



# ADDENDUM OF DATA RELATED TO DRYING OF FAECAL SLUDGE FROM ON-SITE SANITATION FACILITIES AND FRESH FAECES

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## **Preface**

The present document consists of an addendum of data to the Handbook of Methods for Faecal Sludge Analysis. It is part of a project funded by the Bill & Melinda Gates (BMGF) through the OPP1164143, untitled “Characterization of faecal material during drying”. This project was granted for funding after the 5-years Transformative Technologies convening at the BMGF headquarters in 2016, where drying was recognized as a gap in the transformative technologies for the implementation of innovative sanitation technologies. Indeed, drying is a unit operation that plays a relevant role in the faecal sludge treatment chain and reuse of the treated faecal matter. It enables to minimize the volume and weight of the faecal waste, deactivates pathogen organisms and turns the sludge into a suitable fuel. However, drying is challenging to put into practice, and requires the understanding of the process and the evolution of the material characteristics along with the transformation. Currently, there is a lack of available data in the literature about faecal sludge drying, which makes more challenging the implementation of technologies. In this context, this project aims at providing data and knowledge about the behaviour of faecal sludge during drying, which is expected to contribute to the development of guidelines of best practices. One important objective of the project is the dissemination and efficient sharing of the generated data and knowledge. One of the ways selected to meet with this objective is through the present addendum of data.

The addendum of data compiles the results from experiments directly related to drying or having indirect implications in the process. The data was obtained from experimental work conducted from 2013 to date, and involving several research institutions. As the addendum of data is an initiative led by the Pollution Research Group at the University of KwaZulu-Natal, most of the data come from this research group. Partner institutions adhered to this initiative and shared their data, including: (i) Swansea University through the SPECIFIC research group; (ii) Cranfield University through their Bioenergy laboratory; (iii) Duke University through their WASH-AID centre; (iv) Laval University through their Civil and Water Engineering department; (v) Victoria University through their Public & Environmental Engineering laboratory; (vi) Swiss Federal Institute of Aquatic Science and Technology (EAWAG) through their Sanitation, Water and Solid Waste for Development (SANDEC) department. We express our gratitude to these institutions for their contribution that made possible to consolidate the addendum.

In the addendum, the data is organized in datasheets that are categorized in different thematics according to the content. In each datasheet, the data is displayed as graphs and includes an interpretation. In addition to this, the datasheets contain the basic information that is required to understand how the data was obtained, including the information about the feedstock, laboratory equipment, experimental conditions and performed analysis. The datasheets also offer the bibliographic references about where the results can be found in literature and the hyperlink to access to the raw files with the data. Moreover, this document includes a background with a landscape about faecal sludge drying, description of the fundamentals aspects from faecal sludge drying to understand better the significance and applicability of the data, and a summary of the analysis from results from the datasheets with their implications.

We expect that the addendum of data will have a positive impact in the sanitation sector by being a helpful resource to sanitation practitioners for the development, implantation, operation, optimization and improvement of drying technologies.

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***Abbreviations***

ABR	Anaerobic baffled reactor
BMGF	Bill & Melinda Gates Foundation
CST	Capillary suction time
DEWAT	Decentralized wastewater treatment plant
DTG	Differential thermal gravimetric
EC	Electrical conductivity
EPS	Extracellular polymer substances
EAWAG	Swiss Federal Institute of Aquatic Science and Technology
FTIR	Fourier Transformation Infrared Red
MIR	Medium Infrared Drying
LaDePa	Latrine Dehydration Pasteurization
STA	Simultaneous thermal analysis
TGA	Thermo-gravimetric analyser
VIP	Ventilated improved pit
VSS	Volatile suspended solids
SANDEC	Sanitation, Water and Solid Waste for Development
UDDT	Urine diversion dry toilette

Chemical nomenclature

C	Carbon
Ca	Calcium
CO	Carbon Monoxide
CO <sub>2</sub>	Carbion Dioxide
H <sub>2</sub> O	Water
H <sub>2</sub> S	Hydrogen Sulfide
K	Potassium
Mg	Magnesium
N	Nitrogen
NH <sub>3</sub>	Ammonia
NH <sub>4</sub> <sup>+</sup>	Ammonium
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>2</sub> <sup>-</sup>	Nitrites
NO <sub>3</sub> <sup>-</sup>	Nitrates
NOx	Nitrogen oxides
P	Phosphorous
PAH	Polycyclic aromatic hydrocarbons
PM <sub>2.5</sub>	Particulate matter of less than 2.5 µm size
PO <sub>4</sub> <sup>-3</sup>	Phosphates
S	Sulphur
SO <sub>2</sub>	Sulphur dioxide
VOC	Volatile organic compounds

## **Background**

### **Faecal sludge drying landscape**

This section introduces the generalities of the drying process. It describes its application in the sanitation field for the treatment of faecal sludge with the reasons for its implementation and challenges.

#### **D**efinition of drying

Drying is defined as the removal of water or any other solute from a moist solid, slurry, or liquid. This process is a common chemical engineering unit operation with diverse applications in the chemical, biotechnology, food, polymer, ceramic, pharmaceutical, pulp and paper, mineral and wood processing sectors. Drying is regularly conducted by the addition of heat for moisture evaporation, which is referred to as thermal drying. Other drying methods include freeze-drying, which is based on the sublimation of frozen moisture at low pressure, and natural evaporation. The term 'drying' must not be confused with the term 'dewatering', which is a common language misuse in practice.

Thermal drying is a process that involves coupled heat, mass and momentum transfer phenomena with a change of phase from liquid to vapour water. In this process, thermal energy is provided to the material in order to evaporate the moisture within it. The provided heat is diffused within the material where the major part will be utilized for moisture evaporation and a small fraction to raise the temperature of the material. The evaporated moisture is transferred from the solid to the environment, which involves the movement of moisture as liquid or vapour within the material, driven by mass and momentum transfer phenomena.

#### **D**rying technologies

Drying technologies are categorized into three major groups according to the method of providing heat into the system. Dryers are known as direct or adiabatic when they expose the moist solid to a hot gas stream. Dryers, where the moist solid is heated by conduction or radiation, are called indirect or non-adiabatic. The most conventional drying technologies categories are as following:

- Convective drying where the material is in contact with a gas stream, which can be hot air or superheated steam;
- Contact drying where the material is in contact with a hot surface;
- Radiative drying where the heat is provided through a given type of radiation, which can be infrared, microwave or dielectric;
- Solar drying where the heat is provided from solar irradiance.

It is possible to combine different types of drying technologies to gain in performance. Moreover, innovations are under development for the improvement of the process, such as the use of acoustic waves or vibrations during drying for intensifying the heat and mass transfers and, at the same time, promoting solid-liquid separation.

If the reader is interested in having more details about drying technologies, Mujumdar (2006) has compiled a broad number of technologies with the involved fundamental aspects, characteristics and applications in an engineering handbook about industrial drying.

### Importance of faecal sludge drying

Faecal sludge is a slurry composed of colloidal material, particles and polymers that form a network with the moisture. Typically, faecal sludge presents a high moisture content that can go from around 70 to 98%wt (Koné and Strauss, 2004; Zuma *et al.*, 2013; Niwagaba, Mbéguéré and Strande, 2014), implying that moisture is the major constituent of sludge in all cases. The high amounts of moisture and nutrients in the sludge lead to an enabling environment for the development of microorganisms. In addition, one gram of faeces from a sick person can contain about  $10^6$  viral pathogens,  $10^4 - 10^6$  bacterial pathogens,  $10^4$  protozoan cysts and  $10-10^4$  helminth eggs (Wagner, Lanoix and Organization, 1958). Faecal sludge can, therefore, lead to infectious diseases to Humans such as cholera, dysentery, hepatitis A, typhoid, and polio, as well as parasite infections (Freeman *et al.*, 2017).

Drying is an important step for the treatment and disposal of faecal sludge for its safe disposal and resource recovery. Drying allows to eliminate or reduce the biohazard characteristic of the sludge, by killing the pathogenic organisms present on it by the effect of moisture reduction and also high temperatures in the case of thermal drying. Moreover, the mass and volume of sludge are drastically reduced during drying, leading to lower handling, transportation, and storage costs. In addition, the moisture reduction during drying leads to the increase of the calorific value, consequently turning the sludge into a suitable biofuel.

Drying is a necessary step prior to further processing, such as pyrolysis or combustion, or it can lead directly to a pathogen-free product that could be used as biofuel or in agriculture.

### Application of the drying process for faecal sludge treatment

Faecal sludge drying is typically conducted in drying beds, where the sludge is spread on a basin and left there for a few weeks. This method combines both dewatering and drying processes: moisture is removed from the bottom by percolation through a bed of filter media and at the bottom by evaporation (Dodane and Ronteltap, 2014). However, this practice requires long drying times of a few weeks duration and cannot guarantee a satisfying level of pasteurization (Koné and Strauss, 2004; Seck *et al.*, 2015). With the emergence of new technologies in the sanitation sector, thermal drying has gained great interest as it can treat important throughputs of material in a relatively short time and lead to low moisture contents.

Table 1 summarizes a non-exhaustive list of faecal sludge drying technologies that have been deployed in the field or are under development. It can be noted that most of the technologies rely on convective and contact drying, while only a few cases are based on infrared, microwave and solar methods. The current faecal sludge dryers vary on size, going from small units in onsite sanitation facilities with in-situ treatment (e.g. reinvented toilets funded by the Bill & Melinda Gates Foundation) to large-scale processes in faecal sludge treatment plants (e.g. Omniprocessor"). The use of alternative drying methods, such as superheated steam drying and fry-drying, have not been explored up to now, but they have shown to have a great potential for sewage sludge drying (Benamoun, Arlabosse and Léonard, 2013).

## Background

## Addendum of data

Table 1. List of faecal sludge drying technologies

Type of drying	Technology	Application	Place in the treatment process	Energy source	Source
Convective drying	Belt dryer	Faecal sludge treatment plant from Tide Technocrats	Drying before a pyrolysis unit for biochar production	Heat from the combustion of the pyrolysis fumes	(Tide-Technocrats, 2016)
	Vertical multi-tray dryer	Reinvented "Firelight" Toilet from Janicki Industries	Drying before a combustion system	Heat from faecal sludge combustion	(SuSana, 2015)
	Rotary dryer	Faecal sludge treatment plant from Pivot	Final treatment (reuse of the product as biofuel)	Combustion of paperboards	(Pivot, 2016)
Contact drying	Hot surface wall screw conveyor	Faecal sludge treatment plant, "Omniprocessor", operated from Janicki Industries	Drying before a combustion system	Heat from faecal sludge combustion	(Villarreal, 2015)
	Heated rotary plate	Reinvented "A Better Toilet" from Research Triangle Institute	Drying before a combustion system	Heat from faecal sludge combustion	(RTI, 2013)
Convective, contact, radiative drying	Drying in the top of a fixed bed with a smouldering front at the bottom	Reinvented "Sanitation Now" from Toronto University	Drying before a smouldering system	Heat from faecal sludge smouldering	(Yermán, 2016)
Radiative	Infrared drier "LaDePa" (Latrine Dehydration Pasteurisation)	Treatment of faecal sludge from VIP latrines in eThekweni municipality	Final treatment (reuse of the product in agriculture)	Diesel generator providing the hot air and electricity	(Harrison and Wilson, 2012; Mirara <i>et al.</i> , 2015)
Radiative	Microwave dryer	Treatment of faecal sludge in emergency cases	Final treatment	Microwave radiation generated using electricity	(Mawioo <i>et al.</i> , 2017)
Solar	Greenhouse dryer	Faecal sludge treatment plant from Pivot	Pre-drying before the rotary dryer (see above)	Solar energy	(Pivot, 2016)

### Technological gaps

Thermal drying is a challenging process to put into application, with usual high capital and operating costs. The high capital costs could be due to the requirements of thermal insulation and piping, materials resilient to high temperature, instrumentation and process control equipment. The high operating costs are related to the inherent high energy demand for moisture evaporation. In addition, the drying system may require of frequent maintenance due to the fouling and clogging nature of faecal sludge.

As the latent heat of water vaporization is already high, it is of high importance to minimize the energy consumption as possible. A way to achieve this is through the setup of a dewatering stage before drying, in particular for faecal sludge with high moisture content. The dewatering process should remove as much moisture as possible to reduce the need for thermal drying and thus to increase the efficiency of the process.

The source of energy to run the drying process constitutes a major factor of consideration. As it can be noticed for some technologies in Table 2, the heat from combustion can be recovered for drying when faecal sludge is used as a biofuel. When there is no available source of waste heat in the nearby (for example from combustion), drying requires the continuous supply of an external source of energy, such as electricity or fuel, which can lead to high costs at the long term. The use of solar thermal energy could be an interesting possibility to provide a free source of energy to the system and subsequently decrease the operating costs. It could also serve as an additional source of energy in a faecal sludge combustion process, which will permit to get an enough low moisture content of the sludge for a more positive energy balance. A faecal sludge treatment flow diagram considering the aspects mentioned above is proposed in Figure 1.

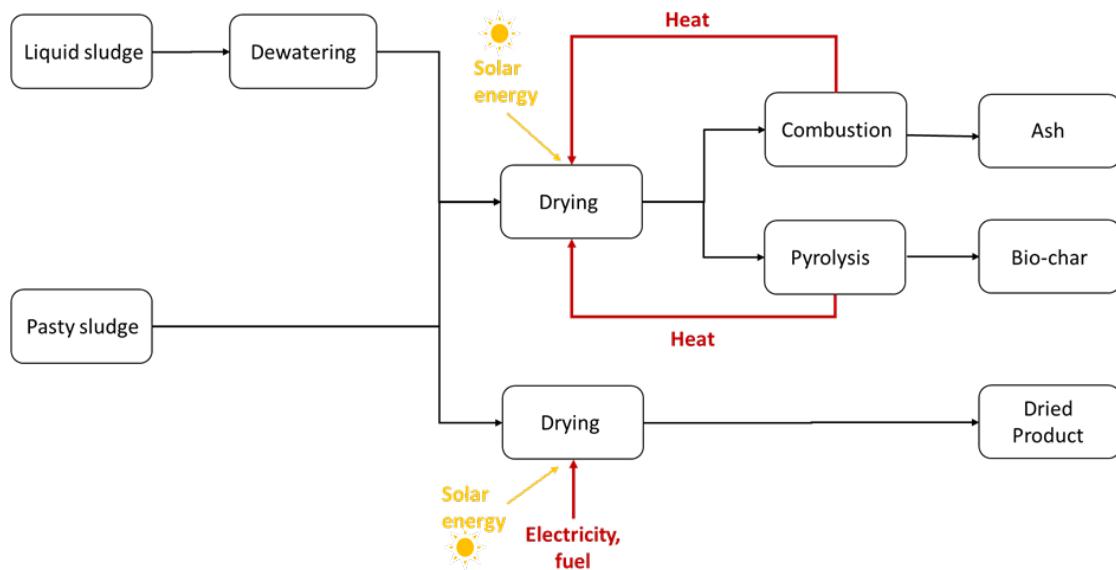


Figure 1. Faecal sludge treatment flow diagram

There is a wide number of sewage sludge drying technologies in the market, mostly from developed countries, which could be potentially used for faecal sludge. However, their adoption could be limited by the high investment that they represent, as the budget are usually more restraint in the faecal sludge sector. Therefore, it would be more convenient to develop drying technologies adapted to the

faecal sludge context, which will require knowledge and insight on the drying properties of the material. The main problem resides in the fact that, in the faecal sludge sector, drying is still in a premature stage and presents wide areas to be explored. Information is available from other sectors where drying is in a more advanced stage, in particular in the case of sewage sludge that is a material with common characteristics than faecal sludge. The information and experience from the other sectors can provide an understanding of the process, lessons and good practices. Still, they cannot be transposed completely due to the inherent characteristics of faecal sludge. Besides, the physicochemical properties of faecal sludge widely vary according to the type of toilet, the geographical location, the habits of the users, among other factors. Therefore, the drying behaviour of a specific faecal sludge needs to be characterized for the design of tailored technologies. This study should be conducted in a holistic way that encompasses, apart from the loss of moisture aspects, the changes undergone by the material susceptible to influence the process.

If the reader is interested to learn more about sewage sludge drying, Chen, Lock Yue and Mujumdar (2002) present a collection of dewatering and drying technologies for sewage sludge. Moreover, Bennamoun, Arlabosse and Léonard (2013) published a comprehensive review on sewage sludge drying.

## Faecal sludge drying fundamental aspects

This section presents the fundamental aspects of the faecal sludge drying process to take into consideration for the development, implementation, operation and improvement of technologies. These aspects involve the thermodynamics and kinetic aspect of the process, as well as the characteristics of the material along with the transformation.

If the reader is interested to learn about the drying fundamentals into more detail, Mujumdar and Devahastin (Mujumdar and Devahastin, 2000) describe the basic concepts of drying comprehensively.

### Thermodynamic concepts

The thermodynamic aspects of a drying system are important to be understood as they can enable to determine the maximal moisture removal that can be achieved at given conditions, the required heat input, the binding strength of moisture, the rehydration abilities of the dried sludge and the thermal behaviour of the material.

#### i. *Equilibrium moisture content*

Drying is driven by a difference of concentration of water between the solid and the surrounding air. This difference in concentration is formally expressed as the difference in chemical potential or thermodynamic activity. During drying, moisture is transferred from the moist solid to the surrounding air that has a lower thermodynamic activity. The evolution of the system stops after reaching the thermodynamic equilibrium, occurring when the water activity in the solid is equal to that from the air. The moisture content at the thermodynamic equilibrium is referred to as to moisture equilibrium content.

*ii. Sorption isotherms*

The sorption isotherms present the relationship of the equilibrium moisture content with the air relative humidity at a constant temperature. Figure 2 illustrates an example of sorption isotherms, where desorption curve corresponds to drying. The pattern of this curve can give an indication of the arrangement of the water molecules within the sludge, which depends on the temperature and the surface properties of the material.

The sorption isotherms enable to determine the minimum moisture content that can be achieved after drying at a given temperature and relative humidity. This approach can be particularly useful for drying at relatively low temperatures, where the air can hold a limited amount of vapour water, leading to elevated relative humidities. In the case of a high temperature drying process, its use becomes less relevant because the air can hold considerable more vapour water without leading to a substantial increase of relative humidity. Above 100°C, the sorption isotherms cannot be applied any further because there is no limitation on the capacity of the air to hold vapour water molecules and thus, the concept of relative humidity is not valid.

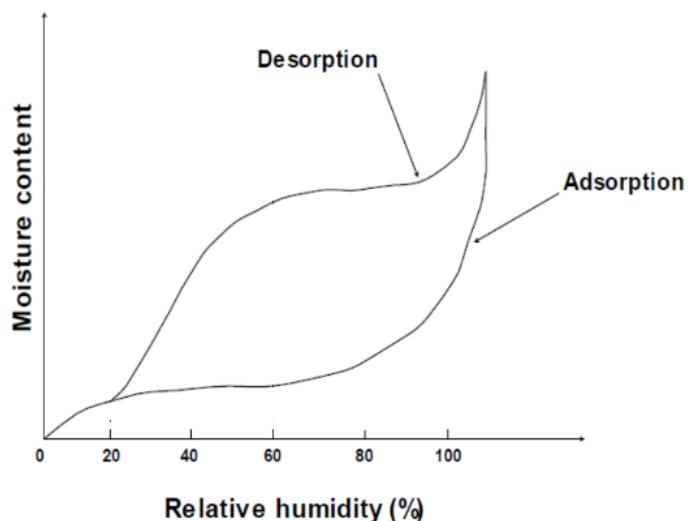


Figure 2. Sorption isotherms of a hygroscopic solid

*iii. Hygroscopy*

Hygroscopic materials can gain moisture after being dried if exposed to humid air. In contrast, non-hygroscopic materials cannot be rehydrated after drying at any conditions.

The hygroscopic material presents sorption isotherms with a desorption and adsorption components, as displayed in Figure 2. The desorption curve corresponds to the dehydration of the material, while the adsorption curve reflects the rehydration. The pattern of the adsorption and desorption curve can differ if the dehydration and rehydration follow different mechanisms.

It is of great importance to determine the hygroscopic characteristics of faecal sludge in order to understand the rehydration capabilities of the material. This aspect has important implications in the way to store the dried sludge, as important rehydration should be avoided because it can reduce the quality of the product and reactivate pathogens.

#### iv. Psychrometry

The equilibrium moisture content depends on the thermodynamic properties of air, so it is very important to determine them. An important tool for this consists in the use of the psychrometrics chart (Figure 3), which displays the thermodynamic properties of an air-vapour mixture at constant pressure. The most relevant parameters relative to drying are as following:

- Absolute humidity, defined as the unit mass of vapour per unit mass of dry air;
- Relative humidity, defined as the ratio of the partial pressure of water vapour in the air to the vapour pressure of water at the same temperature;
- Dry-bulb temperature, which refers to the temperature of the air-vapour mixture.
- Wet-bulb temperature, which refers to the temperature of the wet material.

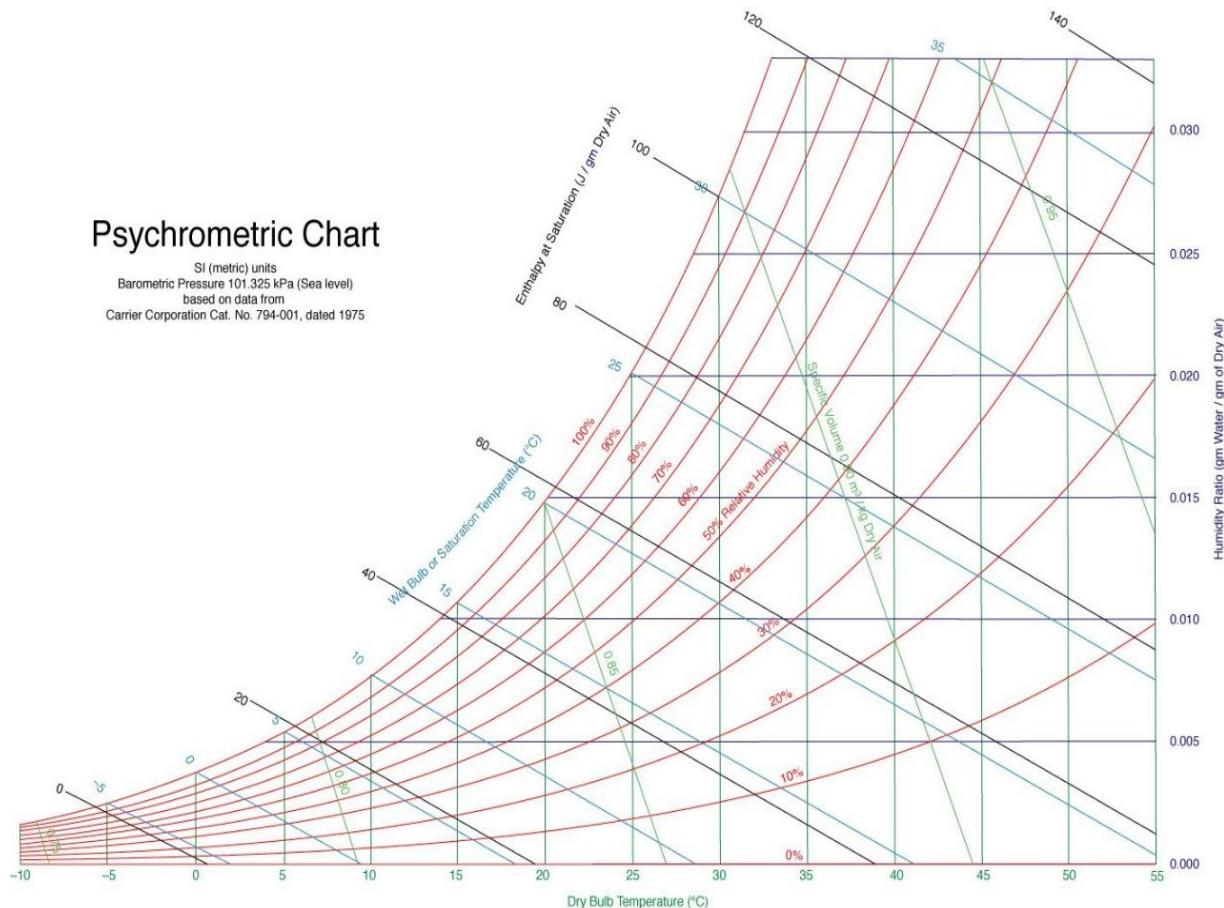


Figure 3. Psychrometric chart of vapour water-air mixture (source: Carrier Corporation)

#### v. Thermodynamic water activity

The thermodynamic activity of water is defined as the ratio of the vapour pressure in a substance (liquid or solid) to the vapour pressure of pure water at the same temperature. This parameter is an indicator of the bonding strength of moisture with the dry solid structure. Two major types of moisture exist:

- Unbound moisture exerts the same equilibrium vapour pressure than that of pure water at the same temperature (thermodynamic activity equal to 1). This type of

- moisture is not linked to the solid matrix by any interaction and then behaves like water.
- Bound moisture exerts a vapour pressure lower than that of water at the same temperature (water activity lower than 1). This type of moisture is linked to the solid matrix biologically, physically or chemically, and so it is usually more difficult to remove.

In the case of faecal sludge, moisture can be integrated into the sludge structure in different ways, as depicted in Figure 3. Moisture can be considered as unbound or free when it is not attached to the dry-bone structure, and then it can move freely within the sludge. Moisture is interstitial when it is trapped within clusters of particles and capillaries. Surface moisture is when it physically or chemically bound to the surface of the flocs. Intracellular moisture is contained inside cells.

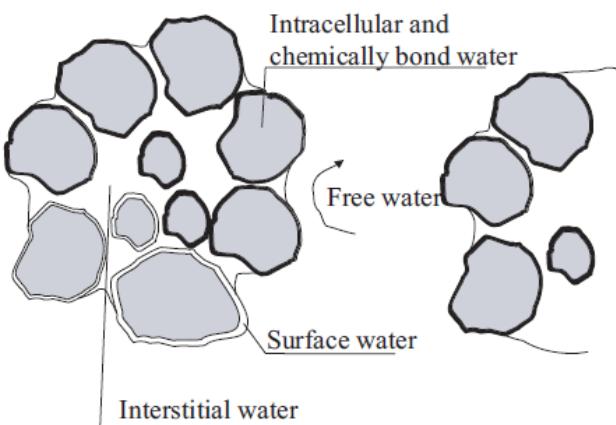


Figure 4. Different types of moisture in the sludge (Chen, Lock Yue and Mujumdar, 2002)

The determination of the distribution of the type of moisture in the sludge can provide valuable information about how drying will proceed. It can be postulated that bound moisture is more difficult to remove than unbound moisture. Therefore, sludge could be expected to dry faster at higher water activity than at lower values.

#### *vi. Heat of drying*

The distribution of the different types of moisture in the sludge also has an impact on the energy requirements. The evaporation of unbounded moisture is expected to demand a similar latent heat than pure water. In contrast, the energy demand will be higher for bound moisture that requires an extra energy input to break the physical, chemical and biological bounds.

Commonly, the latent heat of pure water vaporization is employed to estimate the heat required for drying. This approximation is correct during the evaporation of unbound moisture, but wrong for bound moisture. Therefore, this could cause deviations with reality and underestimate the heat requirements of the overall process. It is therefore important to determine the heat of drying. This parameter can be calculated through the water activity from a Clausius-Clayperon derived equation (Vaxelaire, 2001).

vii. *Thermal stability*

During thermal drying, the heat provided for moisture evaporation can induce a thermal degradation of the material. This phenomenon can cause modifications of the dry-bone structure of the faecal sludge and a loss of material through volatilization, which can have an impact on the quality of sludge for its reuse. It is therefore important to characterize the conditions on which the sludge is thermally degraded.

