

# Overview of a medium infrared dryer process, 'LaDePa', for faecal sludge drying and pasteurisation

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In Durban and its agglomeration, the commitment of the South African government to provide adequate sanitation to every citizen has been reflected on the installation of over 600 000 Ventilated Improved Pit latrines (VIP's) from 1999, as well as the collection and treatment of human waste after the end of the use of the toilet. The eThekweni municipality has set up the 'Latrine Dehydration and Pasteurization' (LaDePa) machine in the Tongaat waste water treatment plant, for the production of dried pellets from faecal sludge collected from Ventilated Improved Pit (VIP) latrines. The sludge drying, which is mainly performed by means of infrared radiation, leads to a product free of pathogens which is planned to be used as soil container or biofuel. This work gives an overview of the whole process and of the end use of the dried product.

The first studied aspect corresponds to the characterization of the rheological properties of faecal sludge, in order to better understand its behavior in the screw extruder leading to the formation of pellets. According to experiments carried out in a rheometer, the faecal sludge behaves as a shear thinning pseudo-plastic fluid. To induce a flow, a minimum shear stress has to be applied. While flowing, the viscosity drastically decreases by increasing the shear rate. Plasticity tests, using a cone penetrometer, show that the faecal sludge has a more liquid behavior than plastic. The low plasticity of faecal sludge could reduce the quality of the pellets after extrusion. In order to increase plasticity, mixing faecal sludge with sawdust or pre-drying could be appropriate.

The second studied aspect focuses on the determination of the process efficiency for drying and pasteurization by using a laboratory scale machine, which has been installed in the Pollution Research Group laboratory at the University of KwaZulu-Natal, Durban, South Africa. The extent of drying and pasteurization was estimated by measuring, respectively, the moisture content and the concentration of viable *Ascaris* eggs in the raw faecal sludge and the processed product. As the intensity of the infrared radiation is higher, the drying rate is faster and the drying times are reduced. However, at high intensities, the temperature received by the sample can exceed 200°C and subsequently the pellets can be thermal degraded, even combusted. Complete pasteurization was certain to be achieved after 8 minutes of residence time.

The last studied aspect is about the evaluation of the dried product as a fertilizer and as a biofuel. For this, faecal sludge was dried in a convective drying rig where complete drying is expected and no thermal degradation would occur. The chemical content of the dried product in the most valuable elements for agriculture, namely potassium, phosphorous and nitrogen, was analyzed. Moreover, the thermal properties of faecal sludge, namely calorific value, heat capacity and thermal conductivity, were determined. The results show the dried faecal sludge, with a nutrient content similar to that of home compost and manure, could be used as a fertilizer. The dried faecal sludge has good fuel characteristics, with a calorific value close to that of wood. However, the thermal conductivity is very low, so a grinding pre-treatment to reduce the particle size of faecal sludge prior to the thermochemical conversion is recommended in order to avoid conversion limitations.