CERIS Civil Engineering Research and Innovation for Sustainability

# Hydraulic and sanitary performance of fecal sludge drying beds in Mozambique

**PhD student**
Raul Muteviue Júnior

**PhD program**
Environmental Engineering (IST, University of Lisbon)

**Supervisor**
José Saldanha Matos (CERIS, IST, University of Lisbon) and Sílvia Monteiro (Núcleo de Microbiologia, IST, University of Lisbon)

**Co-supervisors**
Filipa Ferreira (CERIS, IST, University of Lisbon)

**Period**
2018-2022

**Funding**
Instituto Camões, Instituto da Cooperação e da Língua

## Summary

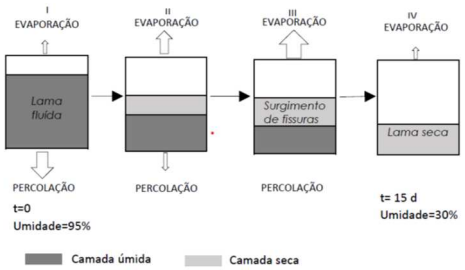
Sanitation services delivered by conventional and centralized infrastructures (sewers, pumping installations and Wastewater Treatment Plants - WWTP) in developing countries only cover a limited part of the population and the water assets often show a high rate of degradation. As a consequence, a major part of the population is dependent on decentralized technologies, frequently under dry conditions (non-water usage or 'dry sanitation'). Sanitation strategies for communities living in peri-urban areas, largely informal and without access to basic services of water supply, energy, solid waste collection and stormwater drainage, must include management options for faecal sludge (FSM) and/or wastewater with on-site solutions. These options should guarantee the technical, financial, social and environmental sustainability of the services.

Sustainability of these services and their contribution to a 'circular economy' increase when the stabilization of sludge from WWTP, latrines or septic tanks (bio-solids), enables its subsequent reuse for improvement of forest soils, for agriculture or for energy production (from biogas generation or from producing biochar). An important challenge is to develop methods which contribute to added value (for agricultural production) to treated effluents and sludge, and simultaneously to the protection of public health and the environment in general. As part of this approach, it is essential to control the dewatering process of faecal sludge and the evolution of its characteristics in terms of hygienization. It is also important that these treatment operations are simple, requiring limited specialized human resources, energy and chemicals. Hence, as far as possible, the operations and processes should be "nature-based". In this context, it is particularly important to assess the performance of faecal sludge drying beds for dewatering and hygienization of sludge coming from different sources, including latrines, and under tropical climatic conditions. Hydraulic and sanitary behaviour of this type of infrastructure has been studied under temperate climatic conditions but the information is missing for tropical climate.

In this study, the dewatering processes (drainage and evaporation) of different types of faecal sludge under varying environmental conditions were analysed. The study included the analysis of the evolution of its bacteriological quality using Escherichia Coli as indicator. To analyze the dewatering and decay processes of pathogenic microorganisms, pilot sludge drying beds (IPLS) facilities were constructed. One of the LS (drying bed) groups was constructed and operated in Portugal, with digested sludge from the Frielas WWTP, in Lisbon. The other group of IPLS was installed and operated in Maputo, Mozambique. Here, sludge originates from latrines, septic tanks and from anaerobic and facultative ponds of the Infulene WWTP. Testes were done for different sludge thickness of the beds. The results at the WWTP of Frielas in Lisbon, has shown a high efficiency of drying beds, with a reduction of 4 Log of E. coli in 50 days, and a reduction in the moisture content between 18 and 42% in 15 days. At the facilities in Maputo, depending on the sludge source (latrine, septic tanks or wastewater ponding systems) and the initial moisture content, the reduction of the moisture content varied between 30 and 70% in 35 days, and the average reduction in E. coli was more than 2 Log over a period of 35 days. Although the limitation of the experiments, in part disturbed by rainfall events, empirical expressions to forecast E. coli concentrations in sludge drying beds were developed taken into account the different sludge sources.

## Keywords

Faecal sludge, drying beds, dewatering, Escherichia coli, hydraulic-sanitary model.




*Schematic representation of the process of experimental verification of dewatering of fecal sludge in drying beds.*