### Kinetics

The drying kinetics refers to the rate at which the process proceeds to attain the equilibrium moisture content. It is essential to ascertain how the kinetics vary as a function of the operating conditions for the development and improvement of drying technologies, setup of operation strategies and optimization of the system. The development of predictive models from the experimental kinetic data could be a useful tool for these purposes.

i. *Drying curves*

The drying curves exhibit the variation of moisture content as a function of time. The drying rate can be calculated from the derivative of the moisture content on dry basis or mass of sample with respect to time. An example of a drying curve with its corresponding drying rate is illustrated in Figure 5. To have more information about the determination of the drying curves, please refer to Chapter 4 from the Book of Standard Methods for Faecal Sludge Analysis.

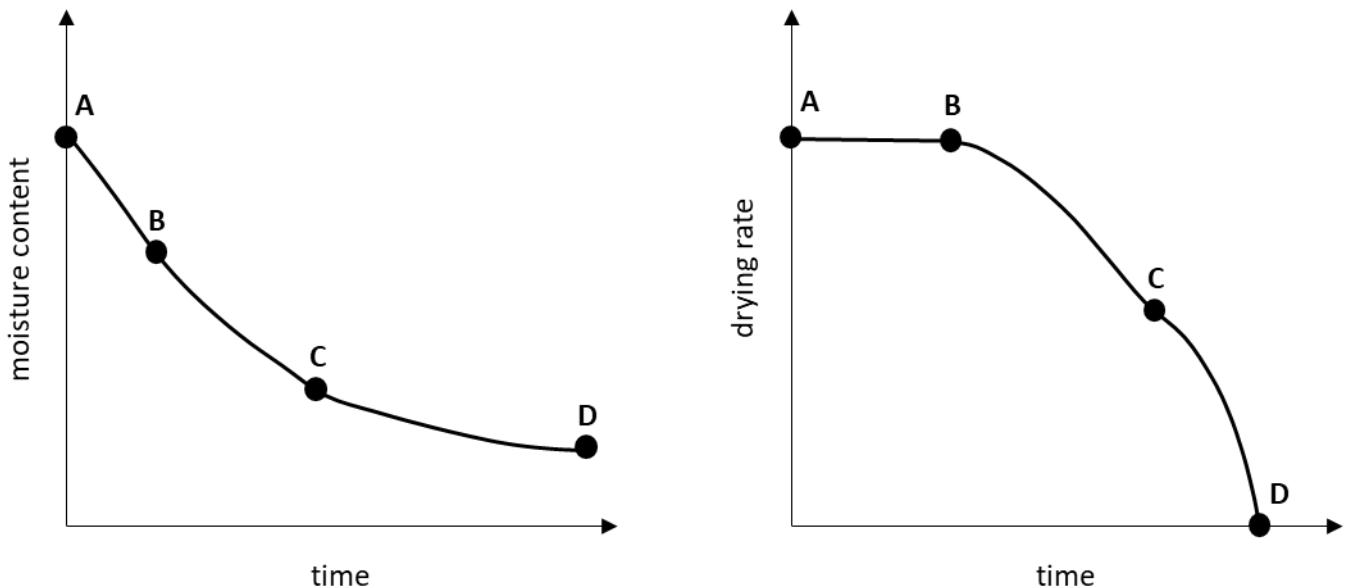


Figure 5. Drying curve (left) and its corresponding drying rate curve (right)

*ii. Drying rate regimes*

Typically, the kinetics are divided into three different phases:

- (1) Constant rate period (segment AB from Figure 5), where the entire surface of the material is saturated in moisture and drying proceeds in steady-state. During this stage, the evaporated moisture leaving the surface is replaced immediately by moisture from inside the material, leading to a dynamic equilibrium between the internal and external mass transfers. The temperature of the material remains fairly constant at approximately the wet-bulb temperature.
- (2) First falling rate period (segment BC from Figure 5), where the surface cannot be anymore maintained saturated in moisture and, in consequence, the drying rate declines. During this stage, the surface is partially saturated in moisture. Moreover, the temperature at the surface starts to increase from the wet to the dry-bulb temperature. The moisture content marking the beginning of the drying rate decline is named as critical moisture content (point B).
- (3) Second falling rate period (segment CD from Figure 5), where the surface of the material is completely dried, leading to a further decrease in the drying rate. During this stage, an evaporation front progress towards the centre of the material and the dried areas of the material attains the final temperature.

In real cases, the three kinetics regimes not always occur. For example, a drying curve can start directly at the falling rate period, without a previous constant rate stage.

*iii. Influence of the operating conditions*

The drying kinetics depend on the factors influencing the heat and mass transfer rates. The kinetics are controlled exclusively by the external transfers during the constant rate period, and by the internal transfers during the second falling rate period. Both internal and external transfer influence the first falling period. The rate of the external transfers depends on the surrounding conditions (air temperature, humidity and velocity) and the bulk characteristics of the material (geometry, size), while the rate of the internal transfers depends on the internal characteristics of the material (temperature, porosity, size). Different mechanisms ensure the internal mass transfer of moisture from the core of the material towards the surface: liquid and vapour diffusion; moisture movement due to capillary and hydrostatic pressure differences.

The comprehension of the influence of the operating conditions on the drying kinetics is indispensable for the proper design, operation, control, optimization and improvement of drying systems. The experimental kinetic data obtained at different operating conditions could serve for the development of predictive kinetic models that could be subsequently inserted into a reactor model and process simulation software.

The determination of the critical moisture content could provide useful information about the duration of the constant rate period and the beginning of the falling rate period. This information could be translated into measures to optimize the process by changing the operating conditions between the kinetic regimes. For instance, if the critical moisture content is known, the air velocity could be set to maximize the external transfers during the constant rate period, in order to lead to faster drying. After reaching the critical moisture content, the air velocity could be reduced as its influence is theoretically much lower during the falling rate period, which will lead to savings in the energy consumption required to create an airflow stream.

Another example is intermittent drying, where the process is stopped after reaching the critical moisture content and resumed after allowing natural re-equilibration of the moisture within the sludge (de Lima *et al.*, 2016). This method is presumed to prolong the constant rate period, in which the drying rate is at its maximal value, and increase the efficiency of the system consequently.

#### *iv. Properties of the material*

During drying, the removal of moisture can provoke changes in the physicochemical, mechanical and properties of the material, which can influence the transfer phenomena and therefore the drying kinetics. Temperature can also play an important role in the modifications undergone by the material and affect the quality of the final product. These modifications have to be taken into account for a full comprehension of the drying process.

#### Morphological characteristics

The removal of moisture content leads to the re-arrangement of the dry bone structure and provokes morphological changes that can be perceived at the naked eye. In our best of knowledge, no investigations to characterize the morphological changes during drying have been carried out for faecal sludge. Nonetheless, an important number of publications about this topic can be found for sewage sludge, and part of the findings could be transposed to faecal sludge.

The loss of moisture in the solid during drying creates void spaces that are eventually occupied by the remaining material, leading to the contraction of the structure and the subsequent shrinkage. Shrinkage of the volume can range between 50 to 70% and occurs mainly during the constant rate period (Léonard *et al.*, 2002, 2004; Léonard, Blacher, Marchot, *et al.*, 2003; Léonard, Blacher, Pirard, *et al.*, 2003; Tao, Peng and Lee, 2005).

The fast depletion of moisture at the surface of the sludge can provoke the formation of a crust, also known as skin. Crust formation tends to occur at high heating rates that lead to fast moisture evaporation at the surface while the core of the material remains wet. The crust affects the drying process negatively as it constitutes a barrier for the migration of moisture from the sludge to the environment, reducing then the mass transfer rate and consequently slowing down the drying process.

The formation of cracks in the surface of the sludge can also occur during drying. Cracking takes place mainly during the falling rate period, with the cracks occupying from 30 to more than 50% of the volume. The cracks tend to enhance the mass transfer, and therefore increase the drying rate (Léonard *et al.*, 2002, 2004; Léonard, Blacher, Marchot, *et al.*, 2003; Léonard, Blacher, Pirard, *et al.*, 2003; Tao, Peng and Lee, 2005).

#### Mechanical properties

The change of faecal sludge consistency from a liquid slurry to granular solid during drying has important implications in the process. During this process, the mechanical properties of the sludge are modified. Faecal sludge and faeces are considered as a shear-thinning fluid whose rheological, viscoelastic and viscoplastic properties depend on the moisture content (Woolley, Buckley, *et al.*, 2014; Woolley, Cottingham, *et al.*, 2014; Septien *et al.*, 2018). Therefore, the viscosity of the material will vary during drying. All these aspects have to be taken into account for the design of the dryer. The feeding or conveying system from the dryer should be able to handle the viscosity variations along the

process and the transformation of the sludge towards a solid. Moreover, the mechanical properties must be taken into account if the sludge is intended to be introduced into the dryer with a particular shape, e.g. pellets.

The change of phase from a suspension to a granular solid passes through a plastic phase characterized by a high stickiness of the sludge. During the sticky phase, the sludge can pose problems of clogging and fouling on the walls inside the dryer. The stickiness of faecal sludge requires then to be characterized and understood with insight, which will allow finding solutions to limit its occurrence and the severity of its effects.

### **Physiochemical properties**

It is important to determine the physicochemical properties of the dried sludge for the evaluation of its reuse as an agricultural product, biofuel, or other. Drying can alter the chemical composition and physical properties of the sludge, which could have an impact on the quality of the dried sludge for its reuse or further processing. During drying, the solid structure of the sludge can be thermally degraded by the high temperatures, leading to the volatilization of organic and inorganic compounds. The loss of the volatilized material can diminish the nutrient and energy content of the material, reducing the quality of the dried sludge for reuse in agriculture or as a biofuel. In addition, the removal of moisture can increase the concentration of the nutrients and organic material in the sludge and can modify some physical properties.

Furthermore, the physical properties that influence the heating and moisture transport during drying, such as the density, thermal properties and radiative properties, should be determined in a process design perspective. As the physical properties may vary during drying, the impact of this variability should be included in the design and operation of the thermal dryer.

### **Other aspects**

#### *i. Disinfection*

The primary goal of drying is to eliminate or reduce the biohazard characteristic of the sludge, by killing the pathogenic organisms present on it by the effect of moisture reduction and high temperatures. As it can be seen in Table 2, most bacteria cannot develop below a water activity of 0.91, including pathogens such as Escherichia Coli, Salmonella, Shigella and Vibrio Cholerae. This result implies that most of the pathogenic bacteria can be deactivated during drying if the sludge achieves a moisture content corresponding to a water activity lower than 0.91. Figure 6 shows how the deactivation time of common pathogens decreases strongly by increasing the temperature. The “safety zone”, where all the pathogens will be deactivated, can be achieved at 70°C in a few minutes. The time to achieve the “safety zone” could be reduced to seconds by increasing the temperature above 70°C, if the trends observed in Figure 6 are extrapolated.

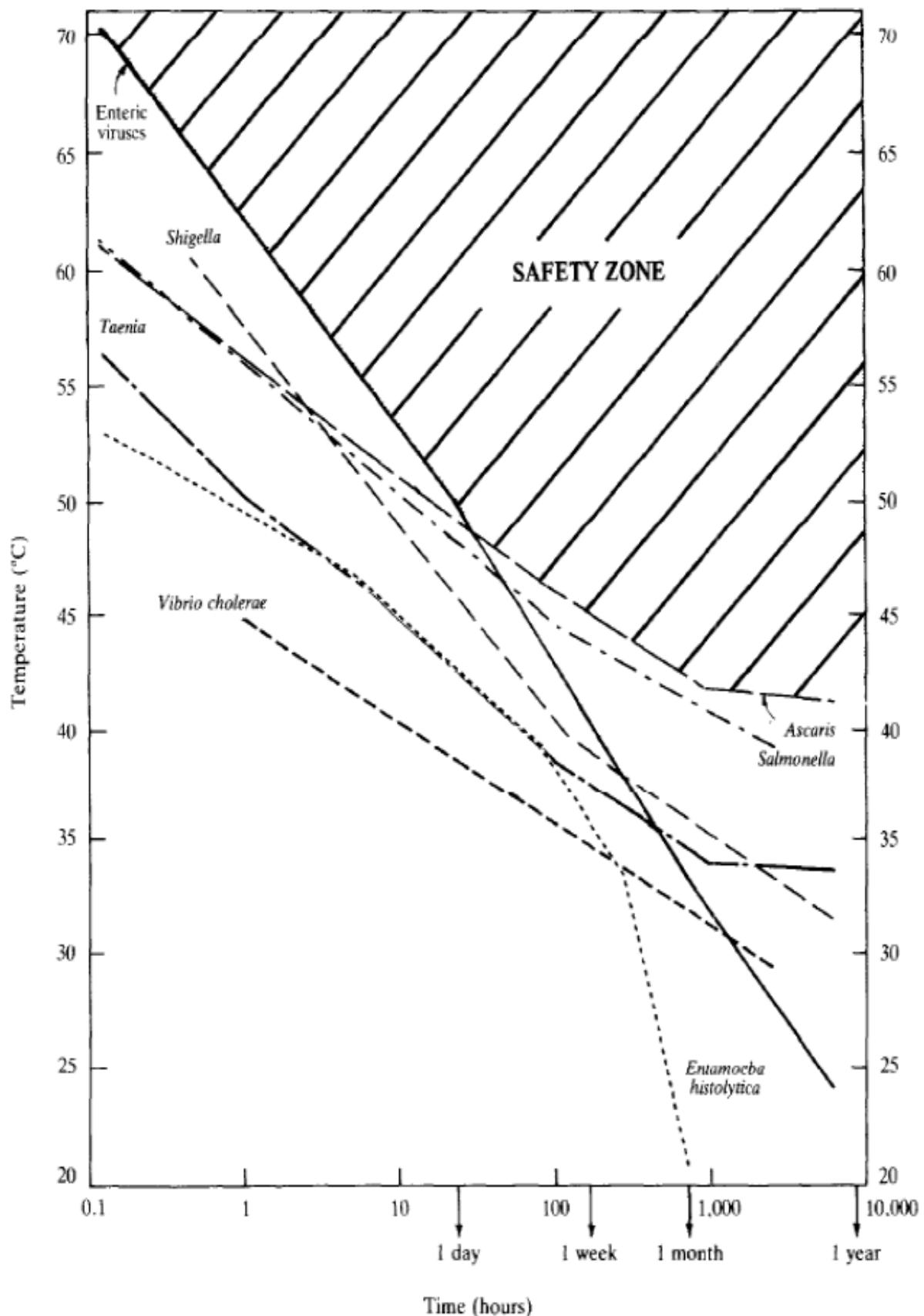


Figure 6. Temperature – time relation for the disinfection of pathogens (Feachem et al., 1983)

Table 2. Minimum water activity for microbial and spore development (Mujumdar and Devahastin, 2000)

Pathogen	Water activity
Pseudomonas, <i>Bacillus cereus</i> spores	0.97
<i>B. subtilis</i> , <i>C. botulinum</i> spores	0.95
<i>C. botulinum</i> , <i>Salmonella</i>	0.93
Most bacteria	0.91
Most yeast	0.88
<i>Aspergillus niger</i>	0.85
Most moulds	0.80
Halophilic bacteria	0.75
Xerophilic fungi	0.65
Osmophilic yeast	0.62

*ii. Dewaterability*

Depending on the moisture boundedness within the sludge, the material will present different dehydration behaviour. Usually, the free or unbound moisture, interstitial moisture and part of the surface moisture (mainly when it is physically bounded) can be removed by dewatering through gravity and mechanical processes. The removal of chemically bound surface moisture and intracellular moisture usually requires thermal drying.

As stated previously, dewatering should be applied before drying to reduce the costs associated with the sludge dehydration. Therefore, it is of high relevance to determine the dewaterability of the sludge by measuring the amount of moisture that can be potentially removed through mechanical means. This information can additionally give access to a better understanding of the type of moisture interaction within the sludge.

*iii. Gas emission*

Faecal sludge drying can enhance the release of volatile organic compounds into the environment, which may cause unpleasant odours. The potential olfactory nuisances at the vicinity of the dryer could impose constraints for the implementation of a drying process (example: need to comply with regulations in regards to odour emission).

The gas emission during drying should be then characterized by identifying the type of released and quantifying their amounts as a function of the operating conditions. This data will enable to set odour management strategies, such as the implementation of gas treatment units, the pertinent selection of operating conditions to minimize the odour emission, the most appropriate location of the plant, among other points.

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## Faecal sludge drying data

The data collected in this addendum is directly related to the drying process or has indirect implications on it. The data was collected from different institutions and is displayed into datasheets with relevant information about the feedstock and experimental conditions. The datasheets were categorized into eight groups: thermodynamics, kinetics, physiochemical properties, morphology, mechanical properties, dewaterability, disinfection, gas emission. Different types of faecal samples were involved on the generation of the data: fresh faeces and faecal sludge from various types of onsite sanitation facilities, among which ventilated improved pit (VIP) latrines, urine diversion dry toilets (UDDT), anaerobic baffled reactor (ABR) from a decentralized wastewater treatment plant (DEWAT). The datasheet can be found in the next section of this document.

This section collates and summarizes the information from the datasheets, and gives a brief explanation of the significance of the results.

### i. Thermodynamics

The datasheets related to the thermodynamics aspects of drying included sorption isotherms, water activity, heat of drying and thermal stability data. The sorption isotherms provide the moisture content of the faecal sample at the thermodynamic equilibrium as a function of the air relative humidity at constant temperature. It also determine the material hygroscopic properties. The water activity is a measure that gives an indication of the level of moisture boundedness within the material. The heat of drying quantifies the amount of energy required to dry the sample up to a given moisture content. The faecal matter thermal stability allows detecting the temperature range on which the sample dries and the one on which it undergoes thermal degradation.

Overall, the equilibrium moisture content was low (> 30%wt) even at high relative humidities for the different faecal materials, suggesting that faecal matter can be dried to low moisture contents even in humid atmospheres (< 90%) at ambient temperature. The water activity tended to drop and the heat of drying to increase exponentially below a moisture content of around 30 - 40%, reflecting that moisture started to be tightly bound to the sludge from this point. The faecal materials shown to be hygroscopic as they can regain humidity after drying if they are placed in a humid atmosphere.

### ii. Kinetics

The kinetics were studied in the datasheets through the drying curves, which display the evolution of moisture content as a function of time at different operating conditions (air temperature or irradiance, air velocity, relative humidity, sample size, etc).

It can be concluded that faecal matter drying kinetics are the most sensitive to the heat input (temperature in the case of convective drying, or irradiance for solar and infrared drying). The air velocity, relative humidity and sample size had a low to moderate influence on the drying kinetics.

### iii. Physiochemical properties

The evolution of the physiochemical properties of the various faecal materials during drying was determined by measuring the composition, calorific value, density and thermal properties at different stages of drying. The radiative properties of the raw samples were also measured in order to evaluate if the faecal materials are suitable for radiative processes (solar and infrared drying).

The results demonstrated that the nutrient content, volatile solids content and calorific value in dry basis remained the same during drying at different conditions. However, the nitrogen chemical form changed during the process (decrease of ammonium, nitrates and nitrites), as well as the thermal properties and density. It was hypothesized that these changes were due to the loss of moisture combined with the increase of moisture boundedness along the process. Concerning the radiative properties, the faecal materials had a higher absorbance than reflectance, with an almost null transmissivity, in the visible light and near-infrared regions. This result implies that faecal matter is a suitable material for solar and infrared processes as most of the received radiation will be absorbed by the material for moisture removal.

#### *iv. Morphology*

The morphology of the faecal material along the process was studied by measuring the shrinkage and through visual inspections. The specific surface and porosity were measured for the faecal matter dried at different temperatures.

The major phenomena detected during drying was: shrinkage up to 70% reduction in volume, cracking and crusting of the surface at the last stages of drying, and change of colour of the material. The drying temperature did not exhibit any significant influence on the specific surface and porosity of the faecal materials.

#### *v. Mechanical properties*

The datasheets mechanical properties included the rheological, stickiness, and plastic properties at different moisture content and temperatures. The rheological properties were characterized by plotting the viscosity and shear stress as a function of the applied shear rate, as well as by the measurement of the loss and storage moduli, i.e. the viscous and elastic response of the material respectively, after short stimuli. The stickiness was studied through the determination of the cohesive and adhesive forces of the faecal materials. The plastic properties were investigated by measuring the plastic and liquid limits.

In summary, all faecal materials exhibited a shear thinning behaviour, meaning that the material viscosity decreased by shearing. At rest, the material exhibited a stronger elastic behaviour than viscous. Therefore, minimum shear stress needs to be applied to overcome the elastic deformation resistance for the material to start to flow. The decrease in the moisture content led to higher viscosities. Below a moisture content of 70 -60%wt, the faecal material lost its ability to flow. The faecal matters attained a peak of stickiness in the range of 60 to 40%wt moisture content, which could be seen by the highest values of the adhesive and cohesive forces. In general, the material cohesive forces were significantly higher than the adhesive ones, suggesting that the stickiness of the material within itself is higher than with surfaces. The faecal materials' liquid limit was located approximately at the moisture content level where the materials could no longer flow. The loss of the ability to flow of the faecal materials could be then correlated to the change of consistency from liquid to plastic. The plastic limit was found in the moisture content range from the sticky region, corroborating that faecal matter plastic and sticky behaviour are related to each other. Indeed, the sticky region marks the transition from a plastic sludge paste to a solid. The temperature modified the rheological and stickiness characteristics slightly by decreasing the viscosity, and increasing the adhesive and cohesive forces.

*vi. Dewaterability*

The dewaterability was assessed by measuring the extent of liquid that can be removed through centrifugation and by capillary suction time (CST) analysis. The results were correlated to the physicochemical characteristics of the faecal matter. The water activity of the solid residue after centrifugation was measured as well.

Faecal samples could be dewatered up to 60 – 70%wt depending on the source of the material. The liquid faecal samples with a moisture content higher than 85%wt presented a high dewaterability, whereas the samples with a thicker consistency (moisture content lower than 80%wt) exhibited moderate or poor dewaterability. The difference of dewaterability between the liquid and thick faecal materials could be due to the difference in unbound moisture content. Indeed, the liquid faecal samples could be dewatered to a further extent by their higher unbound moisture content. The water activity remained approximately equal to 1 before and after centrifugation. It can be then assumed that dewatering removed only unbound moisture under the explored conditions. The CST results could be correlated to the extra-polymer substances (EPS) concentration and electric conductivity (EC), but not for the volatile suspended solids (VSS). None correlation was found for the total solids content of the dewatered faecal material with the EPS concentration, EC and VSS content.

*vii. Disinfection*

The disinfection aspect of drying was studied by tracking the viability of Ascaris eggs with time in faecal materials at different moisture contents and exposed to different temperatures. Ascaris eggs was selected as the pathogen disinfection indicator due to its high resilience. In fact, if the Ascaris eggs are deactivated under certain conditions, it can be supposed that other pathogens will also be destroyed.

According to the datasheets, the Ascaris deactivation rate increased exponentially with temperature. The eggs viability was not affected after exposure to 40°C for 2 hours, whereas complete inactivation was achieved at 80°C after a few seconds. The Ascaris eggs viability was also considerably reduced by exposing the eggs to faecal matter with a moisture content below 40%wt for a few weeks. For wetter faecal materials, the Ascaris eggs viability remained barely the same with time. These results denote that drying at high temperatures ( $> 60^{\circ}\text{C}$ ) and to low moisture contents ( $< 40\%$ wt) enhances the disinfection of the waste.

*viii. Gas emission*

The gas emission was examined by measuring the composition of the exhaust gas during faecal matter drying.

Apart from vapour water, other compounds were identified in the gas exhaust from the drying process, such as organic materials, carbon dioxide, carbon monoxide, nitrogen oxides, sulphur dioxide, ammonia and aerosols.

# THERMODYNAMICS

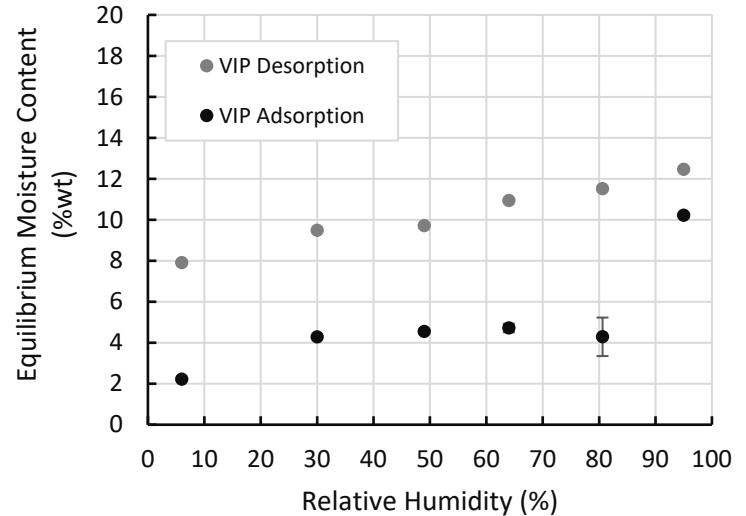
<u>General information</u>	
<b>Type of data</b>	Sorption isotherms
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Saturated salt solution setup
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~20°C)</li> <li>○ Relative humidity (RH): 6, 30, 49, 64, 81 and 95%</li> </ul>
<b>Sample form in the dryer</b>	~ 1.5 g of samples placed in silicon cupcake baking mould
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Direct measurement by the moisture analyzer balance <i>PCE-MB Series</i> (SOP 8.7.1.5)
<u>Publications</u>	
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Data source files																						
<a href="https://www.dropbox.com/s/64gp2lb2fksolmq/2018-2019%20FS%20and%20Fresh%20faeces_Sorption%20isotherms.xlsx?dl=0">https://www.dropbox.com/s/64gp2lb2fksolmq/2018-2019%20FS%20and%20Fresh%20faeces_Sorption%20isotherms.xlsx?dl=0</a>																						
Additional Notes																						
<ul style="list-style-type: none"> <li>○ Samples placed inside a jar with a saturated salt solution to control the relative humidity to a given value</li> <li>○ Employed salts: potassium hydroxide (6%RH), calcium chloride (30% RH), magnesium nitrate (49%RH), potassium iodide (64%RH), ammonium sulphate (80%RH), potassium nitrate (95% RH)</li> <li>○ Equilibrium moisture content reached after the stabilization of the mass</li> </ul>																						
Description of Data																						
<p><u>Equilibrium moisture content versus relative humidity (adsorption and desorption isotherms)</u></p> <table border="1"> <caption>Data points estimated from the scatter plot</caption> <thead> <tr> <th>Relative Humidity (%)</th> <th>ABR Desorption (%wt)</th> <th>ABR Adsorption (%wt)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>~9.5</td> <td>~2.5</td> </tr> <tr> <td>30</td> <td>~10.5</td> <td>~3.0</td> </tr> <tr> <td>50</td> <td>~11.0</td> <td>~4.5</td> </tr> <tr> <td>65</td> <td>~13.5</td> <td>~7.0</td> </tr> <tr> <td>80</td> <td>~14.5</td> <td>~15.0</td> </tr> <tr> <td>95</td> <td>~15.5</td> <td>~16.0</td> </tr> </tbody> </table>	Relative Humidity (%)	ABR Desorption (%wt)	ABR Adsorption (%wt)	10	~9.5	~2.5	30	~10.5	~3.0	50	~11.0	~4.5	65	~13.5	~7.0	80	~14.5	~15.0	95	~15.5	~16.0	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Higher equilibrium moisture contents for moisture desorption than adsorption (except at relative humidities higher than 80%)</li> <li>○ Possible to achieve low moisture content (&lt; 20%wt) at high relative humidities (&lt; 95%)</li> <li>○ Possible to regain slightly in moisture after drying if placed in environment with high relative humidity (hygroscopic behaviour)</li> </ul>
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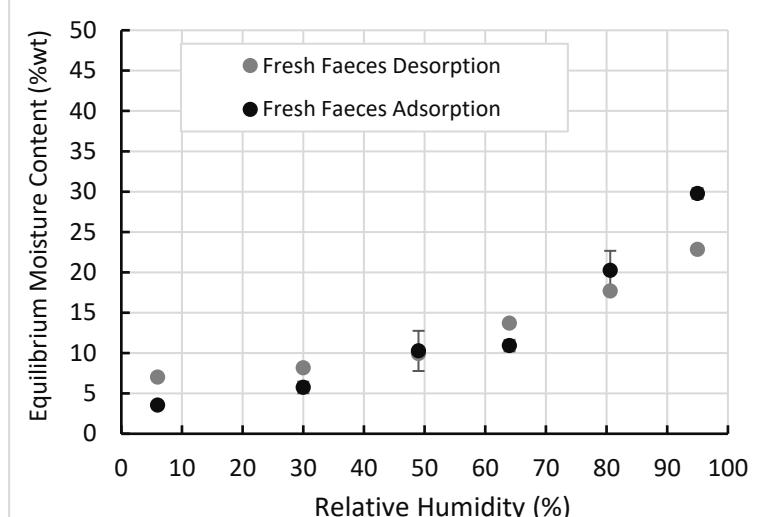
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<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Saturated salt solution setup
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~20°C)</li> <li>○ Relative humidity (RH): 6, 30, 49, 64, 81 and 95%</li> </ul>
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Data source files																						
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Additional Notes																						
<ul style="list-style-type: none"> <li>○ Samples placed inside a jar with a saturated salt solution to control the relative humidity to a given value</li> <li>○ Employed salts: potassium hydroxide (6%RH), calcium chloride (30% RH), magnesium nitrate (49%RH), potassium iodide (64%RH), ammonium sulphate (80%RH), potassium nitrate (95% RH)</li> <li>○ Equilibrium moisture content reached after the stabilization of the mass</li> </ul>																						
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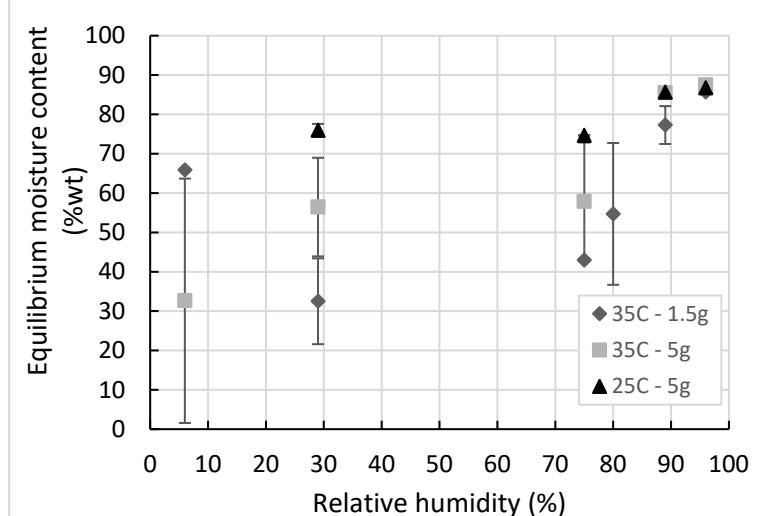
<u>General information</u>	
<b>Type of data</b>	Sorption isotherms
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 40%db
<b>Ash content</b>	~ 60%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Saturated salt solution setup
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~20°C)</li> <li>○ Relative humidity (RH): 6, 30, 49, 64, 81 and 95%</li> </ul>
<b>Sample form in the dryer</b>	~ 1.5 g of samples placed in silicon cupcake baking mould
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Direct measurement by the moisture analyzer balance <i>PCE-MB Series</i> (SOP 8.7.1.5)
<u>Publications</u>	
-	

