# Local Factors Influence FS Characteristics: Research in Hanoi, Vietnam

Understanding faecal sludge characteristics on a citywide scale is essential to optimise the design of treatment technologies. As part of Sandec's ongoing research, a study was conducted in Hanoi to assess how the design and operation of septic tanks influence the faecal sludge. M. Bassan[1,2], A. Ferré[1,2], V. A. Nguyen[3], C. Holliger[2], L. Strande[1]

## Introduction

There is growing acknowledgement of the importance of faecal sludge (FS) management worldwide. It is now accepted that on-site sanitation technologies – where FS accumulates – will remain an important component of sanitation in urban areas of low- and middle-income countries [1]. However, the development and construction of FS treatment technologies still require further research to ensure that they are appropriately designed.

FS is broadly defined as anything extracted from on-site sanitation technologies, which is not transported in sewers. It is collected from individual buildings, and unlike in sewer systems, is not homogenized during transport. Therefore, FS management on a citywide scale includes FS with highly variable characteristics [2].

Many factors influence FS characteristics, as summarized in Figure 1. These include:

- Local context: the geology, climate and customs have a large scale impact on the inflow of groundwater, excreta and other wastes in the toilets.
- User habits: the use and maintenance of on-site sanitation technologies impact the FS characteristics at the household scale. For example, office toilets receive more urine, household toilets more faeces.
- Design: the type of on-site technology, for example, dry toilets with pit latrines, or flush toilets with septic tanks, impact the dilution and degradation processes. Also, FS from septic tanks with sealed or porous bottoms will have different concentrations.
- Emptying methods: the addition of water to extract settled FS (Photo 1) and the extraction mode (manual or mechanical) impact the characteristics of the FS that reaches the treatment plant or discharge site.

To effectively manage highly variable FS, we need to understand the following:

- How can we predict or estimate FS characteristics?
- How can we design adequate and appropriate treatment technologies to manage FS on a citywide scale?

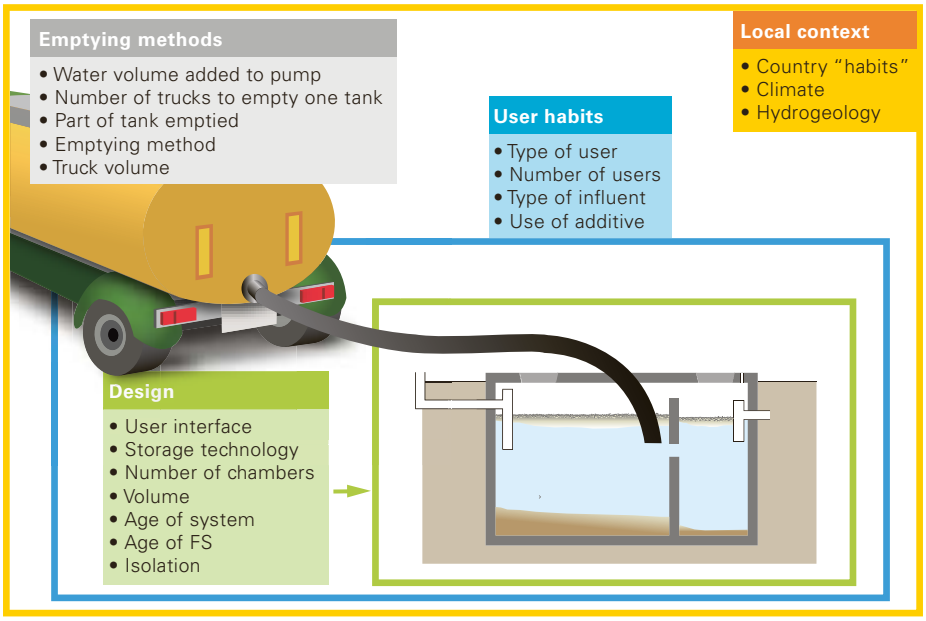
Currently, no methods exist to estimate FS characteristics over large geographic areas, other than intensive and resource demanding sampling campaigns. The result is that when FS treatment plants are built, they are not designed for actual volumes and characteristics [3]. The objective of this study was to evaluate whether the operational and design parameters of septic tanks have any correlation with FS characteristics, and if they could be predictors of FS characteristics.

## Methods

This study was conducted between September 2013 and June 2014 in Hanoi, the capital city of Vietnam. In Hanoi, most houses are equipped with flush toilets and septic tanks that have two chambers and a sealed bottom. The effluent of the septic tank is commonly collected in a combined drainage/sewer network.

