A Pilot-Scale Faecal Sludge Research Facility in Dar es Salaam, Tanzania

This article presents an update about the on-going faecal sludge dewatering innovations and pyrolysis research in Dar es Salaam, Tanzania. The aim of this research is to support comprehensive and affordable faecal sludge management. Nienke Andriessen[1], Richard Kimwaga[2], Linda Strande[1]

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Photo 1: The research team.

Introduction

Existing faecal sludge (FS) treatment technologies are land intensive, and acquiring land in urban areas where space is limited is difficult and expensive. It is, therefore, relevant to develop lower-cost and less space intensive treatment technologies. At the same time, resource recovery can also generate value from FS and could alleviate some of the treatment costs. Sandec and the University of Dar es Salaam (UDSM) in Tanzania are doing collaborative applied research on improved dewatering and resource recovery of FS (Photo 1).

The pilot-scale facility

In 2015, a pilot-scale FS treatment facility was constructed at UDSM. The treatment chain consists of a sludge discharging inlet with a bar screen, two parallel settling-thickening tanks (each with a volume of 18.5 m^3) which are operated alternately, a mixing tank (total volume 7 m^3), and six unplanted drying beds (each 1.5 m x 1.5 m, hydraulic loading rate 45 cm). Master's students of UDSM and École Polytechnique Fédérale de Lausanne (EPFL) are analysing dewatering mechanisms and the solid and liquid streams from the treatment facility.

Experiments

The following details the research at UDSM:

- Because dewatering is one of the biggest challenges to the implementation of FS treatment worldwide, Sandec's research focuses on how using conditioners could improve the flocculation of sludge particles. One student is researching the use of two locally producible conditioners, chitosan and *Moringa oleifera*, on the drying beds and exploring optimal dosages. Dosing is hard to determine due to the variability of sludge. Preliminary results indicate that chitosan could be suitable for certain types of sludge, but more tests are required to determine the proper dosing.
- Geotubes are engineered textile bags that allow liquids to permeate from the inside to the outside, while retaining solids inside. These are already used as a dewatering technology in wastewater treatment, and a student is assessing their potential as an inexpensive and low-tech solution for onsite FS dewatering. The sludge would be delivered to transfer stations, i.e. safe disposal points in neighbourhoods, by manual emptiers, where it would be collected by a larger truck to be transported to a central treatment facility. The outcome of this research could lead to more sludge being transported out of high-density areas without having to transport the water.
- The leachate from the drying beds is currently flowing directly to the waste stabilisation ponds that treat the wastewater from the university. It is unclear how this affects the treatment capacity of the ponds, or whether it could be discharged into the sewer network. This is important to consider particularly when scaling up treatment. One student is characterising the leachate and modelling its effects on the waste stabilisation ponds and sewer. In the future, the leachate from the geotubes will also be characterised and incorporated into the model.
- One way of using the solid fraction of the sludge from the drying beds and geotubes for resource recovery is by pyrolysis. Sandec research has shown that although pyrolysed FS has potential as a solid fuel, its high ash content reduces its calorific value and, thus, the quality of the char. To improve the quality of the produced char, a student is researching how different sludge drying technologies and containment types affect the sand and ash content in FS.
- To optimise the design of treatment technologies, it is important to know how much and what type of sludge is actually arriving at the treatment facility. No validated methods exist currently to do this. For this reason, one student is testing methods for quantifying and characterising sludge.

Figure 1 depicts how these experiments fit together into a comprehensive research program, the goal of which is to reduce the footprint and costs of adequate faecal sludge treatment. It is based on previous Sandec work [1], and four UDSM students are currently completing their Master theses. Stay tuned for their final results in the next issue of Sandec News!

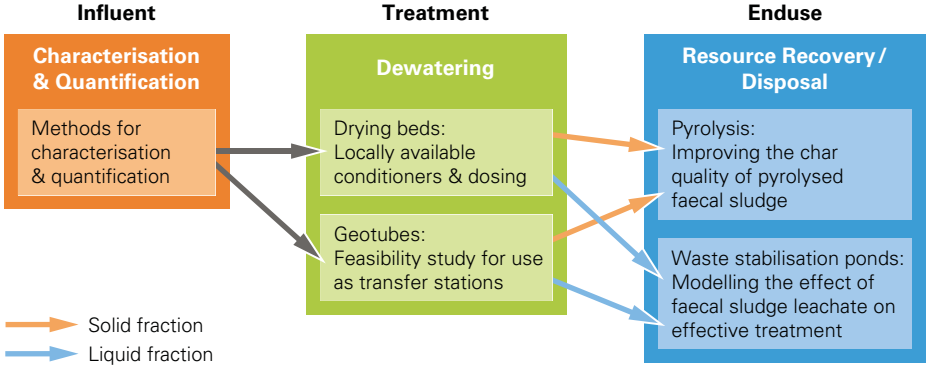

Figure 1: The interconnectedness and collaboration of the research at UDSM.

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