<u>Data source files</u>																						
<a href="https://www.dropbox.com/s/64gp2lb2fksolmq/2018-2019%20FS%20and%20Fresh%20faeces_Sorption%20Isotherms.xlsx?dl=0">https://www.dropbox.com/s/64gp2lb2fksolmq/2018-2019%20FS%20and%20Fresh%20faeces_Sorption%20Isotherms.xlsx?dl=0</a>																						
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<u>Description of Data</u>																						
<u>Equilibrium moisture content versus relative humidity (adsorption and desorption isotherms)</u>  <p>The graph plots Equilibrium Moisture Content (%wt) on the y-axis (0 to 20) against Relative Humidity (%) on the x-axis (0 to 100). Two data series are shown: VIP Desorption (grey circles) and VIP Adsorption (black circles). The desorption curve starts at ~8% at 10% RH and rises to ~13% at 95% RH. The adsorption curve starts at ~2% at 5% RH and rises to ~11% at 95% RH.</p> <table border="1"> <caption>Approximate data points from the graph</caption> <thead> <tr> <th>Relative Humidity (%)</th> <th>VIP Desorption (%wt)</th> <th>VIP Adsorption (%wt)</th> </tr> </thead> <tbody> <tr><td>10</td><td>8</td><td>2</td></tr> <tr><td>30</td><td>10</td><td>4</td></tr> <tr><td>50</td><td>10</td><td>5</td></tr> <tr><td>65</td><td>11</td><td>5</td></tr> <tr><td>80</td><td>12</td><td>4.5</td></tr> <tr><td>95</td><td>13</td><td>10.5</td></tr> </tbody> </table>	Relative Humidity (%)	VIP Desorption (%wt)	VIP Adsorption (%wt)	10	8	2	30	10	4	50	10	5	65	11	5	80	12	4.5	95	13	10.5	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Higher equilibrium moisture contents for moisture desorption than adsorption</li> <li>○ Possible to achieve low moisture content (&lt; 20%wt) at high relative humidities (&lt; 95%)</li> <li>○ Possible for the sludge to regain slightly in moisture after drying if placed in environment with high relative humidity (hygroscopic behaviour)</li> </ul>
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<u>General information</u>	
<b>Type of data</b>	Sorption isotherms
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Saturated salt solution setup
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~20°C)</li> <li>○ Relative humidity (RH): 6, 30, 49, 64, 81 and 95%</li> </ul>
<b>Sample form in the dryer</b>	~ 1.5 g of samples placed in silicon cupcake baking mould
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Direct measurement by the moisture analyzer balance <i>PCE-MB Series</i> (SOP 8.7.1.5)
<u>Publications</u>	
-	

Data source files																						
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<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations from healthy young adults</li> <li>○ Samples placed inside a jar with a saturated salt solution to control the relative humidity to a given value</li> <li>○ Employed salts: potassium hydroxide (6%RH), calcium chloride (30% RH), magnesium nitrate (49%RH), potassium iodide (64%RH), ammonium sulphate (80%RH), potassium nitrate (95% RH)</li> <li>○ Equilibrium moisture content reached after the stabilization of the mass</li> </ul>																						
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<u>General information</u>	
<b>Type of data</b>	Sorption isotherms
<b>Place of experimentation</b>	Civil and Water Engineering Department, Laval University, Quebec (Canada)
<b>Dates of the experiments</b>	2017
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from share pit latrine
<b>Location of collection</b>	Quebec, Canada
<b>Age before collection</b>	1 or 2 years
<b>Moisture content</b>	~ 98 %wt
<b>Total solids content</b>	~ 2 %wt
<b>Volatile solids content</b>	~ 80 %wt
<b>Ash content</b>	~ 20 %wt
<b>Presence of trash?</b>	Yes (plastics, menstrual hygiene product, toilet paper)
<b>Pre-treatment</b>	Removal of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Saturated salt solution setup
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 25°C, and 35°C</li> <li>○ Relative humidity (RH) at 25°C: 29, 75, 89, 97%</li> <li>○ RH at 35°C: 6, 29, 75, 89, 97%</li> </ul>
<b>Sample form in the dryer</b>	1.5 and 5 g of samples placed in weighing tray
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Static gravimetric analysis from the sample mass loss
<u>Publications</u>	
Bourgault, C., Lessard, P., Remington, C., & Dorea, C. C. (2019). Experimental determination of moisture sorption isotherm of fecal sludge. <i>Water</i> , 11(2), 303.	
Bourgault, C. (2018). Characterization and quantification of faecal sludge from pit latrines. PhD thesis. University of Laval, Canada.	

Data source files																													
<a href="https://www.dropbox.com/s/mochav67q0gf0ul/2017%20VIP%20sludge%20Moisture%20Sorption%20Isotherms_Laval%20University.xlsx?dl=0">https://www.dropbox.com/s/mochav67q0gf0ul/2017%20VIP%20sludge%20Moisture%20Sorption%20Isotherms_Laval%20University.xlsx?dl=0</a>																													
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<u>Equilibrium moisture content versus relative humidity at 25 and 35°C (desorption isotherm)</u>  <p>The figure is a scatter plot with error bars showing the relationship between relative humidity and equilibrium moisture content. The x-axis represents relative humidity in percent, ranging from 0 to 100. The y-axis represents equilibrium moisture content in percent weight (wt%), ranging from 0 to 100. Three data series are plotted: 35°C - 1.5g (diamonds), 35°C - 5g (squares), and 25°C - 5g (triangles). All series show a general increase in moisture content as relative humidity increases, with higher temperatures and larger sample masses generally resulting in higher moisture content.</p> <table border="1"> <caption>Estimated data points from the desorption isotherm plot</caption> <thead> <tr> <th>Relative Humidity (%)</th> <th>35°C - 1.5g (%wt)</th> <th>35°C - 5g (%wt)</th> <th>25°C - 5g (%wt)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>~65</td> <td>~32</td> <td>-</td> </tr> <tr> <td>30</td> <td>~32</td> <td>~57</td> <td>~75</td> </tr> <tr> <td>75</td> <td>~43</td> <td>~60</td> <td>~75</td> </tr> <tr> <td>80</td> <td>~55</td> <td>-</td> <td>~78</td> </tr> <tr> <td>90</td> <td>~75</td> <td>~78</td> <td>~85</td> </tr> <tr> <td>95</td> <td>-</td> <td>-</td> <td>~85</td> </tr> </tbody> </table>	Relative Humidity (%)	35°C - 1.5g (%wt)	35°C - 5g (%wt)	25°C - 5g (%wt)	10	~65	~32	-	30	~32	~57	~75	75	~43	~60	~75	80	~55	-	~78	90	~75	~78	~85	95	-	-	~85	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Decrease of equilibrium moisture by decreasing the relative humidity in the range 75 to 96% RH</li> <li>○ Below 75% RH, not clear decrease of the equilibrium moisture content due to the high variability of the results</li> <li>○ Not clear effect of temperature and mass of sample</li> </ul>
Relative Humidity (%)	35°C - 1.5g (%wt)	35°C - 5g (%wt)	25°C - 5g (%wt)																										
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95	-	-	~85																										

<u>General information</u>	
<b>Type of data</b>	Sorption isotherms
<b>Place of experimentation</b>	Public Health & Environmental Engineering Laboratory, University of Victoria, Victoria, (Canada)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Victoria, BC
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Saturated salt solution setup
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 15°C, 25°C, and 35°C</li> <li>○ Relative humidity (RH) at 15°C: 6, 11, 34, 75, 80, 85, 97%</li> <li>○ RH at 25°C: 6, 9, 28, 75, 78, 84, 97%</li> <li>○ RH at 35°C: 6, 7, 23, 75, 76, 83, 97%</li> </ul>
<b>Sample form in the dryer</b>	1, 1.5, and 5 g of samples placed in weighing tray
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Static gravimetric analysis from the sample mass loss
<u>Publications</u>	
Remington, C., Bourgault, C., & Dorea, C. (2020). Measurement and modelling of moisture sorption isotherm and heat of sorption of fresh feces. <i>Water</i> , 12(2), 323. doi:10.3390/w12020323	

Remington, C. (2019). Countering the Porcelain Dream: Key Findings from an Evaluation of the Global Nitrogen Cycle, a Fundamental Characterization of Fresh Faeces, and a Campus Composting Toilet. MSc thesis. University of Victoria, Canada.

### Data source files

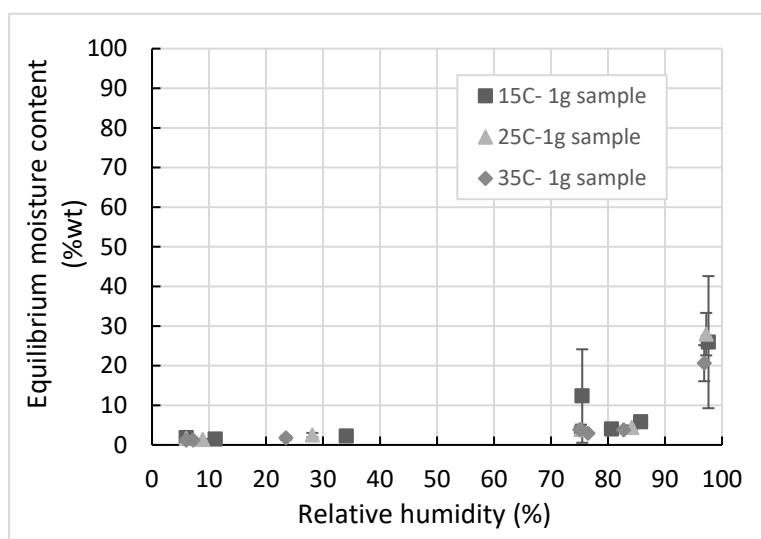
[https://www.dropbox.com/s/hv4i7wb6uigk4di/2018-2019%20Human%20faeces%20Moisture%20Sorption%20Isotherms\\_University%20of%20Victoria.xls?dl=0](https://www.dropbox.com/s/hv4i7wb6uigk4di/2018-2019%20Human%20faeces%20Moisture%20Sorption%20Isotherms_University%20of%20Victoria.xls?dl=0)

### Additional Notes

- Fresh faeces collected from voluntary and anonymous donations from healthy young adults
- Samples placed inside a jar with a saturated salt solution to control the relative humidity to a given value
- Employed salts: sodium hydroxide (6%RH), potassium hydroxide (7 - 11%RH), calcium chloride (23 - 34%RH), sodium chloride (75%RH), ammonium chloride (76 - 80%RH), potassium chloride (83 - 85%RH), potassium sulphate (97%RH)
- Equilibrium moisture content measured after the stabilization of the mass (2 to 4 weeks, depending on the sample)

### Description of Data

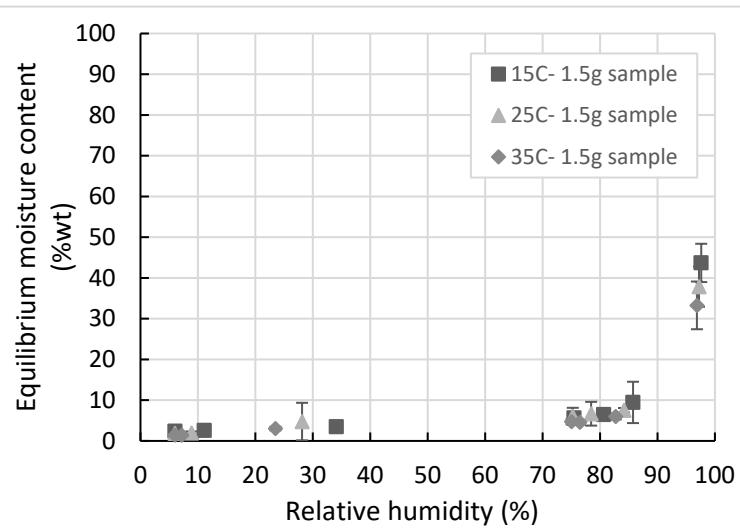
Equilibrium moisture content versus relative humidity at 15, 25 and 35°C for 1 g of sample



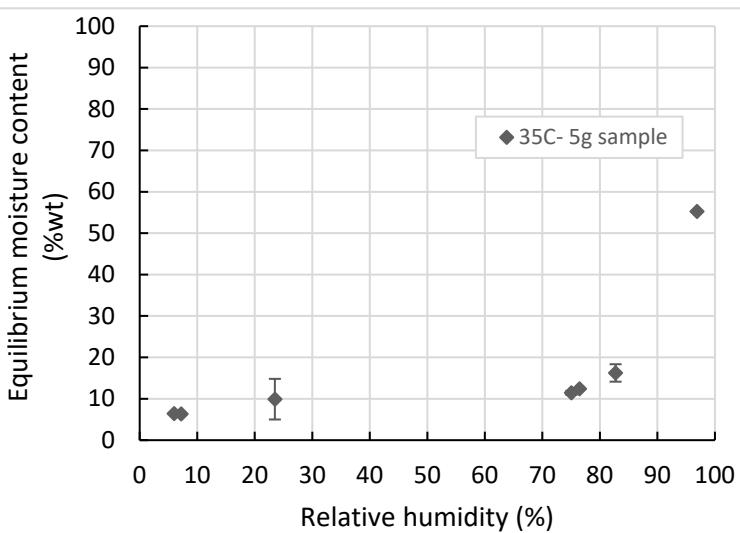
#### Observations:

- High variability of the equilibrium moisture content at 97%RH (probably because of the sorption isotherm tending to a vertical asymptote at 100%RH)
- Fast drop of the equilibrium moisture content below 97%RH
- Low equilibrium moisture content (< 20%) below 85%RH
- No effect of temperature
- Similar pattern for the different mass of sample

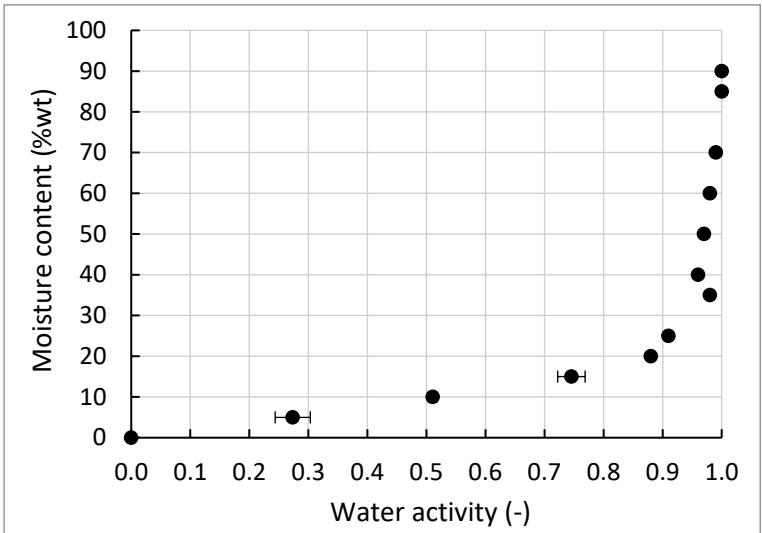
Equilibrium moisture content versus relative humidity at 15, 25 and 35°C for 1.5 g of sample



Equilibrium moisture content versus relative humidity at 15, 25 and 35°C for 5 g of sample



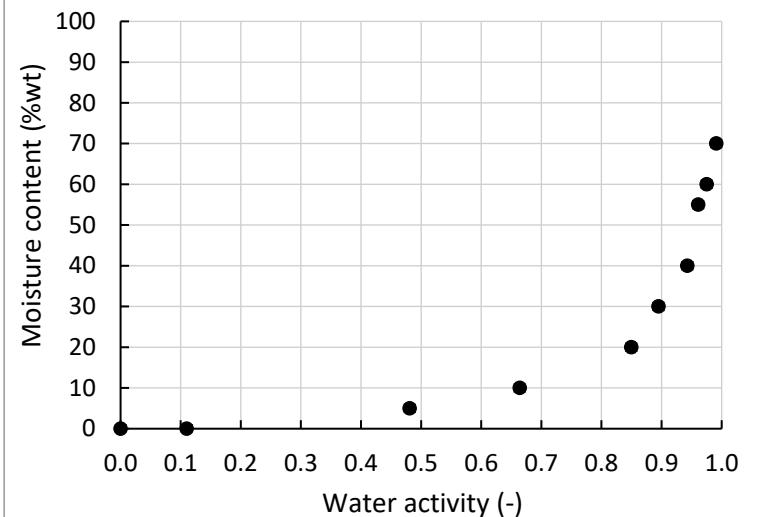
<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until achieving 0, 5, 10, 15, 20, 25, 35, 40, 50, 55, 60, 70 and 85%wt moisture content
<b>Operating conditions</b>	Temperature: 100°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Water activity
<b>Employed methods</b>	Use of water activity analyser <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

<u>Data source files</u>																	
<a href="https://www.dropbox.com/s/ltydxgp1xglrtz/2018-2019%20Moisture%20content%20as%20a%20function%20of%20Water%20activity.xlsx?dl=0">https://www.dropbox.com/s/ltydxgp1xglrtz/2018-2019%20Moisture%20content%20as%20a%20function%20of%20Water%20activity.xlsx?dl=0</a>																	
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<u>Description of Data</u>																	
<u>Water activity as a function of moisture content</u>  <table border="1"><caption>Estimated data points from the scatter plot</caption><thead><tr><th>Water activity (-)</th><th>Moisture content (%wt)</th></tr></thead><tbody><tr><td>0.00</td><td>0</td></tr><tr><td>0.30</td><td>5</td></tr><tr><td>0.50</td><td>10</td></tr><tr><td>0.70</td><td>15</td></tr><tr><td>0.80</td><td>20</td></tr><tr><td>0.90</td><td>25</td></tr><tr><td>0.95</td><td>90</td></tr></tbody></table>	Water activity (-)	Moisture content (%wt)	0.00	0	0.30	5	0.50	10	0.70	15	0.80	20	0.90	25	0.95	90	<u>Observations:</u> <ul style="list-style-type: none"><li>○ Water activity near 1 above 35%wt moisture content</li><li>○ Decrease of water activity below 35%wt moisture content</li></ul>
Water activity (-)	Moisture content (%wt)																
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<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Water activity
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.	

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Moisture content (%wt)	50 °C (a)	105 °C (a)	150 °C (a)	200 °C (a)	Raw sludge (a)																																
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<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until achieving 0, 5, 10, 20, 30, 40, 55, 60%wt moisture content
<b>Operating conditions</b>	Temperature: 100°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Water activity
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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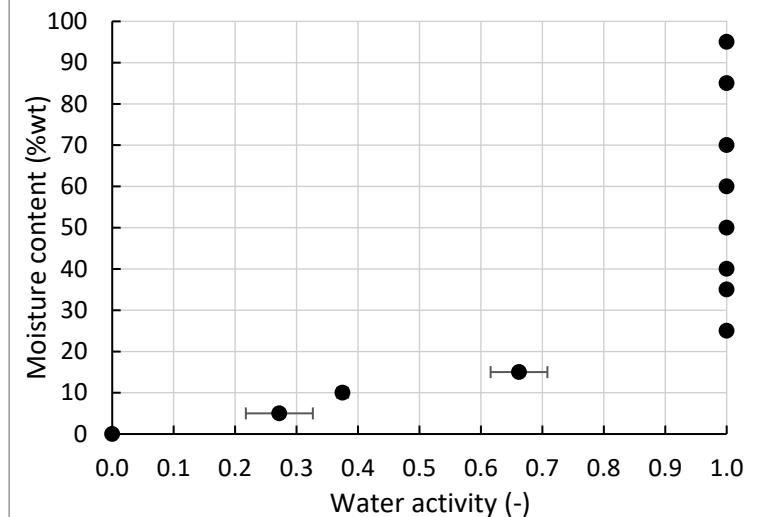
<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Water activity
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (8.8.3.3)
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Moisture content (%wt)	Water activity (a) - 50 K	Water activity (a) - 105 K	Water activity (a) - 150 K	Water activity (a) - 200 K	Water activity (a) - Raw sludge																																
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<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until achieving 20, 30, 40, 50, 60, 70, 80, 90%wt moisture content
<b>Operating conditions</b>	Temperature: 105°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Water activity at ambient (~22°C) and 40°C
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
-	

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Moisture content (%wt)	Water activity (-) (UDDT ambient temp)	Water activity (-) (UDDT 40 degrees C)																										
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<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until achieving 0, 5, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70 and 85%wt moisture content
<b>Operating conditions</b>	Temperature: 100°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Water activity
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~75%wt
<b>Total solids content</b>	~25%wt
<b>Volatile solids content</b>	~40%db
<b>Ash content</b>	~60%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Water activity
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
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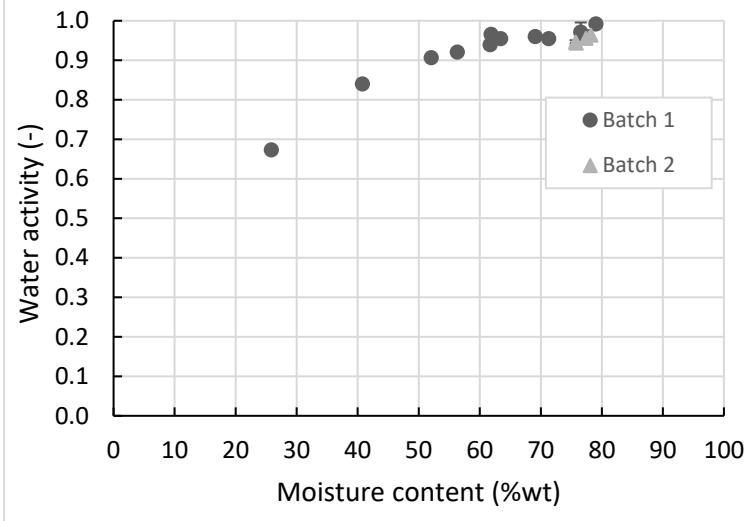
<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until achieving 20, 30, 40, 50, 60, 70, 80, 90%wt moisture content
<b>Operating conditions</b>	Temperature: 105°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Water activity at ambient (~22°C) and 40°C
<b>Employed methods</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
-	

Data source files																												
<a href="https://www.dropbox.com/s/tw20fkfiokv0bdo/2019-2020%20Water%20activity%20as%20a%20function%20of%20moisture%20content.xlsx?dl=0">https://www.dropbox.com/s/tw20fkfiokv0bdo/2019-2020%20Water%20activity%20as%20a%20function%20of%20moisture%20content.xlsx?dl=0</a>																												
Additional Notes																												
-																												
Description of Data																												
<p><u>Water activity as a function of moisture content at different temperatures</u></p> <table border="1"> <caption>Data points estimated from the scatter plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Water activity (VIP ambient temp)</th> <th>Water activity (VIP 40 degrees C)</th> </tr> </thead> <tbody> <tr><td>20</td><td>0.85</td><td>0.85</td></tr> <tr><td>30</td><td>0.88</td><td>0.88</td></tr> <tr><td>40</td><td>0.95</td><td>0.95</td></tr> <tr><td>50</td><td>0.95</td><td>0.95</td></tr> <tr><td>60</td><td>0.98</td><td>0.98</td></tr> <tr><td>70</td><td>0.98</td><td>0.98</td></tr> <tr><td>80</td><td>0.98</td><td>0.98</td></tr> <tr><td>90</td><td>0.98</td><td>0.98</td></tr> </tbody> </table>	Moisture content (%wt)	Water activity (VIP ambient temp)	Water activity (VIP 40 degrees C)	20	0.85	0.85	30	0.88	0.88	40	0.95	0.95	50	0.95	0.95	60	0.98	0.98	70	0.98	0.98	80	0.98	0.98	90	0.98	0.98	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Water activity constant around 1 above a 50%wt moisture content</li> <li>○ Decrease of water activity below 50%wt moisture content</li> <li>○ No effect of temperature in water activity</li> </ul>
Moisture content (%wt)	Water activity (VIP ambient temp)	Water activity (VIP 40 degrees C)																										
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<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Water activity
<b>Employed method</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
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Data source files																															
<a href="https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0</a>																															
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Fresh faeces collected from voluntary and anonymous donations																															
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<p><u>Water activity as a function of moisture content and temperature</u></p> <table border="1"> <caption>Data points estimated from the scatter plot</caption> <thead> <tr> <th>Moisture content (%)</th> <th>Water activity (-) at 50 K</th> <th>Water activity (-) at 105 K</th> <th>Water activity (-) at 150 K</th> <th>Water activity (-) at 200 K</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0.35</td> <td>0.15</td> <td>0.08</td> <td>0.25</td> </tr> <tr> <td>20</td> <td>0.65</td> <td>0.70</td> <td>0.85</td> <td>0.80</td> </tr> <tr> <td>40</td> <td>-</td> <td>-</td> <td>0.90</td> <td>0.90</td> </tr> <tr> <td>60</td> <td>-</td> <td>-</td> <td>0.95</td> <td>0.95</td> </tr> <tr> <td>80</td> <td>-</td> <td>-</td> <td>0.98</td> <td>0.98</td> </tr> </tbody> </table>	Moisture content (%)	Water activity (-) at 50 K	Water activity (-) at 105 K	Water activity (-) at 150 K	Water activity (-) at 200 K	0	0.35	0.15	0.08	0.25	20	0.65	0.70	0.85	0.80	40	-	-	0.90	0.90	60	-	-	0.95	0.95	80	-	-	0.98	0.98	<p><b>Observations:</b></p> <ul style="list-style-type: none"> <li>○ Water activity near 1 above 40%wt moisture content</li> <li>○ Decrease below 40%wt moisture content</li> <li>○ No effect of drying temperature</li> </ul>
Moisture content (%)	Water activity (-) at 50 K	Water activity (-) at 105 K	Water activity (-) at 150 K	Water activity (-) at 200 K																											
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<u>General information</u>	
<b>Type of data</b>	Water Activity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample placed in 1 L plastic bucket
<b>Analysed parameters</b>	Water activity
<b>Employed method</b>	Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
-	