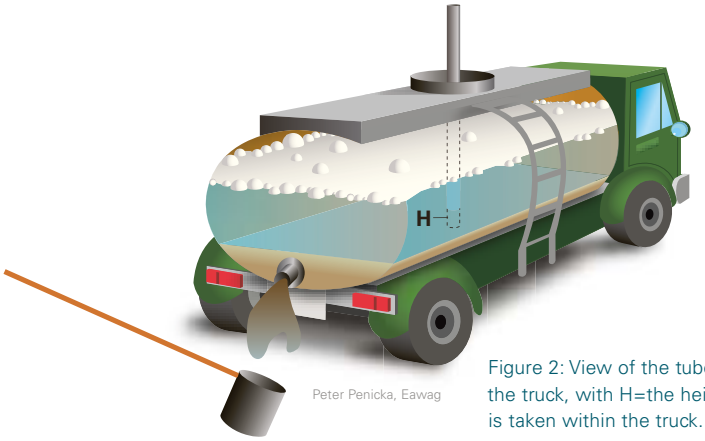
59 core samples were taken from trucks that collected FS from individual households. The samples were taken with a tube sampling device, directly after the FS was pumped into the truck. As seen in Figure 2 and Photo 2, the core-samples were extracted from the access ports of the trucks. They are meant to be representative of the FS characteristics along the depth of FS in the truck. The collected FS was poured into different bottles and stored on ice for transportation to the laboratory.

To assess the influence of local factors on FS characteristics, household information was also recorded. This included: the volume of the septic tank, age of FS (i.e., the time since the tank was last emptied), the number of inhabitants, the use of additives, the number of trucks required to empty the septic tank and whether the tank was partially or fully emptied. An analysis of variance was performed on these




Peter Penicka, Eawag

Figure 1: Different factors that can influence the characteristics of FS collected from septic tanks.




Peter Penicka, Eawag

Figure 2: View of the tube-like sampling device in the truck, with H=the height at which the sample is taken within the truck.

factors to assess how they influenced the solids, organic and nutrient concentrations of FS.

## Results and perspectives

The results of the analyses were highly variable, despite the fact that all samples were taken within the same city, from septic tanks with similar designs, and using the same sampling method. This confirmed that the type of on-site sanitation technology influences FS characteristics, as does their design, construction and operation.

The analysis of variance revealed that the best predictors are the septic tank volume and the age of FS. These two factors very significantly correlated with the solids, nutrient and organic concentrations. The emptying methods also correlated with FS characteristics, but not as strongly. It was also difficult to obtain reliable information on the different emptying protocols used by different service providers.

The other evaluated factors did not significantly correlate with FS characteristics. Sandec is currently conducting research in other cities to confirm whether the results are consistent, and to evaluate additional factors that could provide a more complete set of predictors for FS characteristics.

Magalie Bassan

Photo 1: Adding water to facilitate extraction of settled sludge at the bottom of the tank within the truck.

## Conclusion

The goal of Sandec's research in this area is to develop a reasonable and easy to implement method for estimating FS characteristics in order to design appropriate FS treatment technologies. This would be a great advantage for FS management on a citywide scale. Research is ongoing and the method developed includes:

1. Information on the coverage of existing on-site sanitation technologies in a city, including:
   a. Influential design factors (e.g., tank volume, sealed versus unsealed bottom)
   b. Influential operation factors (e.g., type of wastewater, emptying frequency)
2. An optimized sampling plan based on groups of existing technologies, design and operational factors
3. Laboratory analyses on solids, nutrient and organic concentrations for each group
4. Use of the results to extrapolate on a citywide scale, based on the determined predictors of FS characteristics

The objective is to reduce the resources required to determine FS characteristics on a large geographical scale, and to obtain reliable information. This will assist in the design of treatment technologies that are appropriate and adequate for local situations and the actual FS characteristics.

Adeline Mertenat

Photo 2: Repartition of the sampled FS into bottles for laboratory analysis.


[1] Dodane, P.-H., Mbéguéré, M., Sow, O., Strande, L. (2012): Capital and Operating Costs of Full-Scale Faecal Sludge Management and Wastewater Treatment Systems in Dakar, Senegal. Environmental Science and Technology. *46, (7),* 3705–3711.

[2] Strande, L. (2014): The Global Situation, in *Faecal Sludge Management – System Approach for Implementation and Operation,* ed. by Linda Strande, Mariska Ronteltap, Damir Brdanovic. (IWA: London, UK), pp. 1–14.

[3] Bassan, M., Tchonda, T., Yiougo, L., Zoellig, H., Mahamane, I., Mbéguéré, M., Strande, L. (2013): Characterization of faecal sludge during dry and rainy seasons in Ouagadougou, Burkina Faso, in *Proceedings of the 36th WEDC International Conference,* WEDC: Nakuru, Kenya.



[1] Eawag/Sandec, Switzerland

[2] Laboratory for Environmental Biotechnology, Ecole Polytechnique Fédérale de Lausanne

[3] Institute for Environmental Science and Engineering, Hanoi University of Civil Engineering



This research was conducted as part of the Partnership for Urban Resource Recovery Project (PURR), funded by SECO and Eawag. <http://www.eawag.ch/forschung/sandec/gruppen/EWM/projects_ewm/purr/index_EN>.



Contact: magalie.bassan@eawag.ch or linda.strande@eawag.ch