Increasing Treatment Plant Capacity by Conditioning Faecal Sludge

Locating land for faecal sludge treatment in urban areas is a challenge. Research in Dakar, Senegal, identified that applying conditioners made from locally available resources on faecal sludge can reduce the footprint of drying beds from 6–60 %, depending on treatment goals. M. Gold[1], P. Dayer[1,3], G. Clair[1], Ch. Faye[4], A. Seck[4], S. Niang[4], E. Morgenroth[2,3], L. Strande[1]

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Photo 1: Settling experiments with faecal sludge in Dakar, Senegal.

Introduction

In many low- and middle income countries, treatment plants for faecal sludge (FS) do not exist. This means that the majority of FS produced is being discharged untreated into the environment. Dewatering is a key treatment step, as FS typically consists of > 90 % water. Settling-thickening tanks and drying beds are the most commonly employed technologies for the settling and dewatering of FS, but their application in urban areas is limited due to their large land area requirements. This problem is exacerbating because urban areas are the fastest growing worldwide, hence, treatment technologies need to be optimised in order to meet current and future demands.

Conditioners

Commercial conditioners, such as polyelectrolytes and hydrolysed metals, are commonly used to increase the efficiency of settling and dewatering in the treatment of wastewater sludge. However, commercially available conditioners are expensive and would require importation in low-income countries, frequent reasons why treatment plants often fail [1]. In addition, FS has highly variable characteristics that can affect settling and dewatering performance. This suggests that experiences from the treatment of wastewater sludge are not directly transferable. The objective of this study was to identify conditioners that work well, which could be produced with locally available resources, and, therefore, reduce the land requirements for treatment plants in urban areas.

Methods

Based on literature, five conditioners that could be produced locally were identified: *Moringa oleifera* seeds, press cake, *Jatropha curcas* seeds, *Calotropis procera* leaves and chitosan. The treatment performance of locally available conditioners was compared to commercially available wastewater conditioners as a control. FS was collected from vacuum trucks and conditioned with different dosages in a jar-test device and compared with unconditioned FS. In laboratory experiments, the total suspended solids (TSS) in the supernatant, following 60 minutes settling in Imhoff cones, and the Specific Resistance to Filtration (SRF), were respectively used as metrics for settling and dewatering performance (Photo 1). Following laboratory experiments, settling and dewatering columns were designed to replicate treatment in settling thickening tanks and drying beds [2].

Results

Conditioning FS significantly improved settling and dewatering, and the results showed that the locally available conditioners were comparable to commercial conditioners. TSS in the supernatant and SRF were reduced by at least 80 % compared to unconditioned FS. Chitosan was ranked as the best conditioner investigated in this study, while *J. curcas* seeds and *C. procera leaves* were ruled out due to poor treatment performance.

Reducing the land area required depends on the specific dewatering treatment goals. For example, conditioning FS for use as soil conditioner with chitosan or commercial conditioners could increase dewatering times by 60 %, and 6–20 % for use as solid fuel. These benefits, however, need to be balanced with increased treatment costs. An assessment of the fish industry in Dakar indicated that currently enough shrimp waste could be obtained to produce chitosan for FS treatment. Yet, the operating costs at the treatment plant would increase by around 15–30 % for locally produced chitosan and 35–50 % for imported chitosan, compared to 20–80 % for polymers [2].

Conclusion

The results of this study demonstrate that locally available conditioners can be as effective in increasing treatment performance as commercial products. However, FS conditioning is not a silver bullet as reductions in the required treatment land area also need to be carefully balanced with the increase in treatment costs. In addition, the FS used in this study was mainly collected from septic tanks, and FS from other sources could show different results. Therefore, ongoing research at Sandec is investigating the dewatering properties of different FS types in Japan, Uganda, Vietnam and Switzerland to further optimise the design of FS dewatering technologies.

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