<u>Data source files</u>																															
<a href="https://www.dropbox.com/s/xbv6su0jxsiplk/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PRG.xlsx?dl=0">https://www.dropbox.com/s/xbv6su0jxsiplk/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PRG.xlsx?dl=0</a>																															
<u>Additional Notes</u>																															
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ Containers with sample placed in a ventilated area</li> <li>○ Mesh placed at the opening of the container to avoid the development of maggots</li> <li>○ Samples from batch 1 analysed in a weekly basis for 16 weeks</li> <li>○ Samples from batch 2 analysed at days 0, 3, 5 and 7 during one week</li> </ul>																															
<u>Description of Data</u>																															
<p><u>Water activity as a function of moisture content for the samples from batch 1 and 2</u></p>  <table border="1"> <caption>Data points estimated from the scatter plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Batch 1 (Water activity)</th> <th>Batch 2 (Water activity)</th> </tr> </thead> <tbody> <tr><td>25</td><td>0.68</td><td></td></tr> <tr><td>40</td><td>0.85</td><td></td></tr> <tr><td>50</td><td>0.92</td><td></td></tr> <tr><td>55</td><td>0.94</td><td></td></tr> <tr><td>60</td><td>0.95</td><td></td></tr> <tr><td>65</td><td>0.96</td><td></td></tr> <tr><td>70</td><td>0.96</td><td></td></tr> <tr><td>75</td><td>0.97</td><td>0.97</td></tr> <tr><td>80</td><td>0.98</td><td></td></tr> </tbody> </table>	Moisture content (%wt)	Batch 1 (Water activity)	Batch 2 (Water activity)	25	0.68		40	0.85		50	0.92		55	0.94		60	0.95		65	0.96		70	0.96		75	0.97	0.97	80	0.98		<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Relatively constant water activity above 60%wt moisture content</li> <li>○ Decrease of water activity below 60%wt moisture content</li> </ul>
Moisture content (%wt)	Batch 1 (Water activity)	Batch 2 (Water activity)																													
25	0.68																														
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<u>General information</u>	
<b>Type of data</b>	Heat of drying
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Heat of reaction and Moisture content
<b>Employed method</b>	Determined through the mass (1) and energy (2) variation measured by the STA
<u>Publications</u>	
-	

Data source files	
<a href="https://www.dropbox.com/s/evpydu2nyjolvg/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/evpydu2nyjolvg/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Faecal sludge couriered from South Africa</li> <li>○ Considerable drying of the sample before reaching the set temperature at 105, 155 and 205°C</li> </ul>	
Description of Data	
<p><u>Cumulative heat per evaporated moisture versus moisture content as a function of temperature</u></p> <p>The figure is a scatter plot with multiple curves representing different temperatures. The y-axis is labeled 'Cumulative heat (kJ/kg)' and ranges from 0 to 20,000. The x-axis is labeled 'Moisture content (g/g db)' and ranges from 0 to 7. A legend in the top right corner identifies the curves: 55 degrees C (lightest), 85 degrees C, 105 degrees C, 155 degrees C, and 205 degrees C (darkest). All curves show a general upward trend as moisture content decreases, indicating that more heat is required to remove moisture from drier samples. Higher temperatures correspond to higher cumulative heat values across all moisture contents.</p>	<p><u>Observations</u></p> <ul style="list-style-type: none"> <li>○ High fluctuation of the heat of drying at the beginning of the transformation (probably due to the stabilization of the process)</li> <li>○ Heat of drying fairly constant or slightly increasing during most of process, ranging between about 3000 and 4000 kJ/kg</li> <li>○ Exponential increase of the heat of drying below a moisture content of 1 g/g db</li> <li>○ Heat of drying tending to a vertical asymptote at very low moisture content (~0.1 g/g db)</li> <li>○ No trend observed as a function of the drying temperature</li> <li>○ Heat of drying higher than latent heat of water vaporization (&gt; 2260 kJ/kg)</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Heat of drying
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Heat of reaction and Moisture content
<b>Employed method</b>	Determined through the mass (1) and energy (2) variation measured by the STA
<u>Publications</u>	
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Data source files	
<a href="https://www.dropbox.com/s/evpydu2nyjolvg/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/evpydu2nyjolvg/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Faecal sludge couriered from South Africa</li> <li>○ Considerable drying of the sample before reaching the set temperature at 105, 155 and 205°C</li> </ul>	
Description of Data	
<p><u>Heat of drying versus moisture content as a function of temperature</u></p>	<p><u>Observations</u></p> <ul style="list-style-type: none"> <li>○ High fluctuation of the heat of drying at the beginning of the transformation (probably due to the stabilization of the process)</li> <li>○ Heat of drying fairly constant or slightly increasing during most of process, ranging between about 7000 and 10000 kJ/kg</li> <li>○ Exponential increase of the heat of drying below a moisture content of 0.5 g/g db</li> <li>○ Heat of drying tending to a vertical asymptote at very low moisture content (~0.1 g/g db)</li> <li>○ Apparent lower heating of drying at higher temperature</li> <li>○ Heat of drying higher than latent heat of water vaporization (&gt; 2260 kJ/kg)</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Heat of drying
<b>Place of experimentation</b>	Materials Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis (STA) <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55 and 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Heat of reaction and moisture content
<b>Employed method</b>	Determined through the mass (1) and energy (2) variation measured by the STA
<u>Publications</u>	
-	

Data source files	
<a href="https://www.dropbox.com/s/evpydu2nyjolv/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/evpydu2nyjolv/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Faecal sludge couriered from South Africa</li> <li>○ Considerable drying of the sample before reaching the set temperature at 105, 155 and 205°C</li> </ul>	
Description of Data	
<p><b>Heat of drying versus moisture content as a function of temperature</b></p> <p>The graph illustrates the relationship between cumulative heat of drying (kJ/kg) and moisture content (g/g db) for faecal sludge at various temperatures. The curves show a characteristic 'S' shape, where the rate of heat release is highest during the initial stages of drying and then levels off as the sludge becomes drier. Higher temperatures lead to higher cumulative heat values, particularly at lower moisture contents.</p>	<p><b>Observations</b></p> <ul style="list-style-type: none"> <li>○ High fluctuation of the heat of drying at the beginning of the transformation (probably due to the stabilization of the process)</li> <li>○ Heat of drying fairly constant during most of process, ranging between about 1500 and 2000 kJ/kg (except for 155°C)</li> <li>○ Exponential increase of the heat of drying below a moisture content of 2 g/g db</li> <li>○ Heat of drying tending to a vertical asymptote at very low moisture content (<math>\sim 0.1</math> g/g db)</li> <li>○ No trend observed as a function of the drying temperature</li> <li>○ Heat of drying close to the latent heat of water vaporization during most of the transformation (<math>\sim 2260</math> kJ/kg)</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Heat of drying
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Cranfield, UK
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 60%wt
<b>Total solids content</b>	~ 40%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Heat of reaction and Moisture content
<b>Employed method</b>	Determined through the mass (1) and energy (2) variation measured by the STA
<u>Publications</u>	
-	

<u>Data source files</u>	
<a href="https://www.dropbox.com/s/evpydu2nyjolv/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/evpydu2nyjolv/Swansea%20Heat%20of%20drying%20tests_Faeces%20and%20Faecal%20sludge%20%282018-2020%29.xlsx?dl=0</a>	
<u>Additional Notes</u>	
<ul style="list-style-type: none"> <li>○ Fresh faeces obtained from anonymous and voluntary donations</li> <li>○ Considerable drying of the sample before reaching the set temperature at 105, 155 and 205°C</li> </ul>	
<u>Description of Data</u>	
<p><u>Heat of drying versus moisture content as a function of temperature</u></p> <p>The figure is a scatter plot titled 'Heat of drying versus moisture content as a function of temperature'. The y-axis is labeled 'Cumulative heat (kJ/kg)' and ranges from 0 to 20000. The x-axis is labeled 'Moisture content (g/g db)' and ranges from 0 to 3.5. There are five sets of curves, each corresponding to a different temperature: 55 degrees C (lightest), 85 degrees C, 105 degrees C, 155 degrees C, and 205 degrees C (darkest). Each set of curves shows a general increase in cumulative heat as moisture content increases, with higher temperatures generally resulting in higher cumulative heat values. All curves appear to converge towards a vertical asymptote at very low moisture contents (around 0.5 g/g db).</p>	<p><u>Observations</u></p> <ul style="list-style-type: none"> <li>○ High fluctuation of the heat of drying at the beginning of the transformation (probably due to the stabilization of the process)</li> <li>○ Heat of drying fairly constant or slightly increasing during most of process, ranging between about 5000 and 10000 kJ/kg (except for 85°C)</li> <li>○ Exponential increase of the heat of drying below a moisture content of 0.5 g/g db</li> <li>○ Heat of drying tending to a vertical asymptote at very low moisture content (~0.7 g/g db)</li> <li>○ No trend observed as a function of the drying temperature</li> <li>○ Heat of drying higher than latent heat of water vaporization (&gt; 2260 kJ/kg)</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Thermal stability
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry analyser - differential thermal analyser <i>DTG-60A Shimadu</i>
<b>Drying time</b>	~ 35 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ramp from ambient temperature to 500°C</li> <li>○ Heating rate: 5°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 70 mg sample on aluminium crucible (6 mm diameter × 5 mm height)
<b>Analysed parameters</b>	Mass
<b>Employed method</b>	Measurement by the <i>DTG-60A</i> instrument (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

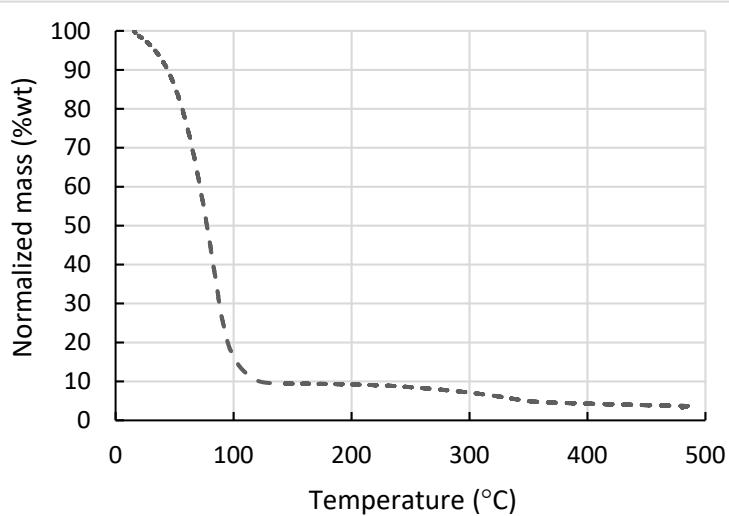
[https://www.dropbox.com/s/dr718ewj9s1k5h0/2018-2019%20Faecal%20sludge\\_Heat%20of%20drying%20and%20Dynamic%20Tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/dr718ewj9s1k5h0/2018-2019%20Faecal%20sludge_Heat%20of%20drying%20and%20Dynamic%20Tests_PRG.xlsx?dl=0)

#### Additional Notes

- Normalized mass at a given instance = mass at given instance / initial mass

#### Description of Data

##### Variation of mass with temperature



##### Observations:

- Large decrease of mass from ambient temperature to around 130°C (due to drying)
- Second slight decrease of mass from 250°C to 350°C (probably due to a thermal degradation)

<u>General information</u>	
<b>Type of data</b>	Thermal stability
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, South Africa
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	1 - 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones and textiles)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry analyser - differential thermal analyser <i>DTG-60A Shimadu</i>
<b>Drying time</b>	~ 35 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ramp from ambient temperature to 500°C</li> <li>○ Heating rate: 5°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~70 mg sample on aluminium crucible (6 mm diameter × 5 mm height)
<b>Analysed parameters</b>	Mass
<b>Employed method</b>	Measurement by the <i>DTG-60A</i> instrument
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

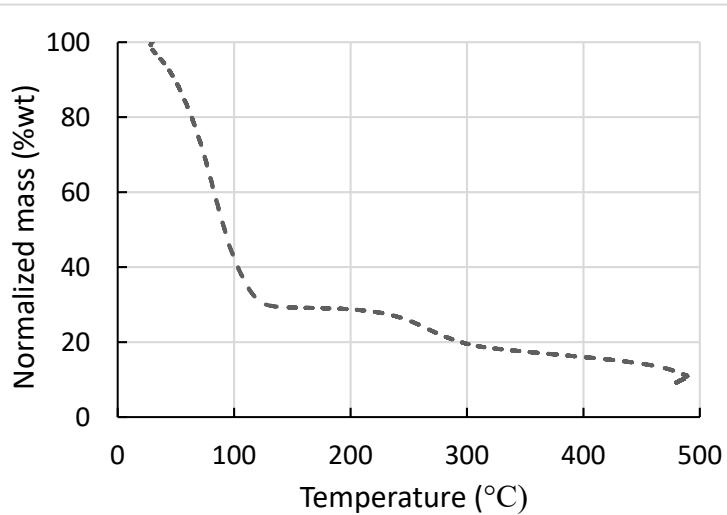
### Data source files

### Additional Notes

Normalized mass at a given instance = mass at given instance / initial mass

### Description of Data

#### Variation of mass with temperature



#### Experimental conditions:

- Temperature: from ambient to 500°C
- Heating rate: 5°C/min
- Airflow rate: 50 ml/min

#### Observations:

- Large decrease of mass from ambient temperature to around 130°C (due to drying)
- Second slight decrease of mass from 250°C to 350°C (probably due to a thermal degradation)

<u>General information</u>	
<b>Type of data</b>	Thermal stability
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, South Africa
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated pit latrines
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	3 – 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry analyser - differential thermal analyser <i>DTG-60A Shimadu</i>
<b>Drying time</b>	~ 35 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ramp from ambient temperature to 500°C</li> <li>○ Heating rate: 5°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~70 mg sample on aluminium crucible (6 mm diameter × 5 mm height)
<b>Analysed parameters</b>	Mass
<b>Employed method</b>	Measurement by the <i>DTG-60A</i> instrument
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

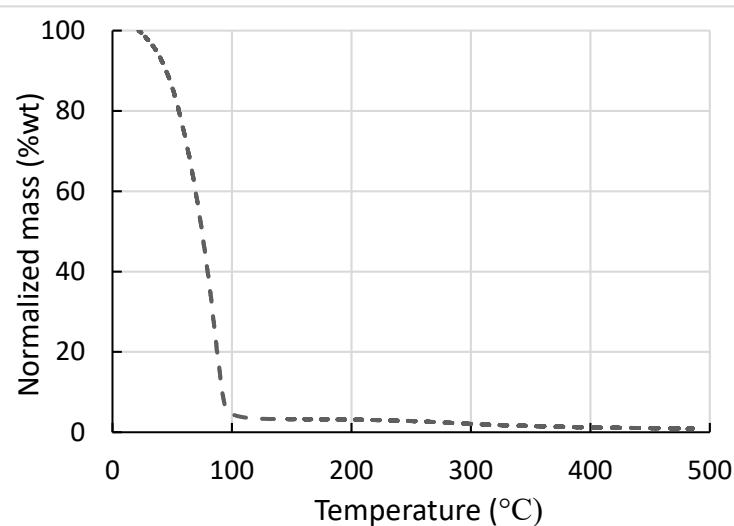
### Data source files

### Additional Notes

Normalized mass at a given instance = mass at given instance / initial mass

### Description of Data

#### Variation of mass with temperature



#### Experimental conditions:

- Temperature: from ambient to 500°C
- Heating rate: 5°C/min
- Airflow rate: 50 ml/min

#### Observations:

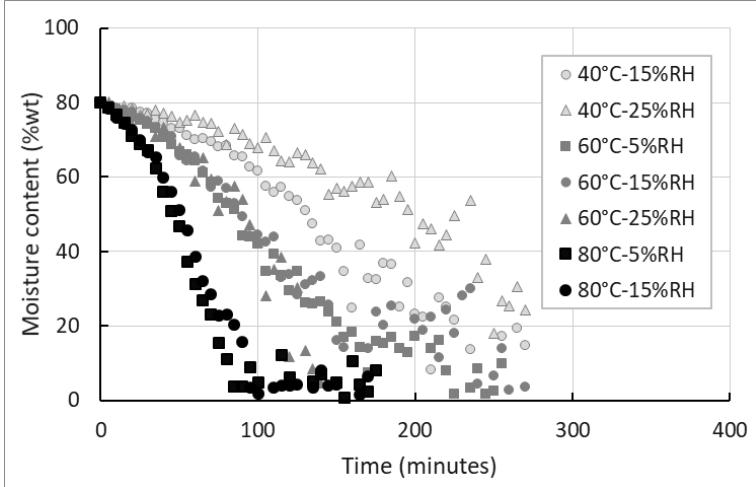
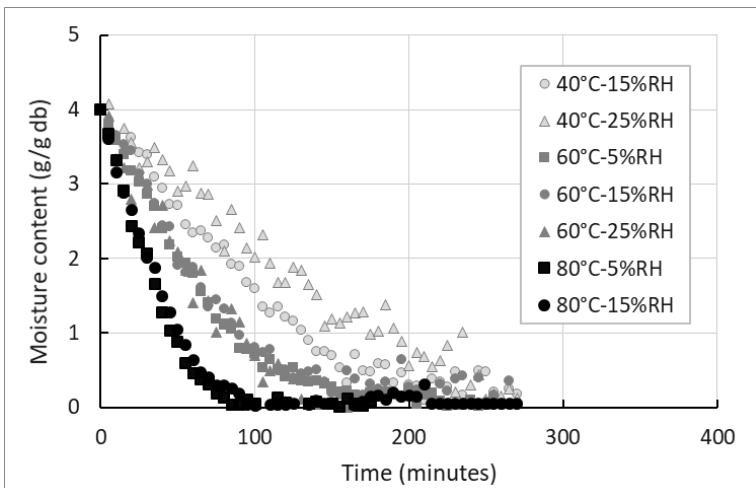
- Large decrease of mass from ambient temperature to around 130°C (due to drying)
- Second slight decrease of mass from 250°C to 350°C (probably due to a thermal degradation)

<u>General information</u>	
<b>Type of data</b>	Thermal stability
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry analyser - differential thermal analyser <i>DTG-60A Shimadu</i>
<b>Drying time</b>	~ 35 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ramp from ambient temperature to 500°C</li> <li>○ Heating rate: 5°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 70 mg sample on aluminium crucible (6 mm diameter × 5 mm height)
<b>Analysed parameters</b>	Mass
<b>Employed method</b>	Measurement by the <i>DTG-60A</i> instrument (SOP 8.8.1.1)
<u>Publications</u>	

<u>Data source files</u>															
<a href="https://www.dropbox.com/s/r185a7e9g4a8r2v/2018-2019%20Fresh%20faeces_Dynamic%20test_PRG.xlsx?dl=0">https://www.dropbox.com/s/r185a7e9g4a8r2v/2018-2019%20Fresh%20faeces_Dynamic%20test_PRG.xlsx?dl=0</a>															
<u>Additional Notes</u>															
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ Normalized mass at a given instance = mass at given instance / initial mass</li> </ul>															
<u>Description of Data</u>															
<p><u>Variation of mass with temperature</u></p> <p>The graph plots Normalized mass (%wt) on the y-axis (0 to 100) against Temperature (°C) on the x-axis (0 to 500). A dashed line shows a sharp initial drop from 100% at 0°C to about 60% at 100°C. This is followed by a more gradual decrease to around 15% at 200°C. Between 200°C and 300°C, there is a slight increase to about 18%. From 300°C to 500°C, the mass continues to decrease slowly, reaching approximately 5% at 500°C.</p> <table border="1"> <caption>Estimated data points from the graph</caption> <thead> <tr> <th>Temperature (°C)</th> <th>Normalized mass (%wt)</th> </tr> </thead> <tbody> <tr><td>0</td><td>100</td></tr> <tr><td>100</td><td>60</td></tr> <tr><td>200</td><td>15</td></tr> <tr><td>300</td><td>10</td></tr> <tr><td>400</td><td>8</td></tr> <tr><td>500</td><td>5</td></tr> </tbody> </table>	Temperature (°C)	Normalized mass (%wt)	0	100	100	60	200	15	300	10	400	8	500	5	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Large decrease of mass from ambient temperature to around 160°C (due to drying)</li> <li>○ Second slight decrease of mass from 220 to 330°C (probably due to a thermal degradation)</li> <li>○ Third slight decrease from 440 to 500°C (probably due to further thermal degradation)</li> </ul>
Temperature (°C)	Normalized mass (%wt)														
0	100														
100	60														
200	15														
300	10														
400	8														
500	5														

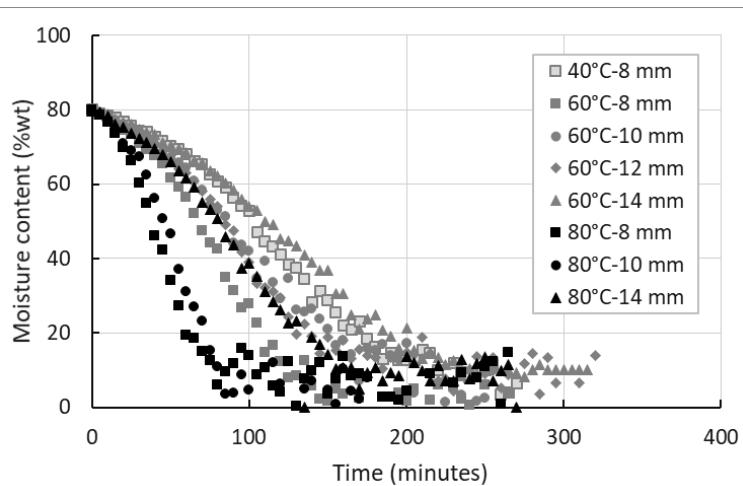
# KINETICS

<u>General information</u>	
<b>Type of data</b>	Kinetics of convective drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design convective drying rig
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0, 15 and 25%</li> <li>○ Air velocity: 0.03, 0.06 and 0.12 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10, 12 and 14 mm diameter
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

Data source files	
<u>Wet basis</u> <a href="https://www.dropbox.com/s/zmm55q2o47iedcp/Convective%20drying%20of%20VIP%20pellets%28wb%29_2014-2015.xlsx?dl=0">https://www.dropbox.com/s/zmm55q2o47iedcp/Convective%20drying%20of%20VIP%20pellets%28wb%29_2014-2015.xlsx?dl=0</a>	
<u>Dry basis</u> <a href="https://www.dropbox.com/s/4a3m2a6pi5e0vfc/Convective%20drying%20of%20VIP%20pellets%20%28db%29_2014-2015.xlsx?dl=0">https://www.dropbox.com/s/4a3m2a6pi5e0vfc/Convective%20drying%20of%20VIP%20pellets%20%28db%29_2014-2015.xlsx?dl=0</a>	
Additional Notes	
-	
Description of Data	
<u>Moisture content as a function of temperature and relative humidity</u> <b>Wet basis</b>  <p>Moisture content (%wt)</p> <p>Time (minutes)</p> <ul style="list-style-type: none"> <li>○ 40°C-15%RH</li> <li>△ 40°C-25%RH</li> <li>■ 60°C-5%RH</li> <li>● 60°C-15%RH</li> <li>▲ 60°C-25%RH</li> <li>■ 80°C-5%RH</li> <li>● 80°C-15%RH</li> </ul>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Drying time varying between 100 and 250 min</li> <li>○ Faster drying at increasing drying temperature and decreasing relative humidity at 40°C</li> <li>○ No effect of relative humidity at 60 and 80°C</li> </ul>
<b>Dry basis</b>  <p>Moisture content (g/g db)</p> <p>Time (minutes)</p> <ul style="list-style-type: none"> <li>○ 40°C-15%RH</li> <li>△ 40°C-25%RH</li> <li>■ 60°C-5%RH</li> <li>● 60°C-15%RH</li> <li>▲ 60°C-25%RH</li> <li>■ 80°C-5%RH</li> <li>● 80°C-15%RH</li> </ul>	

