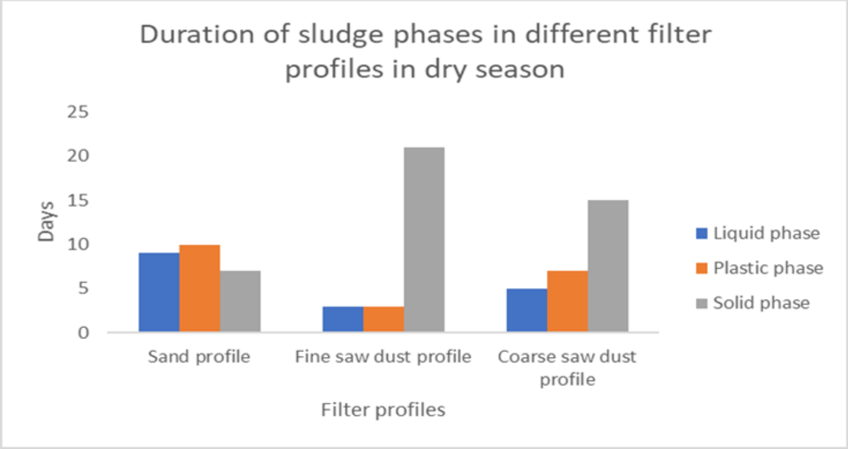
CONTINUATION OF RESULTS & DISCUSSIONS

Table of sludge duration in different phases with different filters in the dry season.

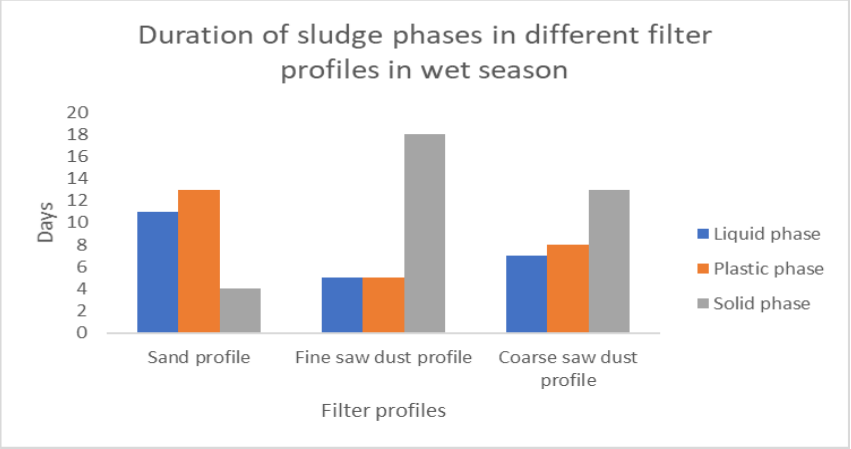
Phase	Sand profile	Fine sawdust	Coarse sawdust
Liquid (days)	9	3	5
Plastic (days)	10	3	7
Solid (days)	8	21	15

Table of sludge duration in different phases with different filters in the wet season.

Phase	sand	Fine sawdust	Coarse sawdust
Liquid (days)	11	5	7
Plastic (days)	13	5	8
Solid (days)	4	18	13



Graph of sludge duration in different phases with different filters in the dry season



Graph of sludge duration in different phases using different filters in the dry season

CONTINUATION OF RESULTS & DISCUSSIONS

Filtering Media	Sand	Coarse sawdust	Fine sawdust
Mean sludge depth (cm) after 8 days	14.9±7	10±8.3	7.9±8.2
Mean sludge depth (cm) after 28 days	8.5±6.6	5.2±6.5	4.2±5.7

- Independent two sample t-tests assuming equal variances showed presence of significant difference between mean sludge depth of sand and fine sawdust t(df) = 56, $p<0.05$).

- Drastic sludge shrinkage for the 3 media types after 8 days followed by gradual sludge shrinkage for 28 days.

- Moisture content (MC) results for dry season showed fine and coarse wood sawdust to achieve values of 28% and 31% respectively after 28 days.

- Sand produced dry faecal sludge with a highest MC of 49% after 28 days.

- Similar results for the performance of the three different media types were observed during the wet season.

CONCLUSIONS

- Fine sawdust performs better than coarse sawdust and sand media in faecal sludge dewatering

- Where available, it can be adopted as a filter media in sludge drying beds within sludge treatment plants as a suitable replacement of sand.

- Sludge dewatering is affected by seasonal changes.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