Dewatering Characterisation of Synthetic Faecal Sludge Project

Dewatering faecal sludge is a crucial step in its treatment. Synthetic faecal sludge was developed for controlled studies of the characteristics impacting dewatering performance. Results indicate that sludge strength and urine concentration both impact dewaterability. Barbara Jeanne Ward[1], Eberhard Morgenroth[1,2], Linda Strande[1]

Introduction

Inefficient dewatering is a major barrier to the implementation of effective faecal sludge (FS) management. Improvements in dewatering technologies can reduce land area requirements for drying beds and produce safer, higher-quality treatment products for resource recovery. Prior to the development of improved FS dewatering methods, a fundamental understanding of what parameters impact dewatering must be developed. Because FS is highly heterogeneous, it has been difficult to perform controlled analyses of the factors that determine dewatering behaviour. To address this, synthetic FS was developed for controlled experiments.

Methodology

Six types of synthetic FS were prepared by combining synthetic faeces [1] with deionized (DI) water and varying concentrations of synthetic urine [2] to simulate low-strength FS (4 wt % synthetic faeces) and high-strength (25 wt %) FS. Both low- and high-strength FS were made at three urine concentrations to simulate urine diverting (no urine), pour-flush (7 % v/v urine/DI water), and waterless toilets (100 % v/v urine/DI water). FS was analysed for total solids (TS), total volatile solids (TVS), chemical oxygen demand (COD), ammoniacal nitrogen (NH_4-N), pH, electrical conductivity (EC) with standard methods [3], dewatering rate by capillary suction time (CST), and dewaterability (% TS in cake) by centrifugation.

Results

Results show that the chemical characteristics of synthetic FS are generally comparable to literature values. Synthetic FS had higher TVS than FS from literature. This can be attributed to the fact that synthetic FS did not undergo digestion, while FS from literature likely experienced degradation during storage in containment. pH values for all synthetic FS samples were lower than literature values, due to the low pH (5.5) of the deionized water. Future experiments will be designed to evaluate changes in parameters of sludge decomposition that effect dewatering.

High-strength sludge had reduced dewatering rates, as illustrated in Figure 1a, and had an increased CST compared to low-strength sludge (even when normalised for TS). High-strength sludge achieved the highest TS in the dewatered sludge cake, but low-strength sludge had the greatest overall increase in TS following dewatering (Figure 1b). These results are in line with findings from empirical FS dewatering studies [4, 5], which report better dewatering performance for less concentrated septic tank sludge compared to high-strength public toilet FS. Urine concentration had no discernible impact on the absolute dewatering rate, but did impact normalised CST and dewaterability. High urine concentrations increased TS before and after dewatering, but decreased the efficiency of centrifuge dewatering for both low- and high-strength synthetic sludge (Figure 1b).

Conclusions

Synthetic FS is useful for evaluating the fundamental dewatering behaviour of FS. Our results indicate that sludge strength and urine concentration impact dewaterability. Future experiments will validate these results with FS and degradation.

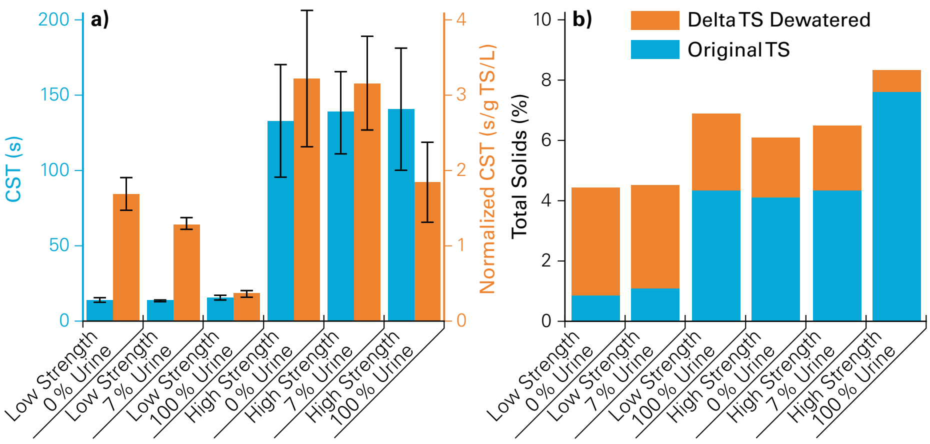

Figure 1: a) CST results for low-strength and high-strength synthetic sludge made with different urine concentrations; b) Comparison of TS in synthetic sludge before and after centrifuge dewatering.

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