Moisture content versus time as a function of temperature and pellet diameter

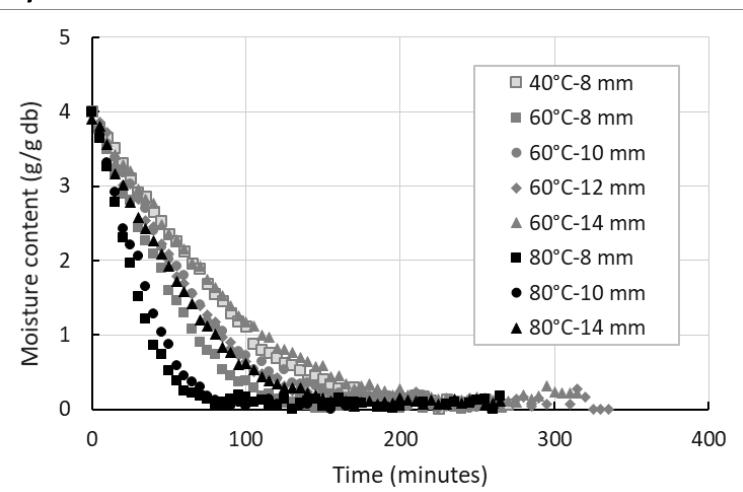
**Wet basis**

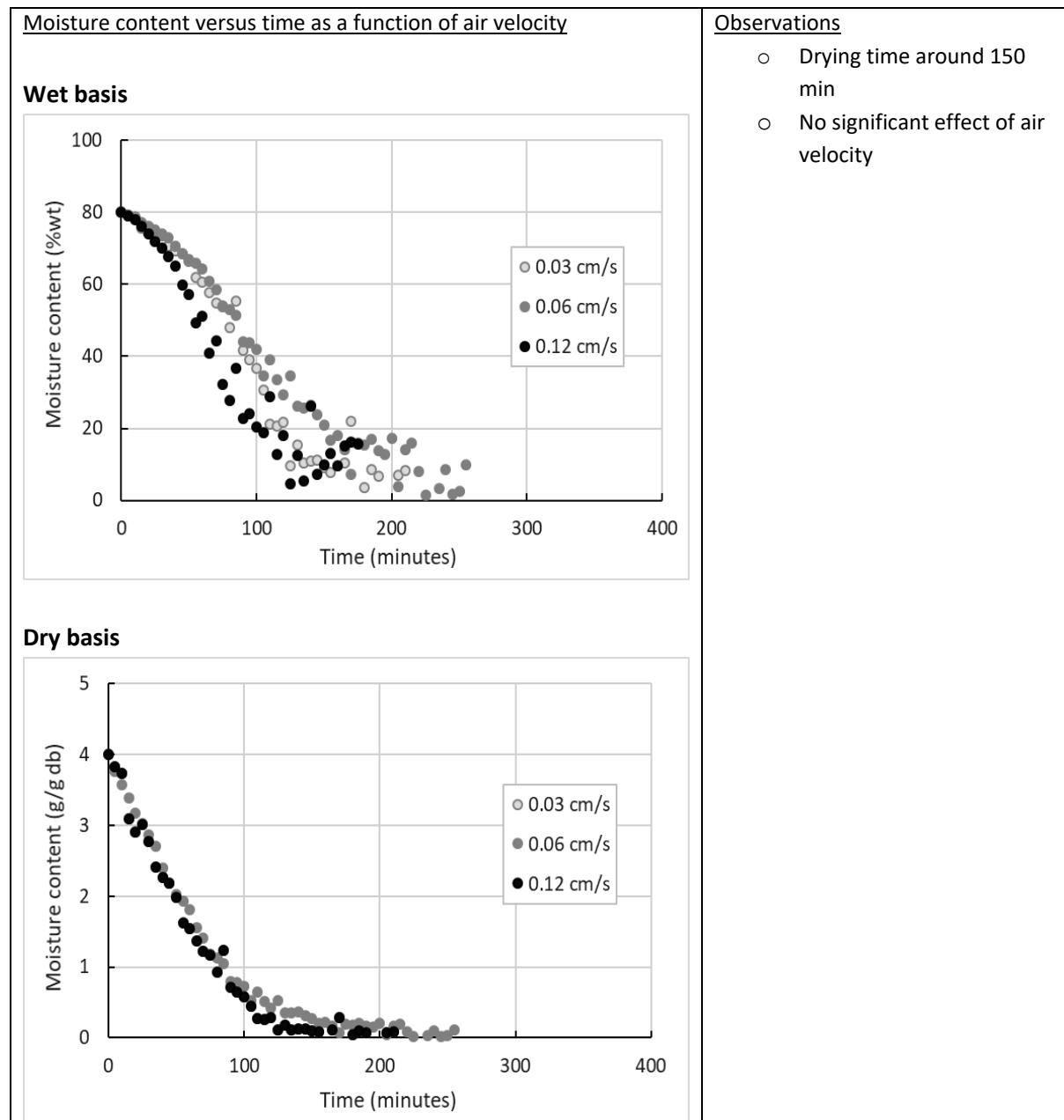


**Observations**

- Drying time varying between 100 and 200 min
- - Faster drying at increasing drying temperature and decreasing pellet diameter

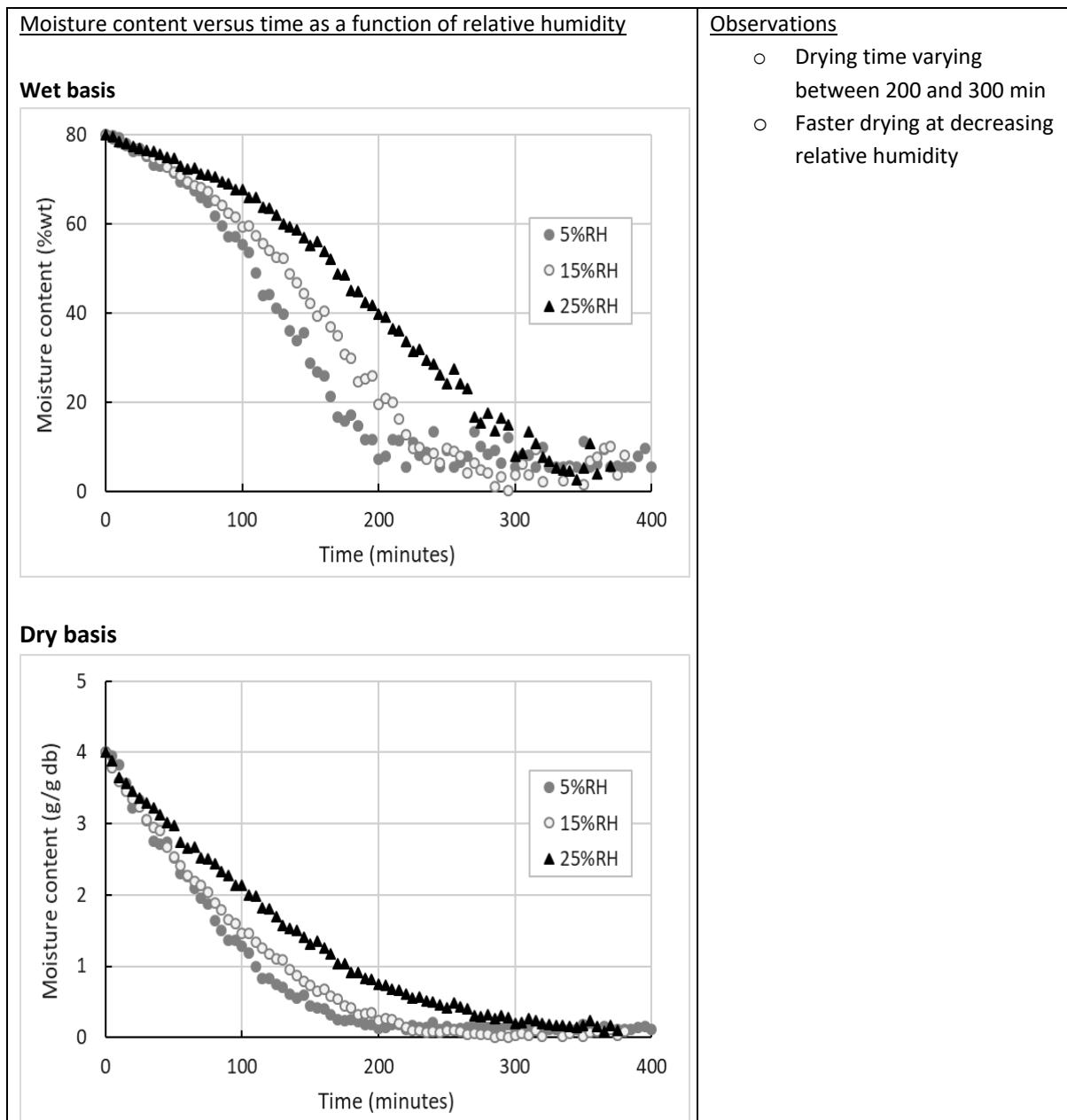
**Dry basis**





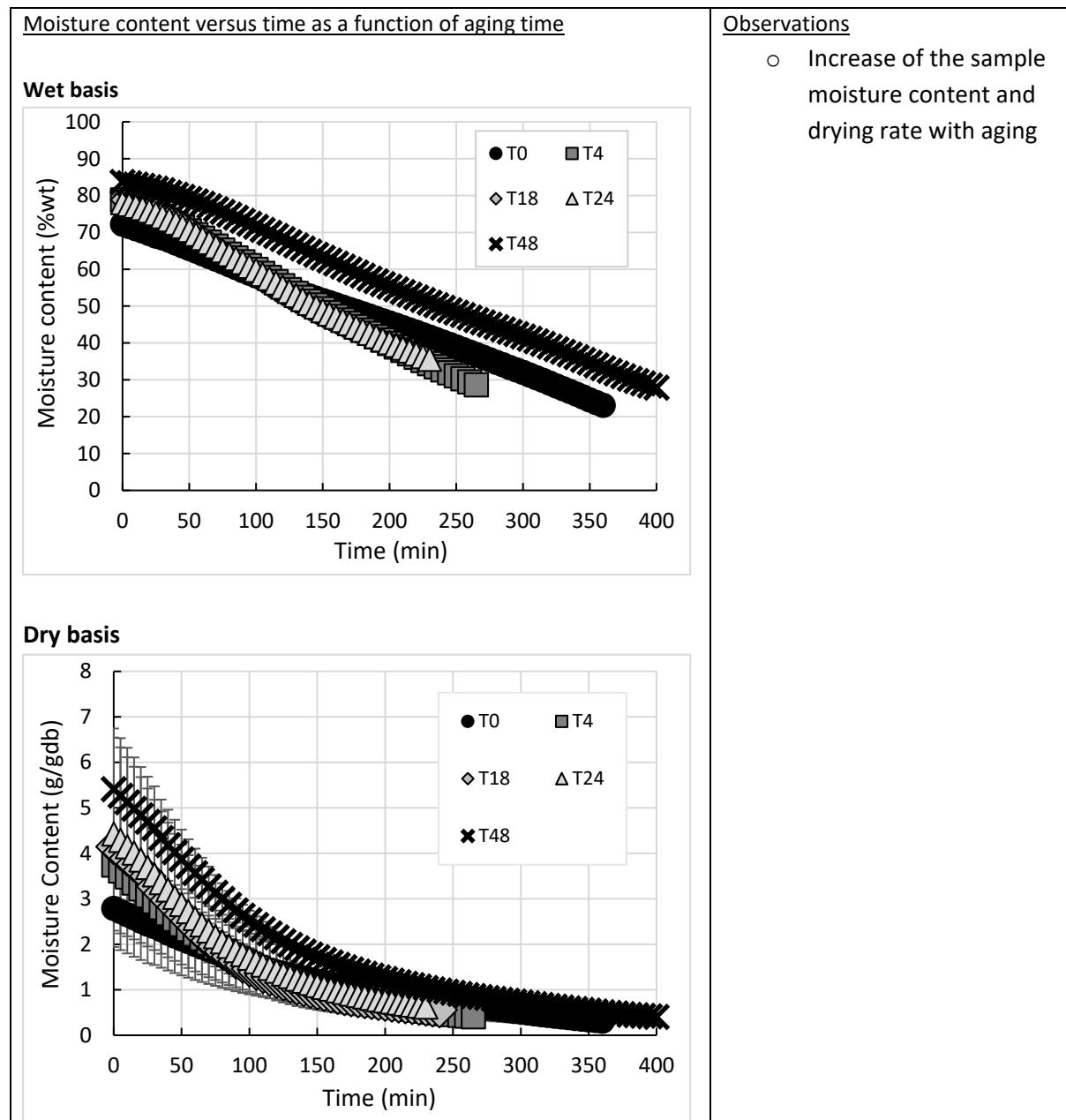
<u>General information</u>	
<b>Type of data</b>	Kinetics of convective drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design convective drying rig
<b>Drying time</b>	Batch until complete drying
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0, 15 and 25%</li> <li>○ Air velocity: 0.03, 0.06 and 0.12 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Thin layer on a petri dish of 70 mm diameter and 4 mm height
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

Data source files	
<u>Wet basis</u> <a href="https://www.dropbox.com/s/9ohytucjwpa8ppb/Convective%20drying%20of%20VIP%20thin%20layer%20%28wb%29_2014-2015.xlsx?dl=0">https://www.dropbox.com/s/9ohytucjwpa8ppb/Convective%20drying%20of%20VIP%20thin%20layer%20%28wb%29_2014-2015.xlsx?dl=0</a>	
<u>Dry basis</u> <a href="https://www.dropbox.com/s/vzlykg6aah163eu/Convective%20drying%20of%20VIP%20thin%20layer%20%28db%29_2014-2015.xlsx?dl=0">https://www.dropbox.com/s/vzlykg6aah163eu/Convective%20drying%20of%20VIP%20thin%20layer%20%28db%29_2014-2015.xlsx?dl=0</a>	
Additional Notes	
-	
Description of Data	
<p><u>Moisture content as a function of temperature and air velocity</u></p> <p><b>Wet basis</b></p> <p>Moisture content (%wt)</p> <p>Time (minutes)</p> <ul style="list-style-type: none"> <li>□ 40°C-0.03 cm/s</li> <li>○ 40°C-0.06 cm/s</li> <li>■ 60°C-0.03 cm/s</li> <li>● 60°C-0.06 cm/s</li> <li>× 60°C-0.12 cm/s</li> <li>■ 80°C-0.03 cm/s</li> <li>● 80°C-0.06 cm/s</li> </ul> <p><b>Dry basis</b></p> <p>Moisture content (g/g db)</p> <p>Time (minutes)</p> <ul style="list-style-type: none"> <li>□ 40°C-0.03 cm/s</li> <li>○ 40°C-0.06 cm/s</li> <li>■ 60°C-0.03 cm/s</li> <li>● 60°C-0.06 cm/s</li> <li>× 60°C-0.12 cm/s</li> <li>■ 80°C-0.03 cm/s</li> <li>● 80°C-0.06 cm/s</li> </ul>	<p><u>Observations</u></p> <ul style="list-style-type: none"> <li>○ Drying time varying between 150 and 300 min</li> <li>○ Faster drying at increasing drying temperature</li> <li>○ Slight faster drying at increasing air velocity</li> </ul>



<u>General information</u>	
<b>Type of data</b>	Kinetics of convective drying
<b>Place of experimentation</b>	Duke University, Center for WaSH-AID, Durham, MC
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durham, NC
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~20%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Aging (sample placed in container with urine and flush water for 4, 18, 24 and 48 h)
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design convective drying rig
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 5%</li> <li>○ Air velocity: 0.03 cm/s</li> </ul>
<b>Sample form in the dryer</b>	10 - 50 g of 9 mm thick sample in a 100 mm diameter petri dish
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
-	

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<a href="https://www.dropbox.com/s/rzksa0gr6n5beez/Human%20Faeces%20convective%20drying%20kinetics%20and%20effects%20of%20conditioning%20data_Duke%20University%20%282018-2019%29%20.xlsx?dl=0">https://www.dropbox.com/s/rzksa0gr6n5beez/Human%20Faeces%20convective%20drying%20kinetics%20and%20effects%20of%20conditioning%20data_Duke%20University%20%282018-2019%29%20.xlsx?dl=0</a>																																																																																																																																																																									
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<u>General information</u>	
<b>Type of data</b>	Kinetics of convective drying
<b>Place of experimentation</b>	RTI International, Research Triangle Park, North Carolina (USA)
<b>Dates of the experiments</b>	2016 - 2017
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	North Carolina, USA
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	N/A
<b>Ash content</b>	N/A
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	None
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Convection toaster oven
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 105, 120 and 150°C</li> <li>○ Relative humidity: ambient</li> <li>○ Air velocity: none</li> </ul>
<b>Sample form in the dryer</b>	9 mm thick sample in a 100 m diameter petri dish
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
Hawkins BT, Sellgren KL, Cellini E, Klem EJD, Rogers T, Lynch B, Piascik JR, Stoner BR. Remediation of suspended solids and turbidity by improved settling tank design in a small-scale, free-standing toilet system using recycled blackwater. Water and Environment Journal, 2018.	

Sellgren KL, Gregory CW, Hunt MI, Raut AS, Hawkins BT, Parker CB, Klem EJD, Piascik JR, Stoner BR. Development of an electrochemical process for blackwater disinfection in a free-standing, additive-free toilet, RTI Press, 2017

### Data source files

[https://www.dropbox.com/s/tgg4sehv3xjlhq/RTI%20International%20data\\_fresh%20faeces%20convective%20drying%20kinetics%20and%20shrinkage%20%282016-2017%29.xlsx?dl=0](https://www.dropbox.com/s/tgg4sehv3xjlhq/RTI%20International%20data_fresh%20faeces%20convective%20drying%20kinetics%20and%20shrinkage%20%282016-2017%29.xlsx?dl=0)

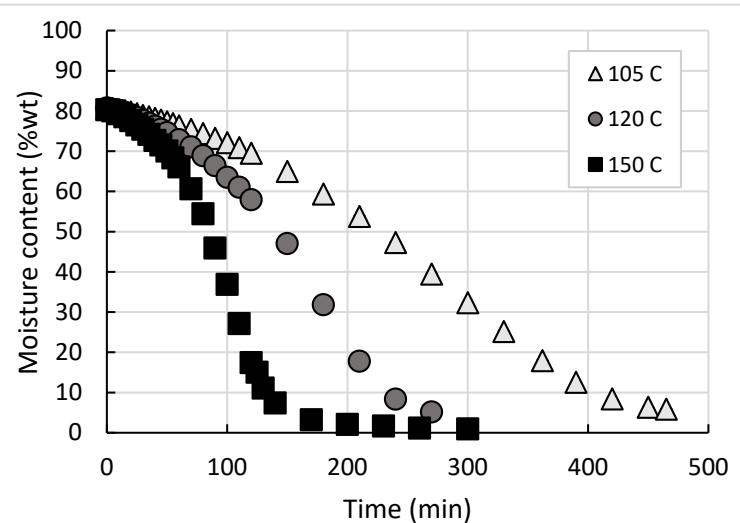
### Additional Notes

- Fresh faeces collected from voluntary and anonymous donations

### Description of Data

#### Moisture content as a function of temperature

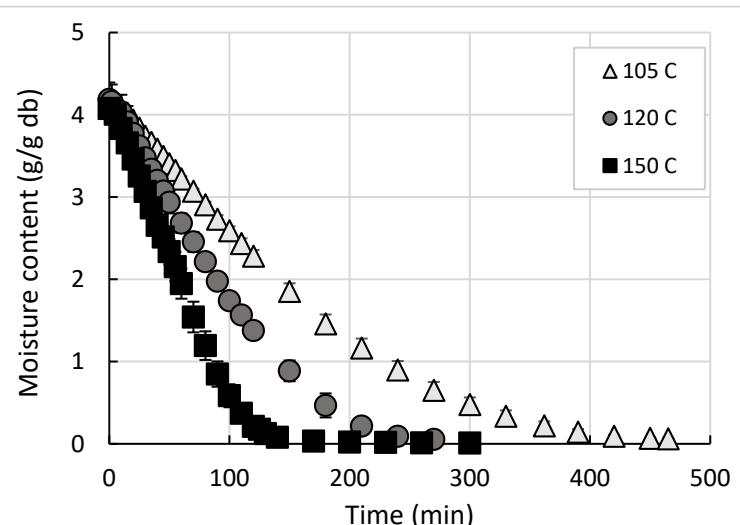
##### **Wet basis**



##### **Observations**

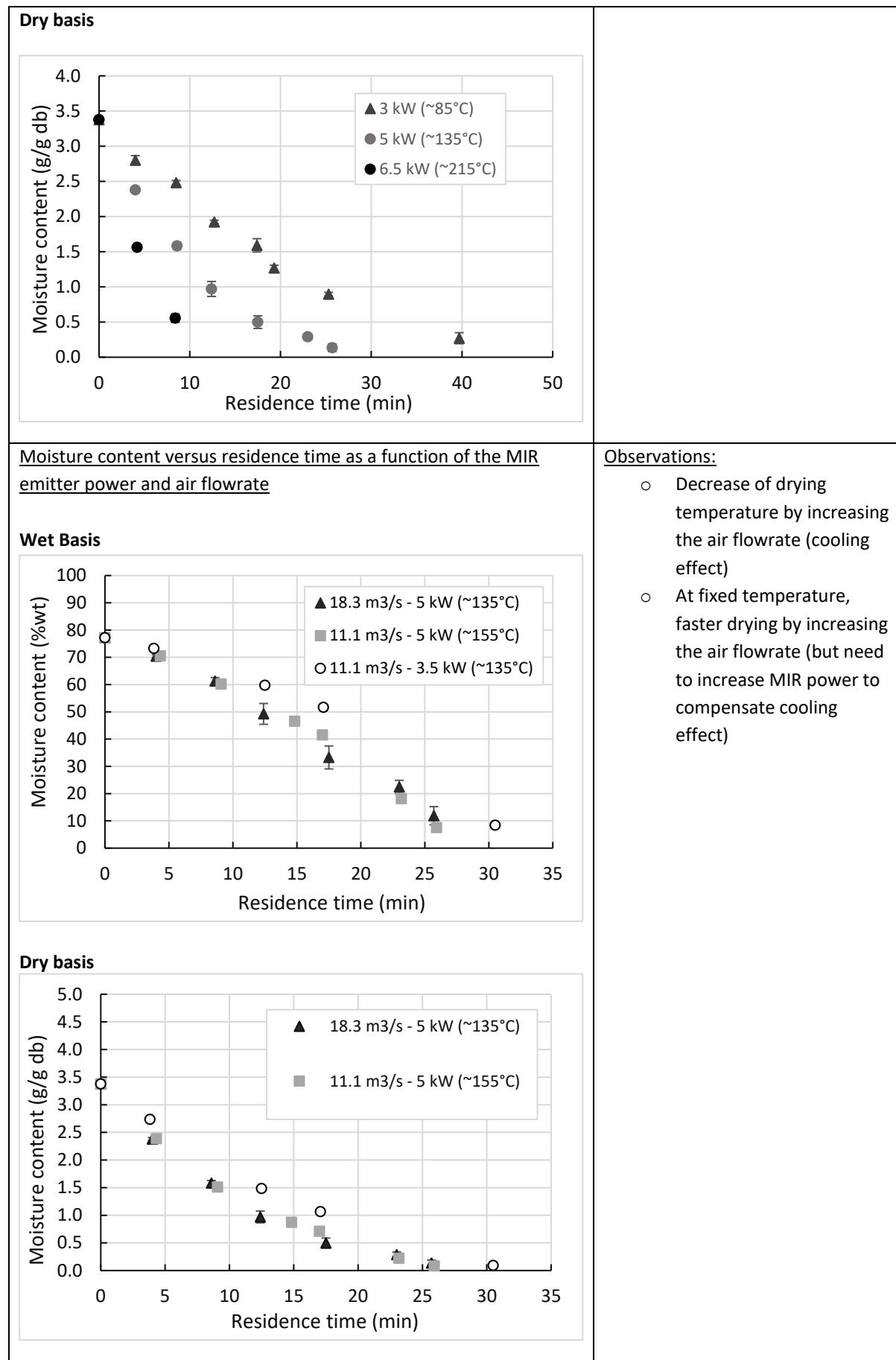
- Faster drying at increasing drying temperature
- Crust formed on surface of fecal material at all temperatures

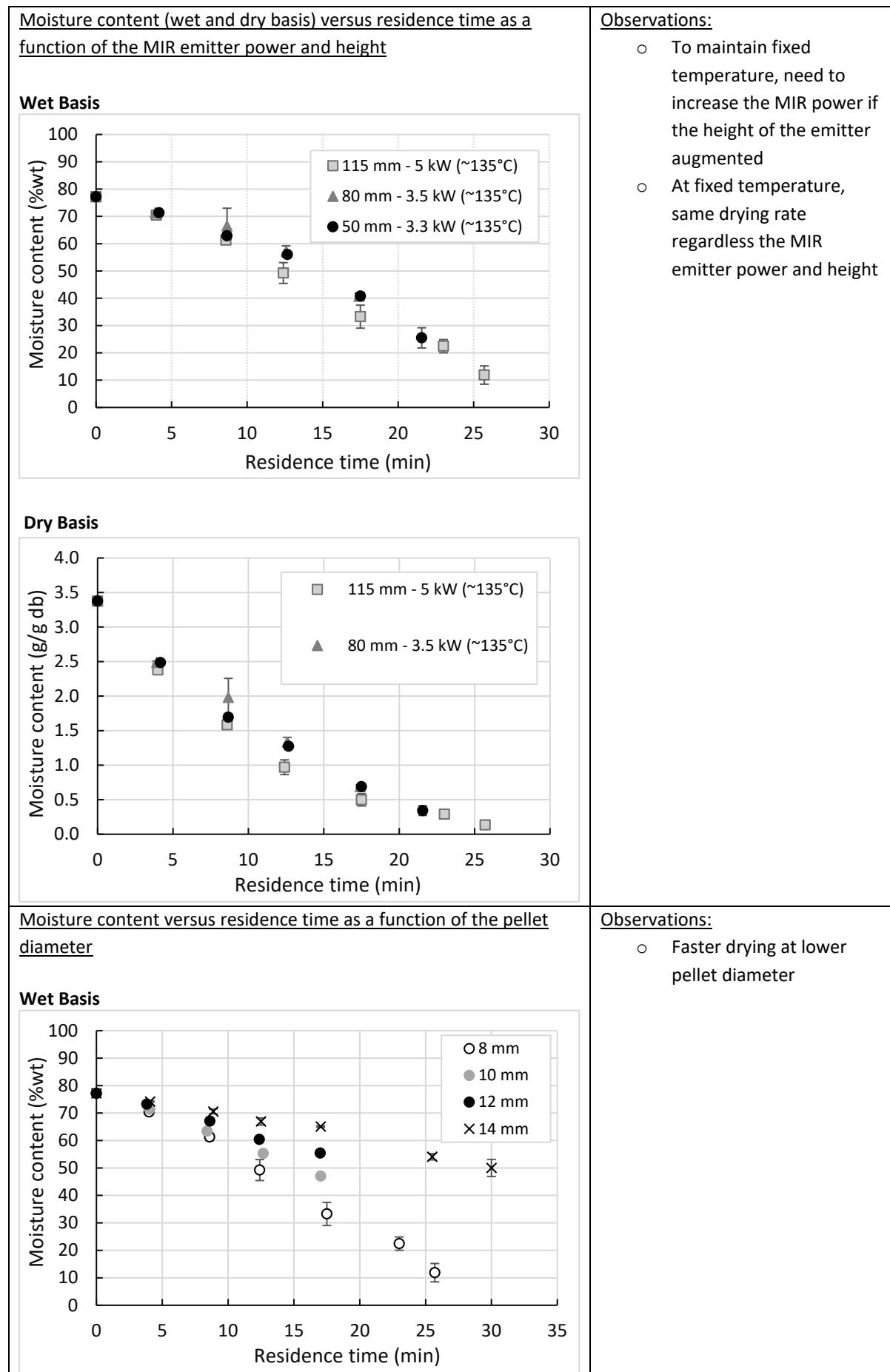
##### **Dry basis**

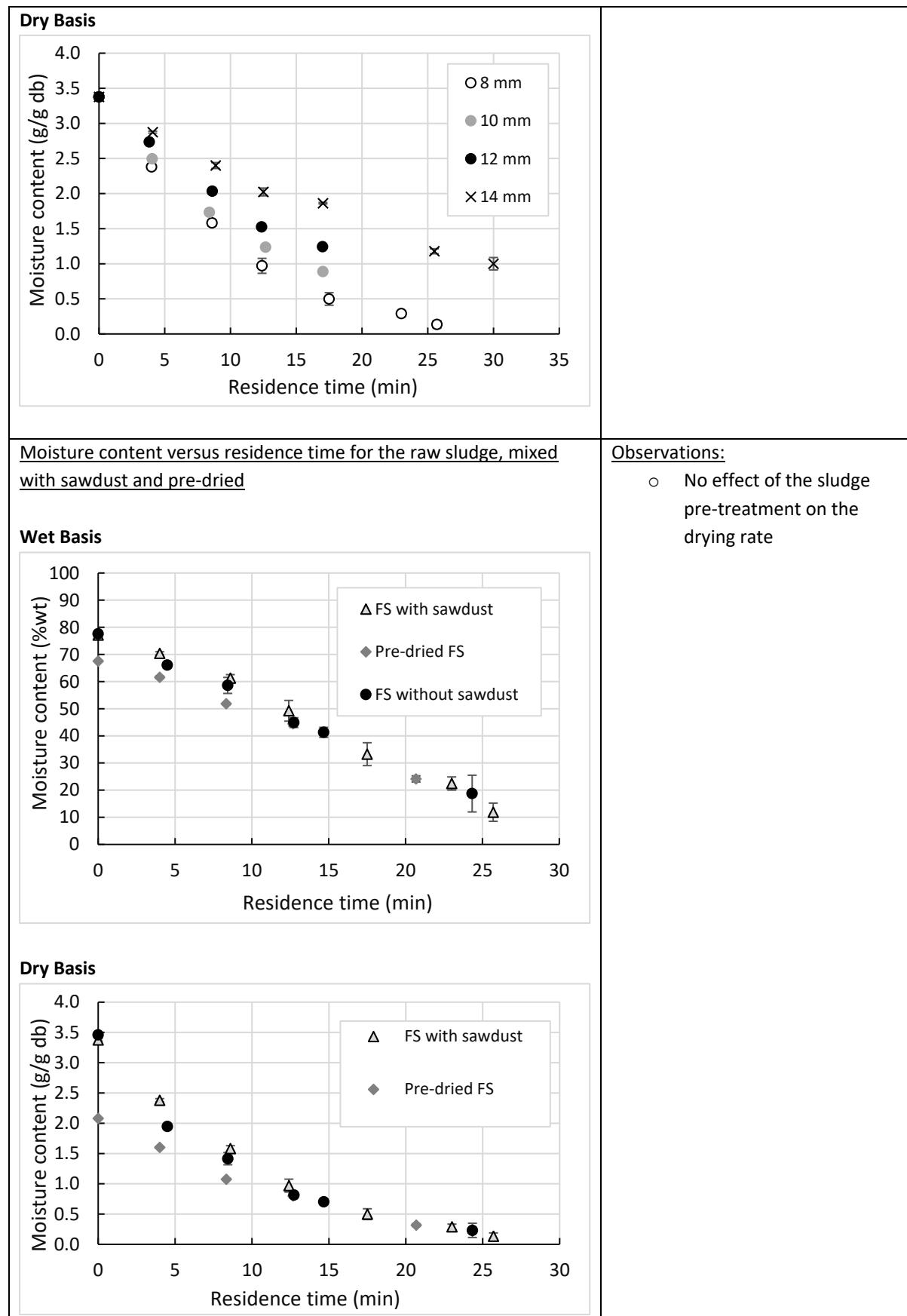


<u>General information</u>	
<b>Type of data</b>	Kinetics of infrared drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 70% db
<b>Ash content</b>	~ 30% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	0, 4, 9, 13, 17, 25, 40 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3.0, 3.3, 3.5, 5.0 and 6.5 kW</li> <li>○ Distance between the emitters and the sample: 50, 80 and 115 mm</li> <li>○ Air stream flowrate: 11.1 and 18.3 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10, 12 and 14 mm diameter
<b>Analysed parameters</b>	Moisture Content
<b>Employed methods</b>	Weighing the sample before and after oven drying at 105°C for 24 h (SOP 8.7.1.1)

<u>Publications</u>																																					
Mirara, S.W. (2017). Drying and Pasteurisation of VIP Latrine Faecal Sludge using a Bench Scale Medium Infrared Machine. Master thesis. University of KwaZulu-Natal, Durban, South Africa.																																					
Septien, S., Singh, A., Mirara, S. W., Teba, L., Velkushanova, K., & Buckley, C. A. (2018). 'LaDePa' process for the drying and pasteurization of faecal sludge from VIP latrines using infrared radiation. South African journal of chemical engineering, 25, 147-158.																																					
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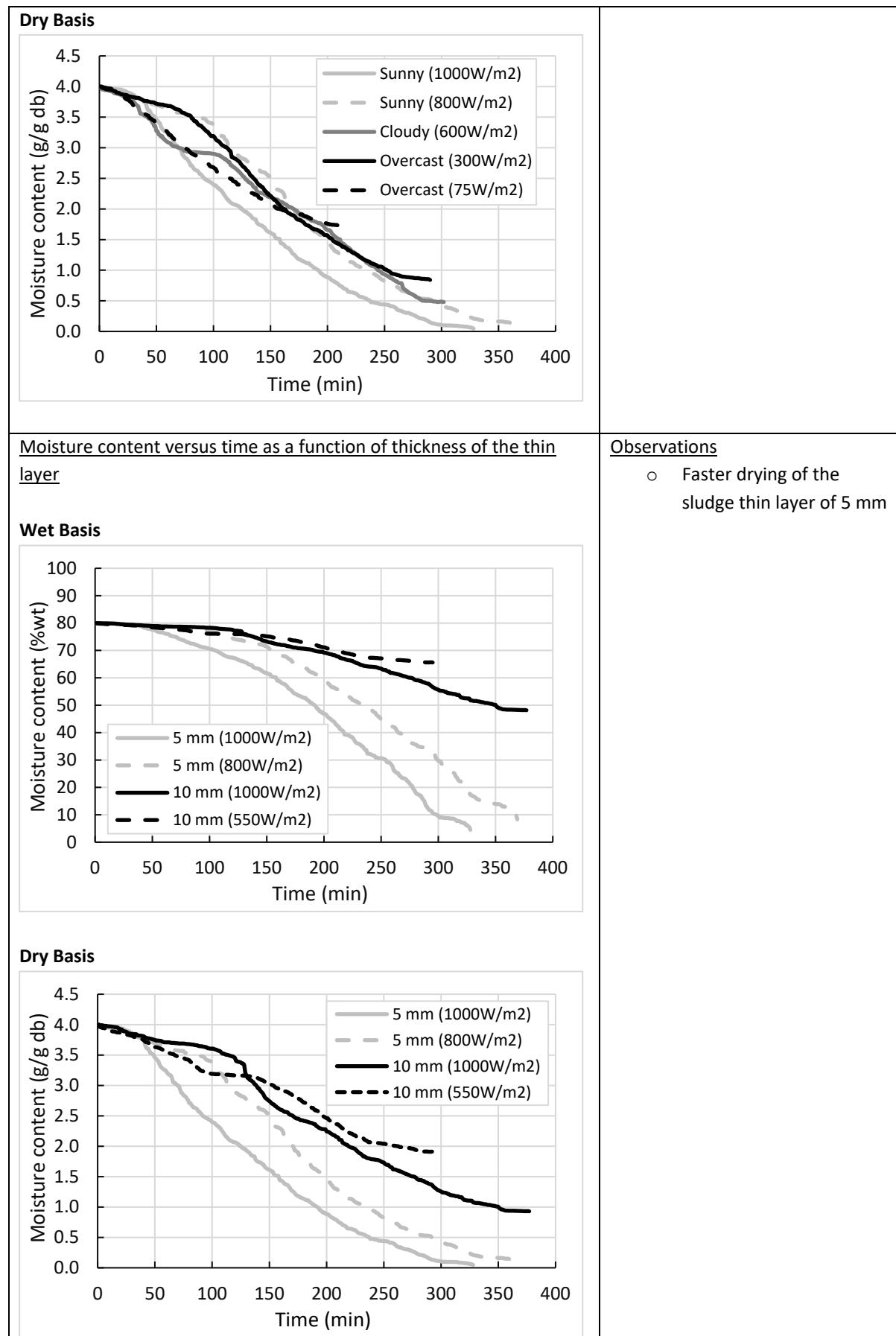


<u>General information</u>	
<b>Type of data</b>	Kinetics of solar thermal drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019-2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: ~ 1000 W/m<sup>2</sup> (sunny conditions)</li> <li>○ Air flowrate: 0.5 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 m/s)</li> <li>○ Air temperature: ambient (~20°C), 40 and 80°C</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form</b>	~ 90 g of sample as a thin layer of 5 mm thickness and 110 mm diameter
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)

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<p><u>Moisture content versus time as a function of the air temperature</u></p> <p><b>Wet basis</b></p> <p>The graph plots moisture content (%wt) on the y-axis (0 to 80) against time (min) on the x-axis (0 to 360). Six data series are shown: ambient run 1 (1020 W/m²), 40°C run 1 (1032 W/m²), 80°C run 1 (1109 W/m²), ambient run 2 (1176 W/m²), 40°C run 2 (776 W/m²), and 80°C run 2 (1172 W/m²). All series show a decreasing trend over time, with higher temperatures generally leading to faster drying.</p> <table border="1"> <caption>Approximate data points from the Wet Basis graph</caption> <thead> <tr> <th>Time (min)</th> <th>ambient, run 1 (1020 W/m²)</th> <th>40°C, run 1 (1032 W/m²)</th> <th>80°C, run 1 (1109 W/m²)</th> <th>ambient, run 2 (1176 W/m²)</th> <th>40°C, run 2 (776 W/m²)</th> <th>80°C, run 2 (1172 W/m²)</th> </tr> </thead> <tbody> <tr><td>0</td><td>75</td><td>75</td><td>75</td><td>75</td><td>75</td><td>75</td></tr> <tr><td>40</td><td>73</td><td>72</td><td>71</td><td>72</td><td>71</td><td>70</td></tr> <tr><td>80</td><td>70</td><td>69</td><td>68</td><td>70</td><td>69</td><td>68</td></tr> <tr><td>120</td><td>68</td><td>67</td><td>66</td><td>68</td><td>67</td><td>66</td></tr> <tr><td>160</td><td>66</td><td>65</td><td>64</td><td>66</td><td>65</td><td>64</td></tr> <tr><td>200</td><td>64</td><td>63</td><td>62</td><td>64</td><td>63</td><td>62</td></tr> <tr><td>240</td><td>62</td><td>61</td><td>60</td><td>62</td><td>61</td><td>60</td></tr> <tr><td>280</td><td>60</td><td>59</td><td>58</td><td>60</td><td>59</td><td>58</td></tr> <tr><td>320</td><td>58</td><td>57</td><td>56</td><td>58</td><td>57</td><td>56</td></tr> <tr><td>360</td><td>57</td><td>56</td><td>55</td><td>57</td><td>56</td><td>55</td></tr> </tbody> </table> <p><b>Dry basis</b></p> <p>The graph plots moisture content (g/g db) on the y-axis (0 to 3.5) against time (min) on the x-axis (0 to 360). The same six data series are shown. The dry basis graphs show a more rapid initial decrease in moisture content compared to the wet basis graphs.</p> <table border="1"> <caption>Approximate data points from the Dry Basis graph</caption> <thead> <tr> <th>Time (min)</th> <th>ambient, run 1 (1020 W/m²)</th> <th>40°C, run 1 (1032 W/m²)</th> <th>80°C, run 1 (1109 W/m²)</th> <th>ambient, run 2 (1176 W/m²)</th> <th>40°C, run 2 (776 W/m²)</th> <th>80°C, run 2 (1172 W/m²)</th> </tr> </thead> <tbody> <tr><td>0</td><td>3.0</td><td>3.0</td><td>3.0</td><td>3.0</td><td>3.0</td><td>3.0</td></tr> <tr><td>40</td><td>2.8</td><td>2.8</td><td>2.8</td><td>2.8</td><td>2.8</td><td>2.8</td></tr> <tr><td>80</td><td>2.7</td><td>2.7</td><td>2.7</td><td>2.7</td><td>2.7</td><td>2.7</td></tr> <tr><td>120</td><td>2.6</td><td>2.6</td><td>2.6</td><td>2.6</td><td>2.6</td><td>2.6</td></tr> <tr><td>160</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td></tr> <tr><td>200</td><td>2.4</td><td>2.4</td><td>2.4</td><td>2.4</td><td>2.4</td><td>2.4</td></tr> <tr><td>240</td><td>2.3</td><td>2.3</td><td>2.3</td><td>2.3</td><td>2.3</td><td>2.3</td></tr> <tr><td>280</td><td>2.2</td><td>2.2</td><td>2.2</td><td>2.2</td><td>2.2</td><td>2.2</td></tr> <tr><td>320</td><td>2.1</td><td>2.1</td><td>2.1</td><td>2.1</td><td>2.1</td><td>2.1</td></tr> <tr><td>360</td><td>2.0</td><td>2.0</td><td>2.0</td><td>2.0</td><td>2.0</td><td>2.0</td></tr> </tbody> </table>	Time (min)	ambient, run 1 (1020 W/m²)	40°C, run 1 (1032 W/m²)	80°C, run 1 (1109 W/m²)	ambient, run 2 (1176 W/m²)	40°C, run 2 (776 W/m²)	80°C, run 2 (1172 W/m²)	0	75	75	75	75	75	75	40	73	72	71	72	71	70	80	70	69	68	70	69	68	120	68	67	66	68	67	66	160	66	65	64	66	65	64	200	64	63	62	64	63	62	240	62	61	60	62	61	60	280	60	59	58	60	59	58	320	58	57	56	58	57	56	360	57	56	55	57	56	55	Time (min)	ambient, run 1 (1020 W/m²)	40°C, run 1 (1032 W/m²)	80°C, run 1 (1109 W/m²)	ambient, run 2 (1176 W/m²)	40°C, run 2 (776 W/m²)	80°C, run 2 (1172 W/m²)	0	3.0	3.0	3.0	3.0	3.0	3.0	40	2.8	2.8	2.8	2.8	2.8	2.8	80	2.7	2.7	2.7	2.7	2.7	2.7	120	2.6	2.6	2.6	2.6	2.6	2.6	160	2.5	2.5	2.5	2.5	2.5	2.5	200	2.4	2.4	2.4	2.4	2.4	2.4	240	2.3	2.3	2.3	2.3	2.3	2.3	280	2.2	2.2	2.2	2.2	2.2	2.2	320	2.1	2.1	2.1	2.1	2.1	2.1	360	2.0	2.0	2.0	2.0	2.0	2.0	<p><b>Observations:</b></p> <ul style="list-style-type: none"> <li>○ Similar drying rate between the different air temperatures</li> </ul>
Time (min)	ambient, run 1 (1020 W/m²)	40°C, run 1 (1032 W/m²)	80°C, run 1 (1109 W/m²)	ambient, run 2 (1176 W/m²)	40°C, run 2 (776 W/m²)	80°C, run 2 (1172 W/m²)																																																																																																																																																					
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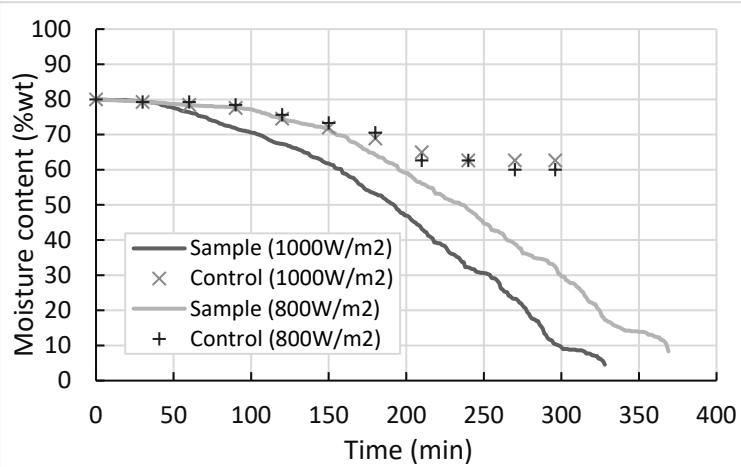
<u>General information</u>	
<b>Type of data</b>	Kinetics of solar thermal drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	3 to 5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: from 75 to 1000 W/m<sup>2</sup> (from overcast to sunny conditions)</li> <li>○ Air flowrate: 0.5 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 m/s)</li> <li>○ Air temperature: ambient (~20°C)</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form in the dryer</b>	Thin layer of 5 and 10 mm thickness and 60 mm diameter
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)

<u>Publications</u>																																																							
Septien, S., Mugauri, T.R., Singh, A., & Inambao, F. (2019). Drying of Faecal Sludge using Solar Thermal Energy. WRC project final report.																																																							
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Time (min)	Sunny (1000W/m²) (%wt)	Sunny (800W/m²) (%wt)	Cloudy (600W/m²) (%wt)	Overcast (300W/m²) (%wt)	Overcast (75W/m²) (%wt)																																																		
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Moisture content versus time inside the solar drier and the control (sample placed at the open air) during sunny conditions

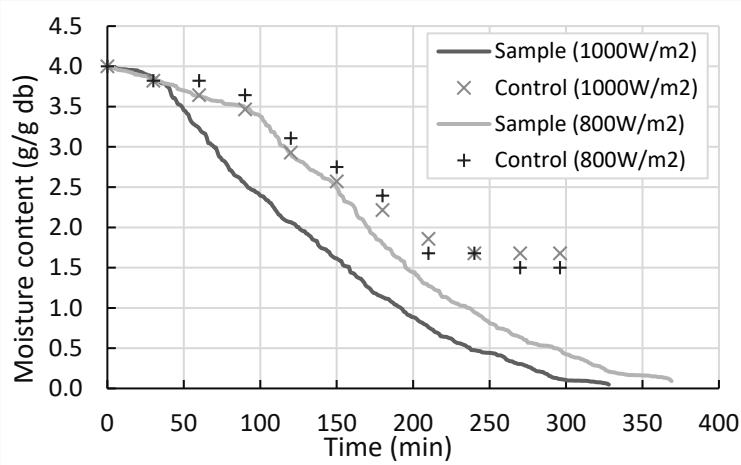
**Wet Basis**



**Observations**

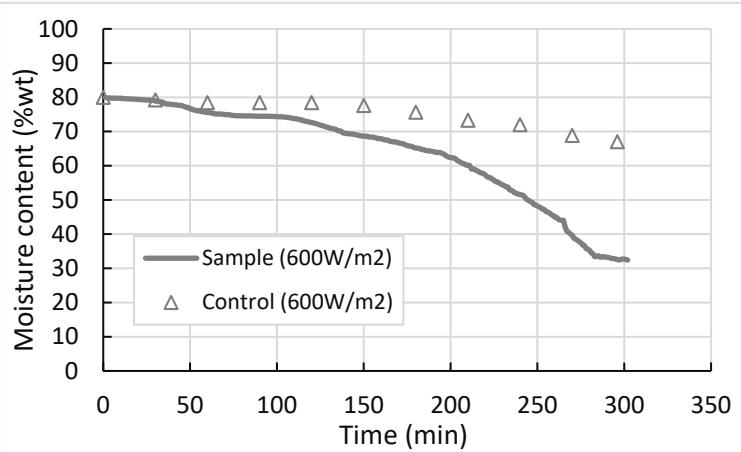
- Faster drying of the sample inside the solar dryer

**Dry Basis**



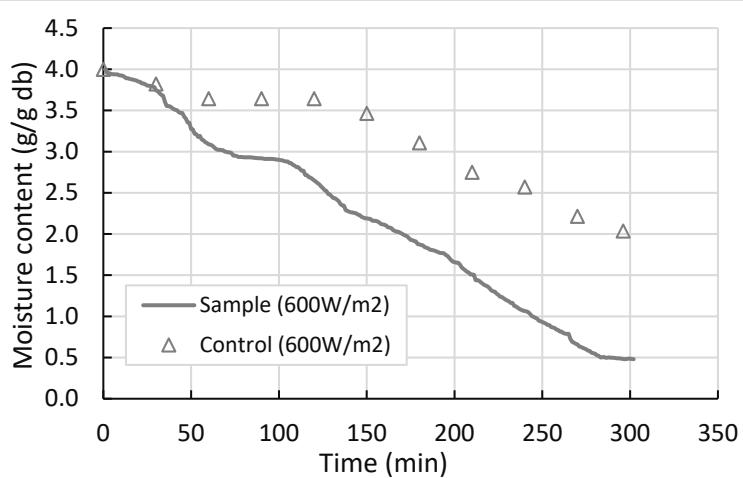
Moisture content versus time inside the solar drier and the control (sample placed at the open air) during cloudy conditions

**Wet Basis**

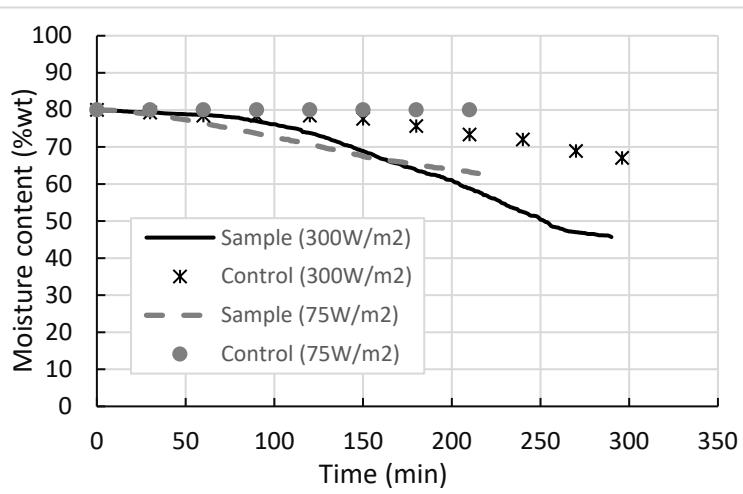
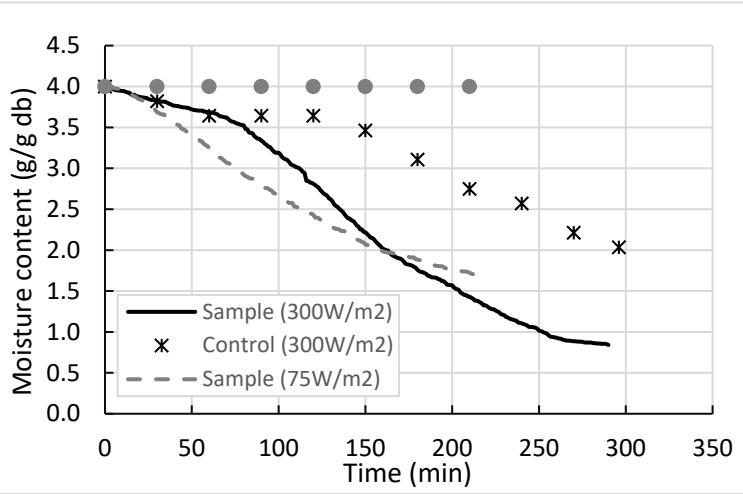


**Observations**

- Faster drying of the sample inside the solar dryer

**Dry Basis**

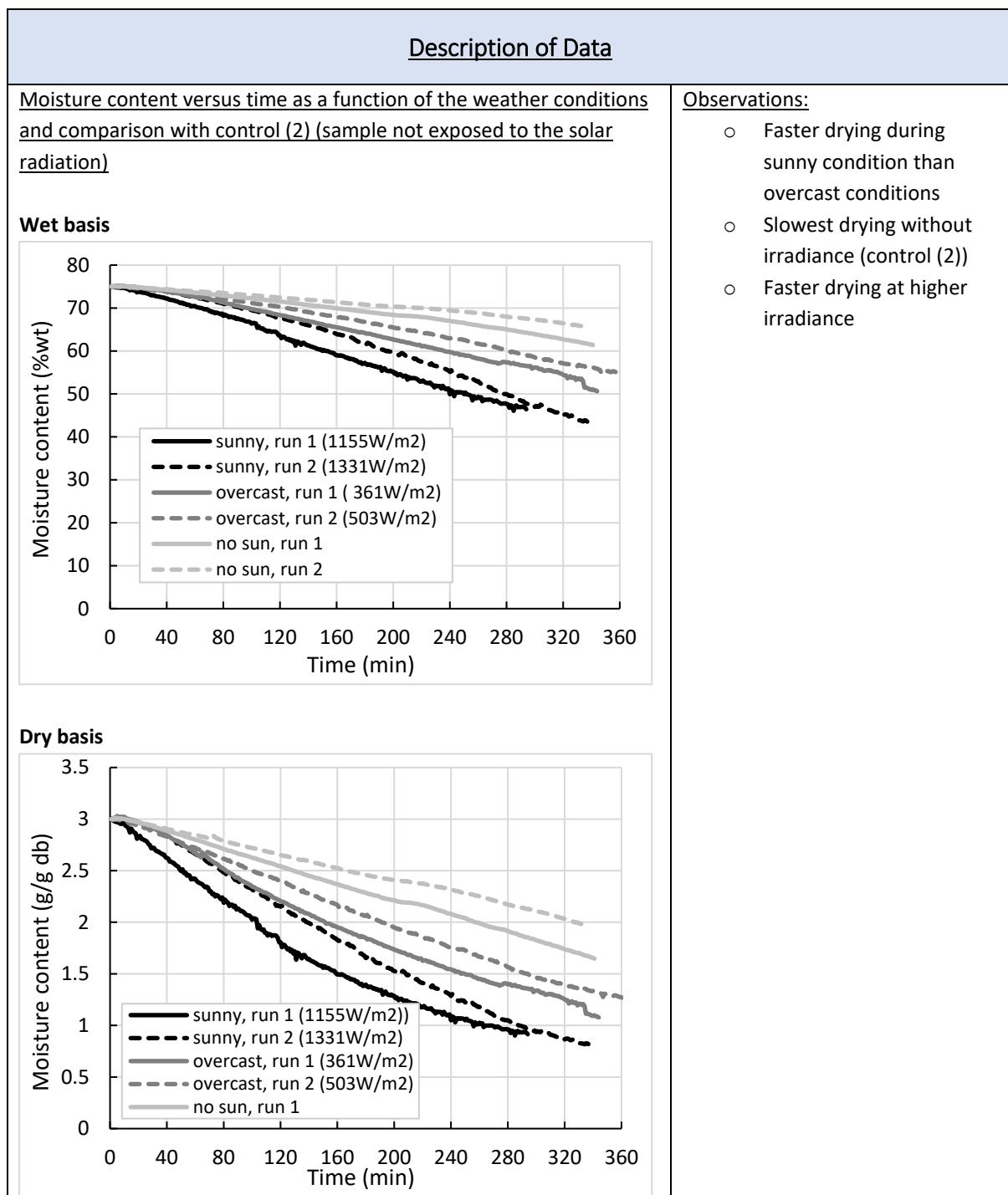
Moisture content versus time inside the solar drier and the control (sample placed at the open air) during overcast conditions

**Wet Basis****Dry Basis****Observations**

- Faster drying of the sample inside the solar dryer

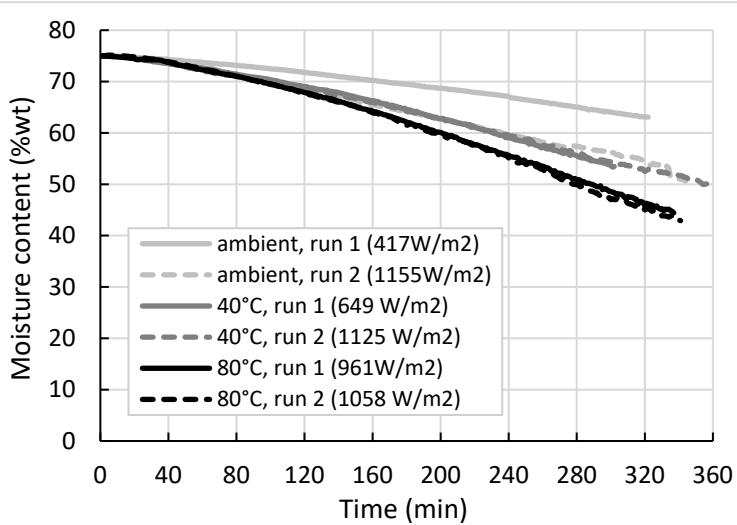
<u>General information</u>	
<b>Type of data</b>	Kinetics of solar thermal drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: 300 – 1300 W/m<sup>2</sup> (from overcast to sunny conditions)</li> <li>○ Air flowrate: 0.5 and 1 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 and 1 m/s)</li> <li>○ Air temperature: ambient (~20°C), 40 and 80°C</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form</b>	~ 90 and 170 g of sample as a thin layer of 5 and 10 mm thickness respectively, and 110 mm diameter
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)

<u>Publications</u>
-
<u>Data source files</u>
<b>Sunny and overcast weather conditions</b> <a href="https://www.dropbox.com/s/z5hfymnuljctwsc/2019-2020%20VIP%20solar%20drying%20based%20on%20weather%20conditions.xlsx?dl=0">https://www.dropbox.com/s/z5hfymnuljctwsc/2019-2020%20VIP%20solar%20drying%20based%20on%20weather%20conditions.xlsx?dl=0</a>
<b>Different temperatures at air velocity of 0.5 m/s</b> <a href="https://www.dropbox.com/s/7qksuoct2p05q3k/2019-2020%20Solar%20drying%20of%20VIP%205mm%20at%200.5m%20per%20sec%20.xlsx?dl=0">https://www.dropbox.com/s/7qksuoct2p05q3k/2019-2020%20Solar%20drying%20of%20VIP%205mm%20at%200.5m%20per%20sec%20.xlsx?dl=0</a>
<b>Different temperatures at air velocity of 1.0 m/s</b> <a href="https://www.dropbox.com/s/kvpjzpjob8zml5/2019-2020%20Solar%20drying%20of%20VIP%205mm%20at%201m%20per%20sec.xlsx?dl=0">https://www.dropbox.com/s/kvpjzpjob8zml5/2019-2020%20Solar%20drying%20of%20VIP%205mm%20at%201m%20per%20sec.xlsx?dl=0</a>
<b>Ambient temperature and varying air velocities</b> <a href="https://www.dropbox.com/s/ngrboytch6am0p8/2019-2020%20VIP%20solar%20drying%20at%20varied%20air%20velocities%20%28ambient%20temp%29_UKZN.xlsx?dl=0">https://www.dropbox.com/s/ngrboytch6am0p8/2019-2020%20VIP%20solar%20drying%20at%20varied%20air%20velocities%20%28ambient%20temp%29_UKZN.xlsx?dl=0</a>
<b>Open drying</b> <a href="https://www.dropbox.com/s/reqvrb7s4ik4ofg/2019-2020%20VIP%20Open%20drying%20tests.xlsx?dl=0">https://www.dropbox.com/s/reqvrb7s4ik4ofg/2019-2020%20VIP%20Open%20drying%20tests.xlsx?dl=0</a>
<u>Additional Notes</u>
<ul style="list-style-type: none"><li>○ Control experiments: (1) sample placed at the open-air and (2) drying chamber covered by an opaque sheet to block the solar radiation to penetrate within it</li><li>○ The measured average irradiance included in the results below for each experiment</li></ul>



Moisture content versus time as a function of the air temperature at an air velocity of 0.5 m/s

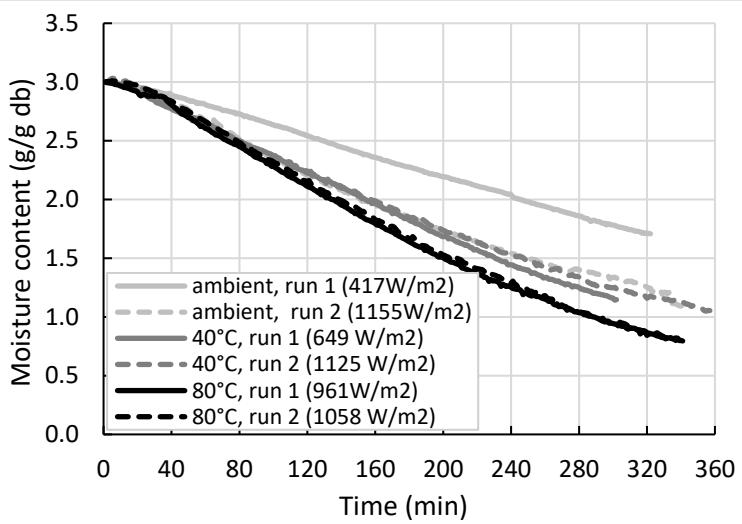
**Wet basis**



**Observations:**

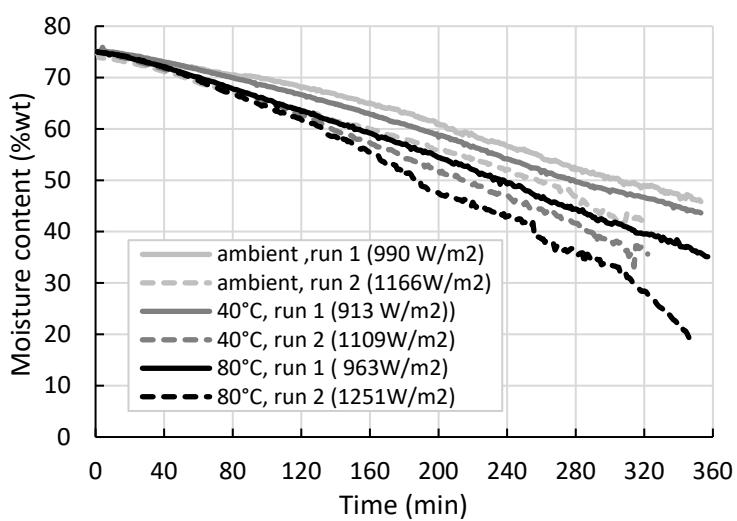
- Faster drying at 80°C
- No significant difference between ambient temperature and 40°C

**Dry basis**



Moisture content versus time as a function of the air temperature at an air velocity of 1 m/s

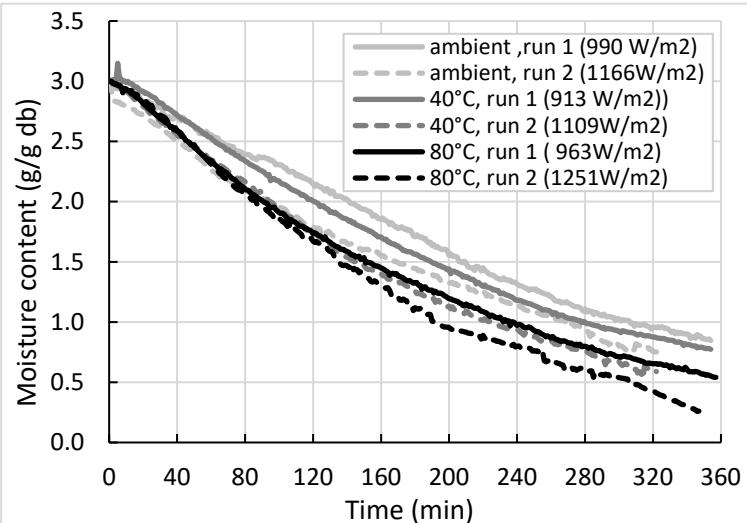
**Wet basis**

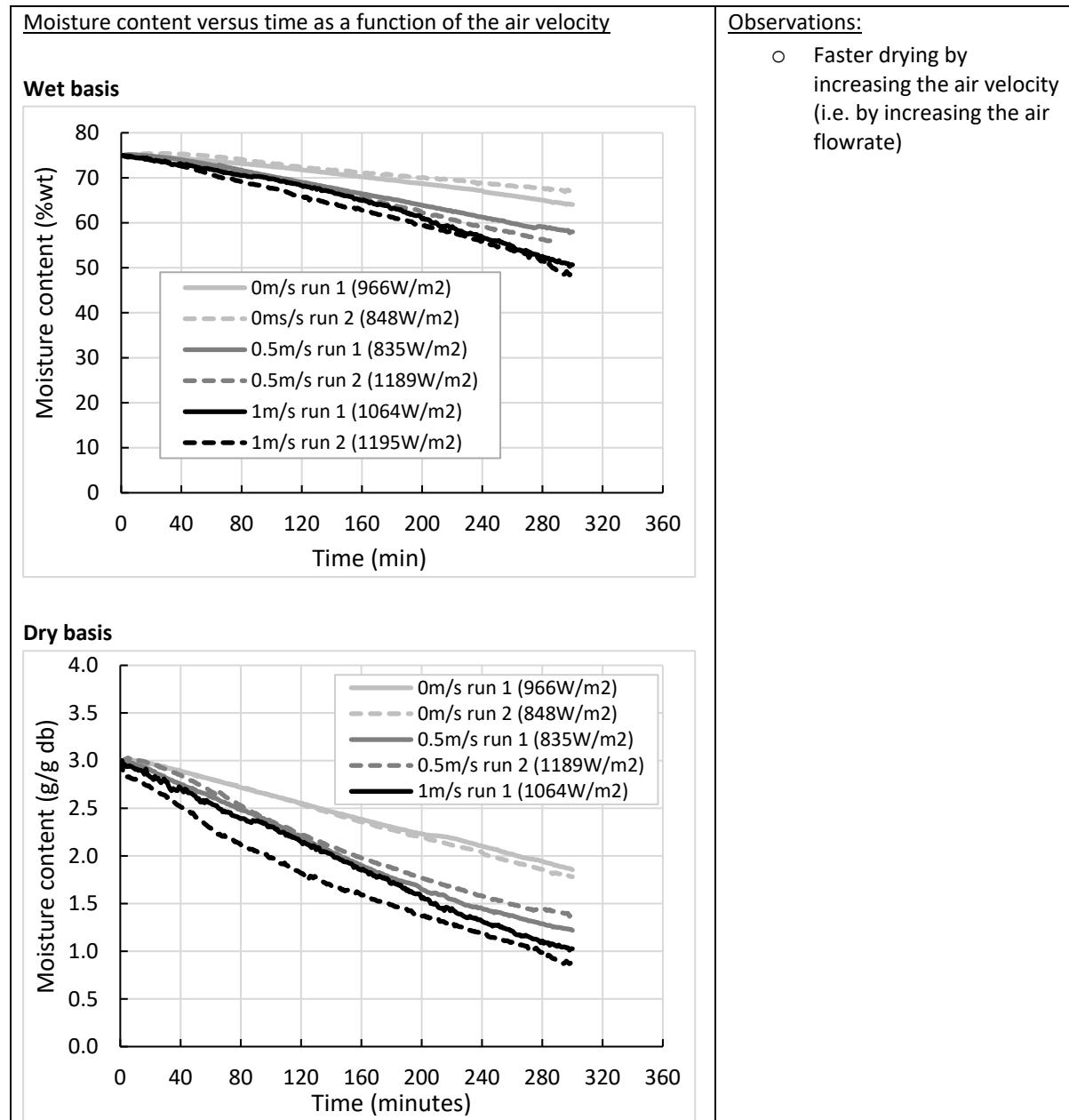


**Observations:**

- Faster drying at 80°C than at ambient conditions, with 40°C as intermediate

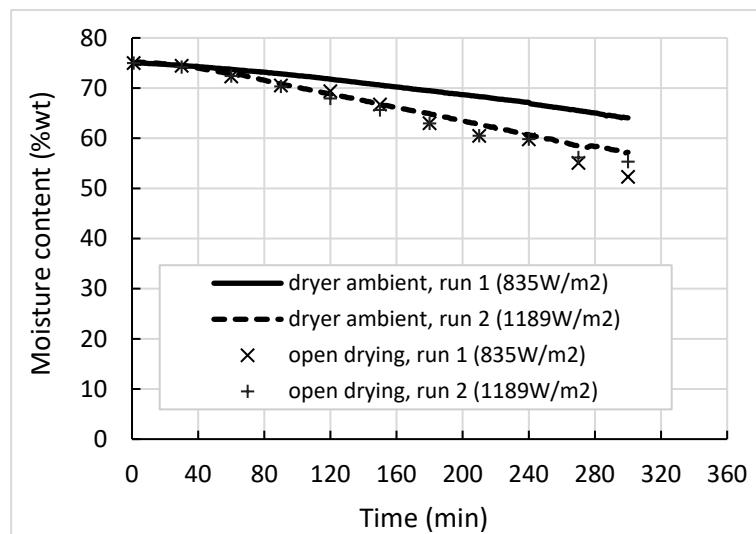
**Dry basis**





Moisture content versus time inside the solar drier and the control (sample placed at the open air) during sunny conditions

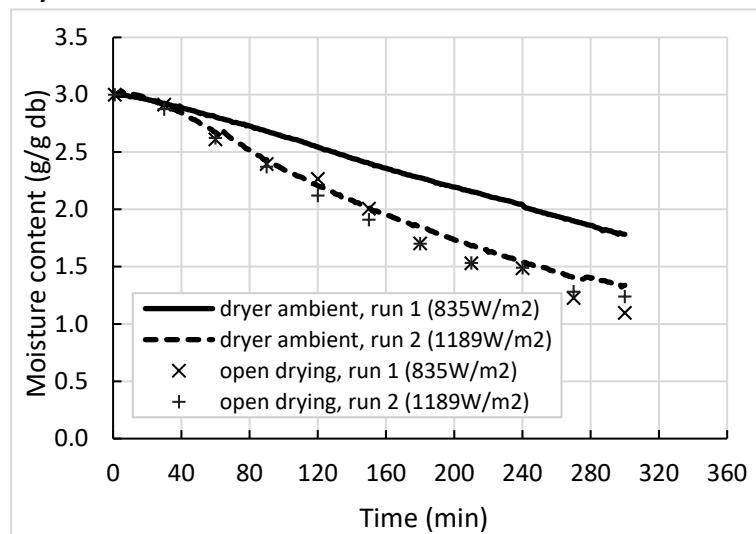
**Wet basis**



**Observations:**

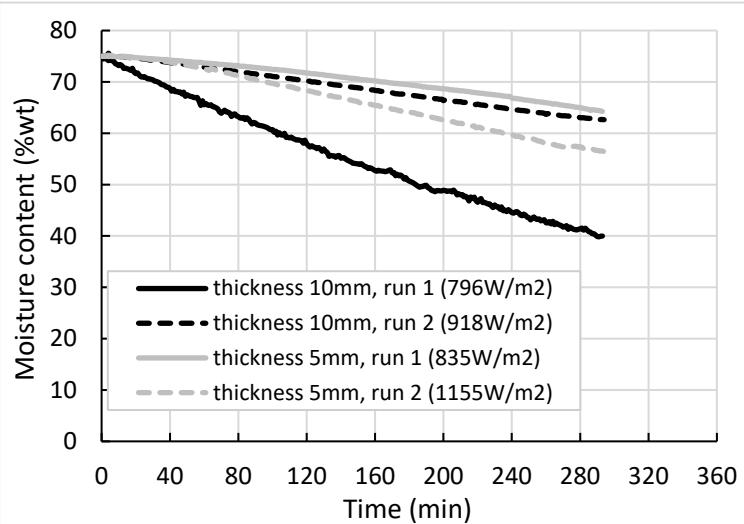
- Similar drying rate between the sample inside the drying chamber and the sample placed at the open air (control (1)) during the experiment with an average irradiance of 1189 W/m<sup>2</sup>
- Faster drying for the open-air sample compared to the sample inside the drying chamber during the experiment with an average irradiance of 835 W/m<sup>2</sup> (probably due to the windy conditions on that day)

**Dry basis**



Moisture content versus time as a function of the sample thickness

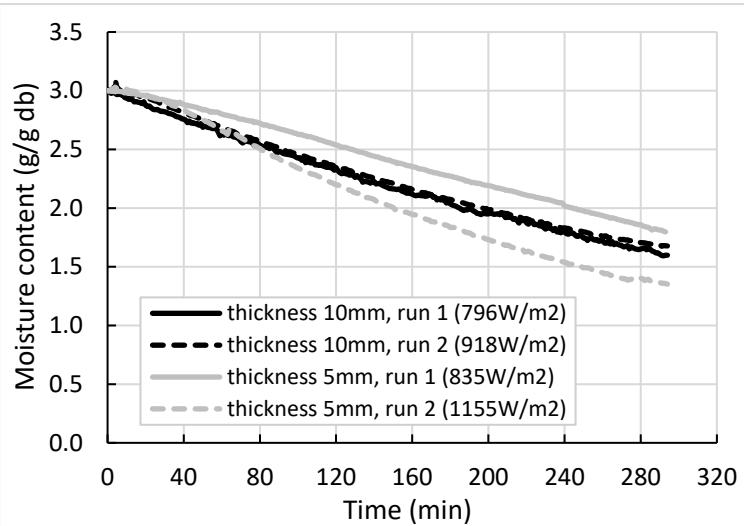
**Wet basis**



**Observations:**

- No effect of the sludge thickness on the drying rate

**Dry basis**



<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry - differential thermal analyser <i>SHIMADU DTG-60A</i>
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 50, 100, 150 and 200°C</li> <li>○ Heating rate: 50°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 70 mg sample on aluminium crucible of 6 mm diameter and 5 mm height
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	
-	

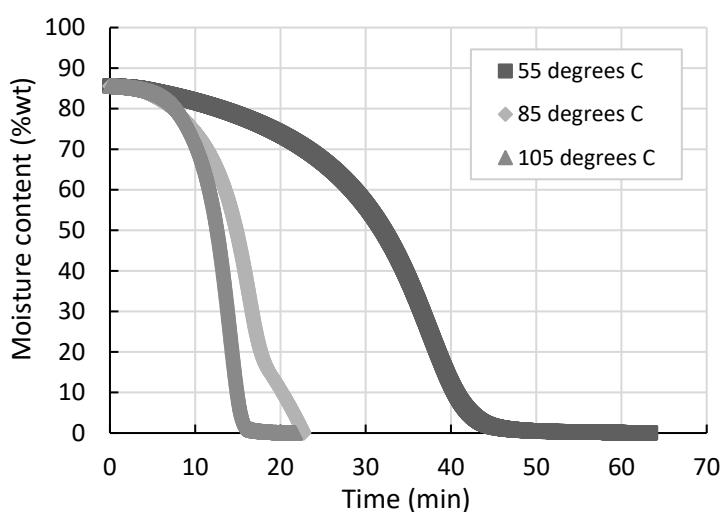
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75	0.1	0.02	0.01	0.005																																																																																																	

<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10 and 100°C/min</li> <li>○ Flow rate: 4 mL/min</li> </ul>
<b>Sample in the drier</b>	~ 40 mg sample on a 3 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
Somorin T, Getahun S, Septien S et al. Isothermal drying characteristics and kinetics of human faecal sludges [version 1; peer review: awaiting peer review]. Gates Open Res 2020, 4:67	

Data source files																																																																																																													
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Time (min)	55°C (%wt)	85°C (%wt)	105°C (%wt)	155°C (%wt)	205°C (%wt)																																																																																																								
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Moisture content versus time as a function of temperature at a heating rate of 10°C/min

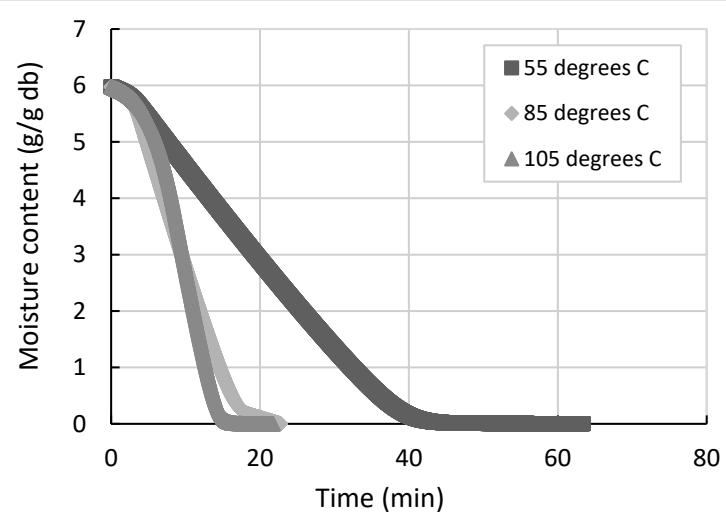
**Wet basis**



**Observations:**

- Faster drying by increasing temperature

**Dry basis**



<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
-	

Data source files**Wet basis**

[https://www.dropbox.com/s/r2jsoyod36pte3a/Swansea%20University\\_Sludge%20TGA%20Isothermal%20kinetics\\_wet%20basis%20%282018-2020%29.xlsx?dl=0](https://www.dropbox.com/s/r2jsoyod36pte3a/Swansea%20University_Sludge%20TGA%20Isothermal%20kinetics_wet%20basis%20%282018-2020%29.xlsx?dl=0)

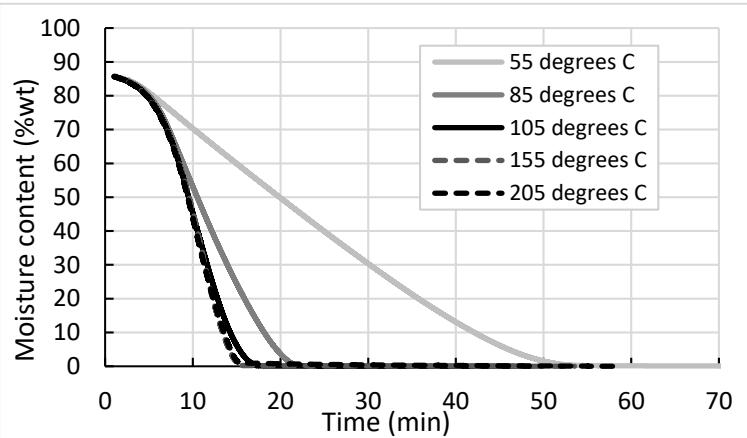
**Dry basis**

[https://www.dropbox.com/s/w1zkkuuu7z21hyj/Swansea%20University\\_Sludge%20TGA%20Isothermal%20Kinetics\\_dry%20basis%20%282018-2020%29.xlsx?dl=0](https://www.dropbox.com/s/w1zkkuuu7z21hyj/Swansea%20University_Sludge%20TGA%20Isothermal%20Kinetics_dry%20basis%20%282018-2020%29.xlsx?dl=0)

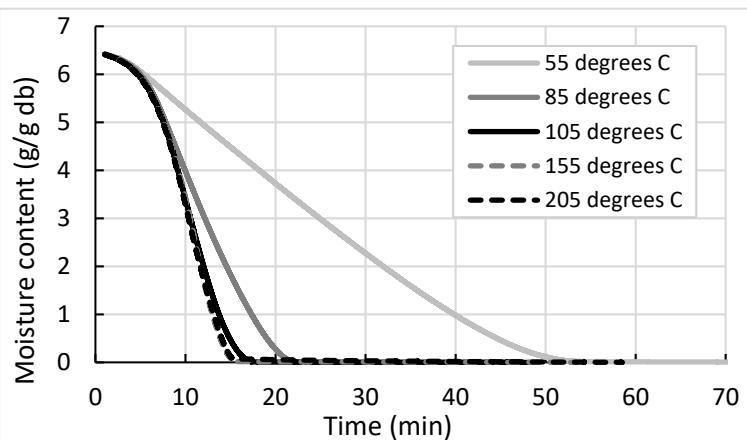
[https://www.dropbox.com/s/w1zkkuuu7z21hyj/Swansea%20University\\_Sludge%20TGA%20Isothermal%20Kinetics\\_dry%20basis%20%282018-2020%29.xlsx?dl=0](https://www.dropbox.com/s/w1zkkuuu7z21hyj/Swansea%20University_Sludge%20TGA%20Isothermal%20Kinetics_dry%20basis%20%282018-2020%29.xlsx?dl=0)

Additional Notes

- Samples couriered from South Africa
- Considerable drying of the sample before reaching the set temperature at 105, 155 and 205°C

Description of DataMoisture content versus time as a function of temperature**Wet basis**Observations

- Faster drying by increasing the temperature from 55 to 105°C
- Drying achieved before 20 minutes at temperatures above 85°C
- Same drying rate between 155 and 205°C (probably because major part of the drying occurred during the heating stage before reaching the final temperature)

**Dry basis**

<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry - differential thermal analyser <i>SHIMADU DTG-60A</i>
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 50, 100, 150 and 200°C</li> <li>○ Heating rate: 50°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 70 mg sample on aluminium crucible of 6 mm diameter and 5 mm height
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	

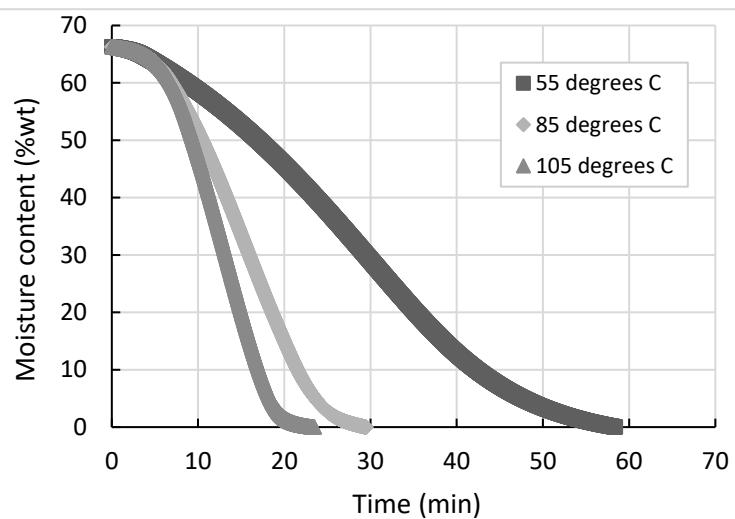
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<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 50%wt
<b>Total solids content</b>	~ 50%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 100°C/min</li> <li>○ Flow rate: 4 mL/min</li> </ul>
<b>Sample form</b>	~ 40 mg sample on a 3 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
Somorin T, Getahun S, Septien S et al. Isothermal drying characteristics and kinetics of human faecal sludges [version 1; peer review: awaiting peer review]. Gates Open Res 2020, 4:67	

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Moisture content versus time as a function of temperature at a heating rate of  $10^{\circ}\text{C}/\text{min}$

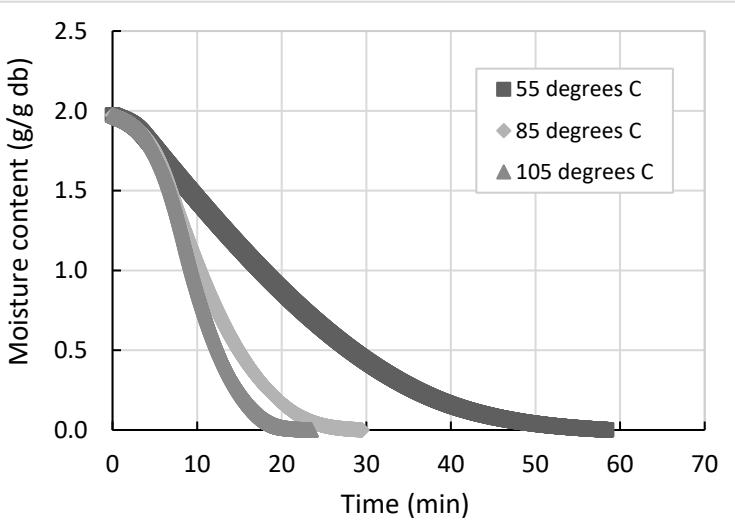
**Wet basis**



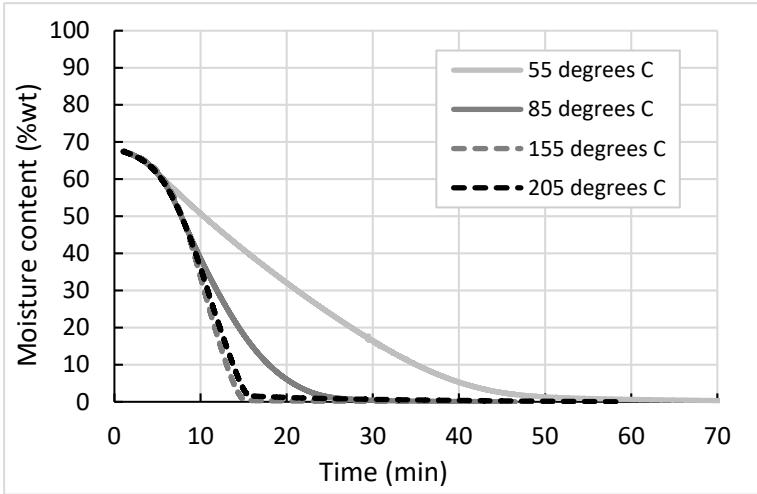
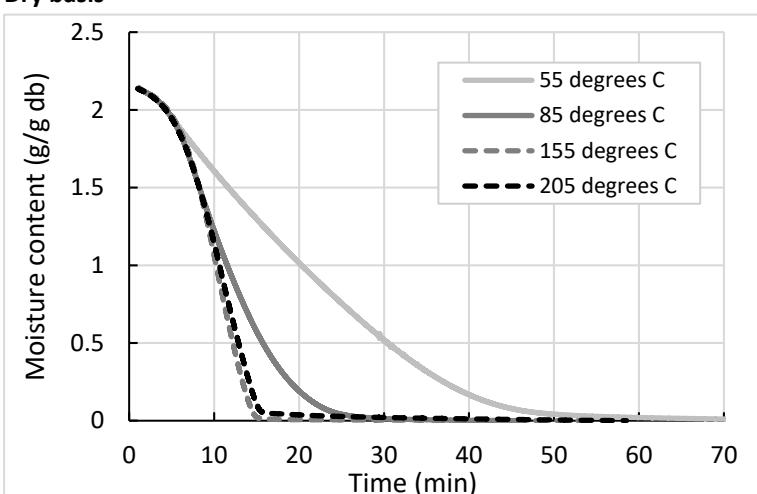
**Observations:**

- Faster drying by increasing temperature

**Dry basis**



<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
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Time (min)	55°C	85°C	155°C	205°C																																																																																																	
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5	2.0	1.8	1.6	1.4																																																																																																	
10	1.5	1.0	0.7	0.5																																																																																																	
20	0.5	0.2	0.1	0.05																																																																																																	
30	0.3	0.15	0.05	0.02																																																																																																	
40	0.15	0.08	0.02	0.01																																																																																																	
50	0.08	0.04	0.01	0.005																																																																																																	
60	0.04	0.02	0.005	0.002																																																																																																	
70	0.02	0.01	0.002	0.001																																																																																																	

<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry - differential thermal analyser SHIMADU DTG-60A
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 50, 100, 150 and 200°C</li> <li>○ Heating rate: 50°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 70 mg sample on aluminium crucible of 6 mm diameter and 5 mm height
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

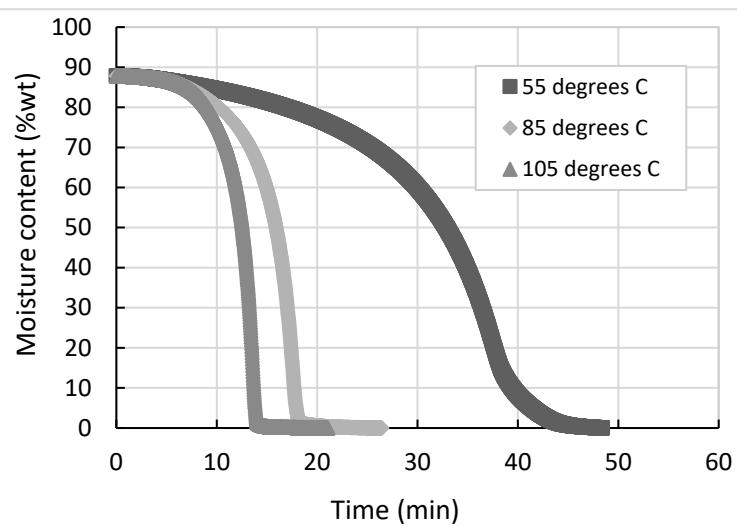
<u>Data source files</u>	
<a href="https://www.dropbox.com/s/khl5b44277bgqw2/2018-2019%20VIP%20Isothermal%20Tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/khl5b44277bgqw2/2018-2019%20VIP%20Isothermal%20Tests_PRG.xlsx?dl=0</a>	
<u>Additional Notes</u>	
-	
<u>Description of Data</u>	
<p><u>Moisture content versus time as a function of temperature</u></p> <p><b>Wet basis</b></p> <p>Moisture content (%wt)</p> <p>Time (min)</p> <p>50 100 150 200</p> <p><b>Dry basis</b></p> <p>Moisture content (g/g db)</p> <p>Time (min)</p> <p>50 100 150 200</p>	<p><b>Observations:</b></p> <ul style="list-style-type: none"> <li>○ Faster drying by increasing temperature</li> <li>○ Strong influence of temperature on the drying rate below 150°C</li> <li>○ Weak effect of temperature above 150°C</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 100°C/min</li> <li>○ Flow rate: 4 mL/min</li> </ul>
<b>Sample form</b>	~ 40 mg sample on a 3 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
Somorin T, Getahun S, Septien S et al. Isothermal drying characteristics and kinetics of human faecal sludges [version 1; peer review: awaiting peer review]. Gates Open Res 2020, 4:67	

Data source files																																																																																																	
<a href="https://www.dropbox.com/s/rhp4d3okk1sgaxb/Cranfield%20University%20VIP%20sludge_TGA%20isothermal%20kinetics%20%282018-2019%29.xlsx?dl=0">https://www.dropbox.com/s/rhp4d3okk1sgaxb/Cranfield%20University%20VIP%20sludge_TGA%20isothermal%20kinetics%20%282018-2019%29.xlsx?dl=0</a>																																																																																																	
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Time (min)	55°C (%wt)	85°C (%wt)	105°C (%wt)	155°C (%wt)	205°C (%wt)																																																																																												
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Moisture content versus time as a function of temperature at a heating rate of 10°C/min

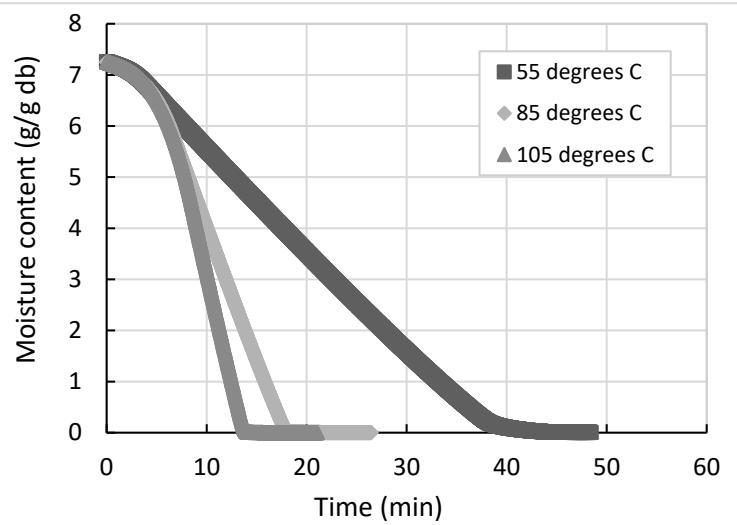
**Wet basis**



**Observations:**

- Faster drying by increasing temperature

**Dry basis**



<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Materials Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
-	

<u>Data source files</u>																																																																																																																									
<b>Wet basis</b> <a href="https://www.dropbox.com/s/r2jsoyod36pte3a/Swansea%20University_Sludge%20TGA%20Isothermal%20kinetics_wet%20basis%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/r2jsoyod36pte3a/Swansea%20University_Sludge%20TGA%20Isothermal%20kinetics_wet%20basis%20%282018-2020%29.xlsx?dl=0</a>																																																																																																																									
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<u>Additional Notes</u>																																																																																																																									
<ul style="list-style-type: none"> <li>○ Faecal sludge couriered from South Africa</li> <li>○ Considerable drying of the sample before reaching the set temperature at 105, 155 and 205°C</li> </ul>																																																																																																																									
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Time (min)	55°C	85°C	105°C	155°C	205°C																																																																																																																				
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<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetry - differential thermal analyser SHIMADU DTG-60A
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 50, 100, 150 and 200°C</li> <li>○ Heating rate: 50°C/min</li> <li>○ Air flowrate: 50 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 70 mg sample on aluminium crucible of 6 mm diameter and 5 mm height
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

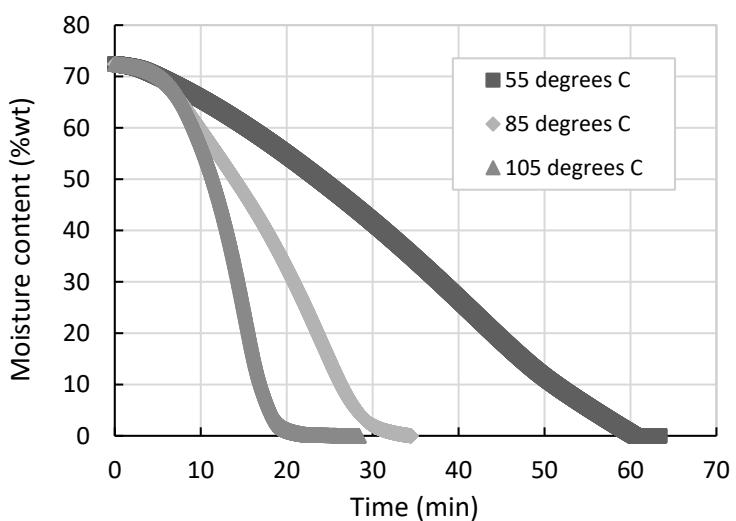
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<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Cranfield, UK
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 60%wt
<b>Total solids content</b>	~ 40%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10 and 100°C/min</li> <li>○ Flow rate: 4 mL/min</li> </ul>
<b>Sample form</b>	~ 40 mg sample on a 3 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
Somorin T, Getahun S, Septien S et al. Isothermal drying characteristics and kinetics of human faecal sludges [version 1; peer review: awaiting peer review]. Gates Open Res 2020, 4:67	

Data source files																																																																																					
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Moisture content versus time as a function of temperature at a heating rate of  $10^{\circ}\text{C}/\text{min}$

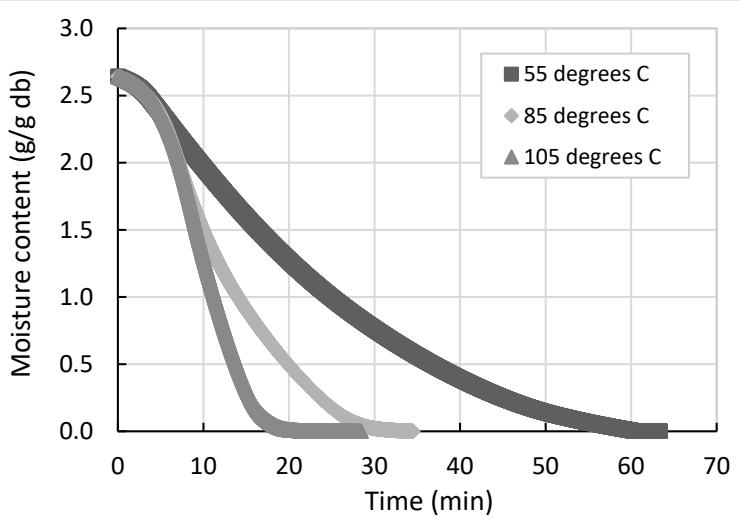
**Wet basis**



**Observations:**

- Faster drying by increasing temperature

**Dry basis**



<u>General information</u>	
<b>Type of data</b>	Isothermal kinetics in a thermogravimetric analyser
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Cranfield, UK
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 60%wt
<b>Total solids content</b>	~ 40%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Drying time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55, 85, 105, 155 and 205°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
<u>Publications</u>	
-	

<u>Data source files</u>																																																																																																																																					
<b>Wet basis</b> <a href="https://www.dropbox.com/s/r2jsoyod36pte3a/Swansea%20University_Sludge%20TGA%20Isothermal%20kinetics_wet%20basis%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/r2jsoyod36pte3a/Swansea%20University_Sludge%20TGA%20Isothermal%20kinetics_wet%20basis%20%282018-2020%29.xlsx?dl=0</a>																																																																																																																																					
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Time (min)	55°C	85°C	105°C	155°C	205°C																																																																																																																																
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<u>General information</u>	
<b>Type of data</b>	Non isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	~ 2, 4, 17 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: from ambient to 200°C</li> <li>○ Heating rate: 10, 50 and 100°C/min</li> <li>○ Flow rate: 4 mL/min</li> </ul>
<b>Sample form</b>	~ 40 mg sample on a 3 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation)
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<b>Type of data</b>	Non-isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 50%wt
<b>Total solids content</b>	~ 50%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	Until temperature ramp reaching 200°C
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: from ambient to 200°C</li> <li>○ Heating rate: 10, 50 and 100°C/min</li> <li>○ Flow rate: 4 mL/min</li> </ul>
<b>Sample form</b>	~ 40 mg sample on a 3 mm diameter aluminium crucible
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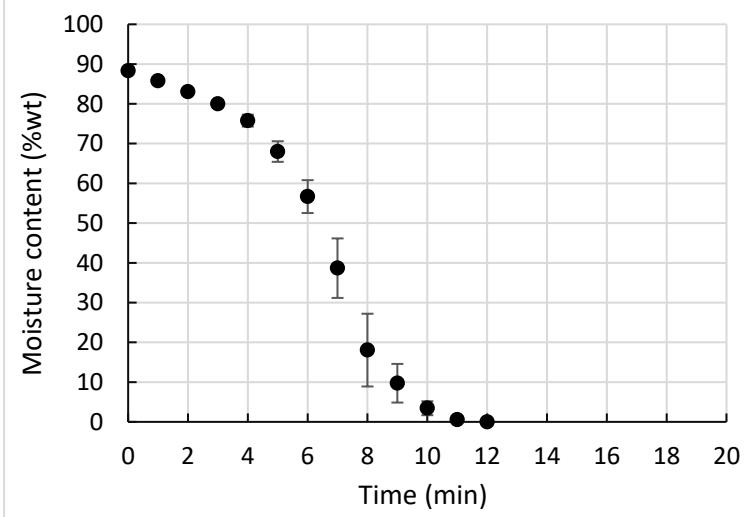
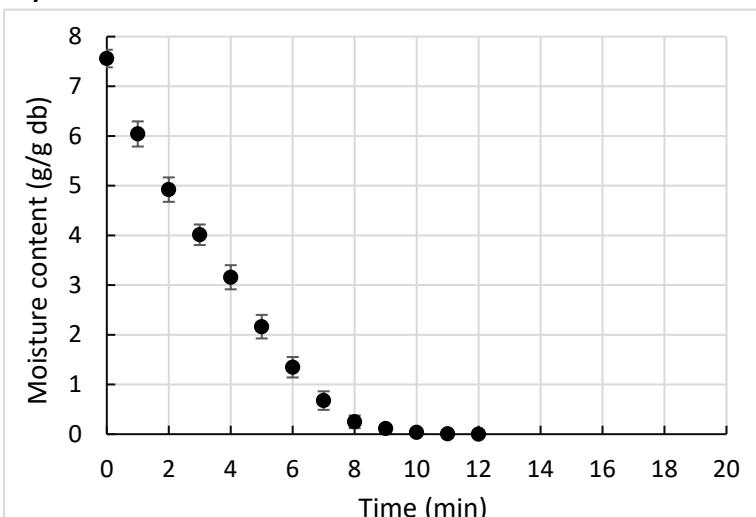
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<b>Type of data</b>	Non isothermal kinetics in a thermogravimetry analyser
<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	~ 2, 4, 17 min
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<b>Place of experimentation</b>	Bioenergy Lab, Cranfield Energy & Power, Cranfield University (United Kingdom)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Cranfield, UK
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 60%wt
<b>Total solids content</b>	~ 40%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser <i>PerkinElmer TGA 8000™</i>
<b>Drying time</b>	~ 2, 4, 17 min
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180	0.2	1.4	1.8																																																						

<u>General information</u>	
<b>Type of data</b>	Kinetics in a moisture analyser balance
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 100°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Direct measurement by moisture analyser balance <i>PCE-MB Series</i> (SOP 8.7.1.5)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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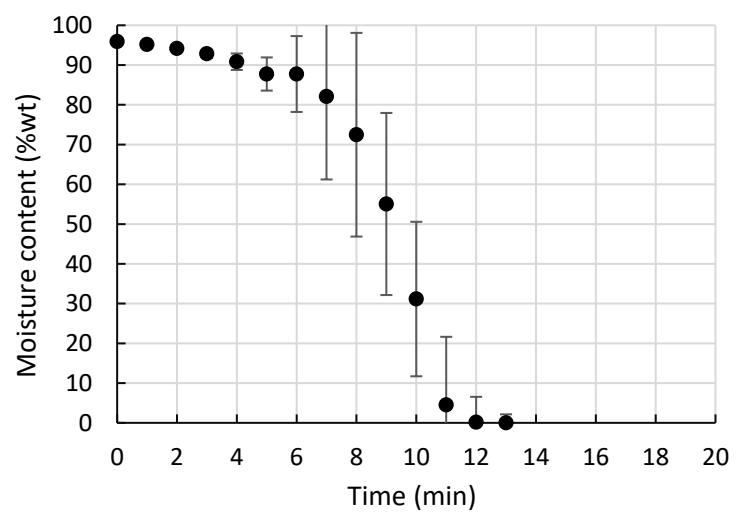
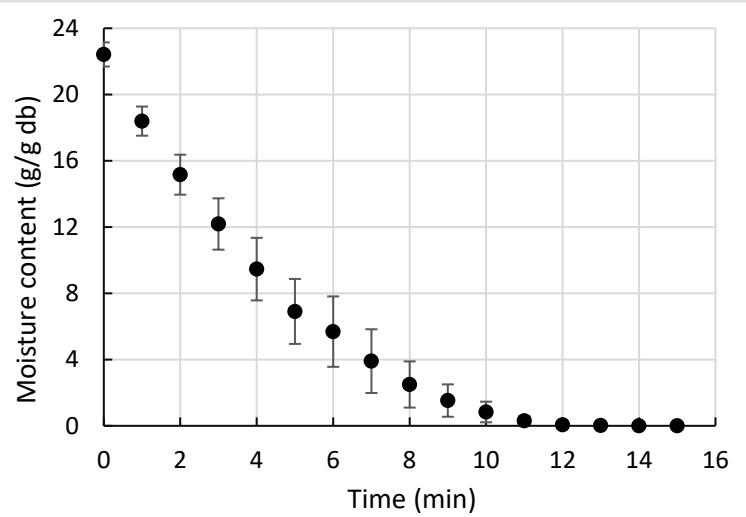
<u>General information</u>	
<b>Type of data</b>	Kinetics in a moisture analyser balance
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 100°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Direct measurement by moisture analyser balance PCE-MB Series (SOP 8.7.1.5)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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<u>General information</u>	
<b>Type of data</b>	Kinetics in a moisture analyser balance
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	Temperature: 40, 60 and 80°C
<b>Sample form</b>	~ 3 g of faecal sludge in a crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) in a thermal balance (SOP 8.7.1.5)
<u>Publications</u>	
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Data source files																																																	
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<u>General information</u>	
<b>Type of data</b>	Kinetics in a moisture analyser balance
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture Analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 100°C
<b>Sample form in the dryer</b>	1.5 g of sample on an 90 mm diameter aluminium crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Thermogravimetry (determined through the measurement of the sample mass variation) (SOP 8.7.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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<b>Type of data</b>	Kinetics in a moisture analyser balance
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine toilet (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Moisture analyser balance <i>PCE-MB Series</i>
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	Temperature: 40, 60 and 80°C
<b>Sample form</b>	~ 3 g of faecal sludge in a crucible
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Thermogravimetry (determined through the measurement of the sample mass variation) in a thermal balance (SOP 8.7.1.5)
<u>Publications</u>	
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Data source files																																																									
<a href="https://www.dropbox.com/s/56rm46w5t144p4t/2019-2020%20FS%20drying%20tests_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/56rm46w5t144p4t/2019-2020%20FS%20drying%20tests_PRG-UKZN.xlsx?dl=0</a>																																																									
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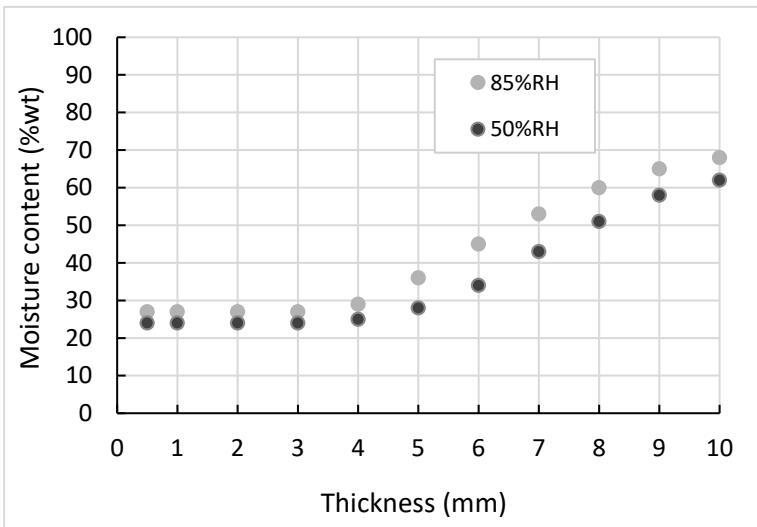
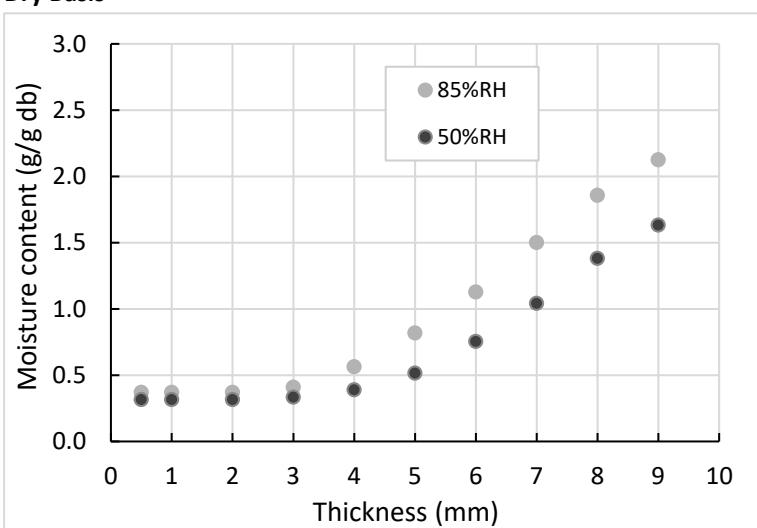
<u>General information</u>	
<b>Type of data</b>	Kinetics in a moisture analyser balance
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample placed in 1 L plastic bucket
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Direct measurement by moisture analyser balance <i>PCE-MB Series</i> (SOP 8.7.1.5)
<u>Publications</u>	
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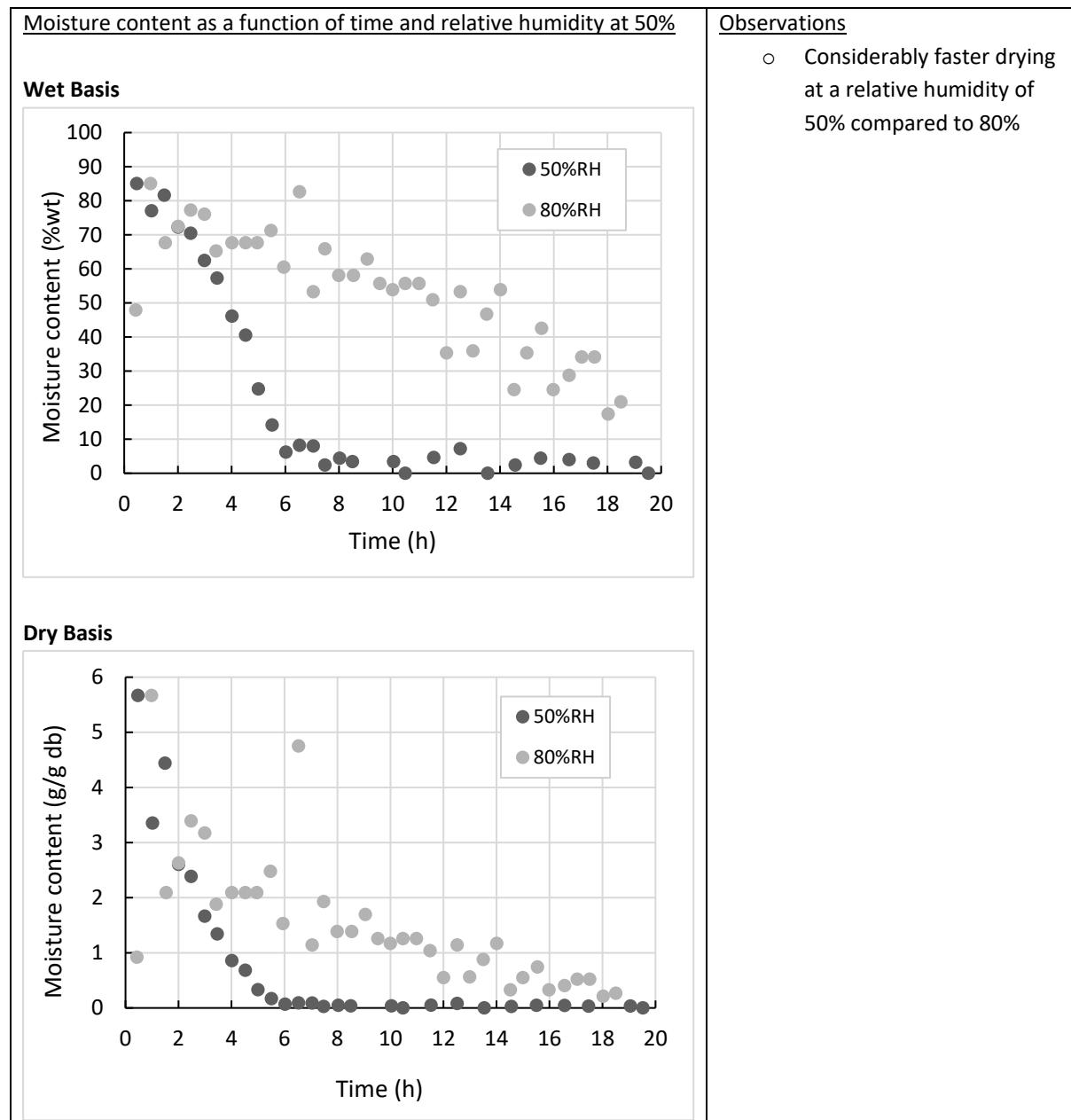
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<u>Normalized moisture content (with respect to the initial value) as a function of time for the samples from batch 1 and 2</u> <p>The graph displays the normalized moisture content over time for various samples from two batches. The y-axis represents the normalized moisture content, ranging from 0.0 to 1.0. The x-axis represents time in minutes, ranging from 0 to 35. The legend provides the initial moisture content for each sample:</p> <table border="1"> <thead> <tr> <th>Sample Description</th> <th>Initial Moisture Content (%wt)</th> </tr> </thead> <tbody> <tr> <td>Batch 1, Day 0</td> <td>79.0</td> </tr> <tr> <td>Batch 1, Week 1</td> <td>76.6</td> </tr> <tr> <td>Batch 1, Week 2</td> <td>71.3</td> </tr> <tr> <td>Batch 1, Week 3</td> <td>69.1</td> </tr> <tr> <td>Batch 1, Week 4</td> <td>63.4</td> </tr> <tr> <td>Batch 1, Week 5</td> <td>61.7</td> </tr> <tr> <td>Batch 1, Week 6</td> <td>61.9</td> </tr> <tr> <td>Batch 1, Week 7</td> <td>52.1</td> </tr> <tr> <td>Batch 1, Week 8</td> <td>56.3</td> </tr> <tr> <td>Batch 1, Week 12</td> <td>40.8</td> </tr> <tr> <td>Batch 1, Week 16</td> <td>25.9</td> </tr> <tr> <td>Batch 2, Day 0</td> <td>78.2</td> </tr> <tr> <td>Batch 2, Day 3</td> <td>77.4</td> </tr> <tr> <td>Batch 2, Day 5</td> <td>75.7</td> </tr> <tr> <td>Batch 2, Day 7</td> <td>75.8</td> </tr> </tbody> </table>	Sample Description	Initial Moisture Content (%wt)	Batch 1, Day 0	79.0	Batch 1, Week 1	76.6	Batch 1, Week 2	71.3	Batch 1, Week 3	69.1	Batch 1, Week 4	63.4	Batch 1, Week 5	61.7	Batch 1, Week 6	61.9	Batch 1, Week 7	52.1	Batch 1, Week 8	56.3	Batch 1, Week 12	40.8	Batch 1, Week 16	25.9	Batch 2, Day 0	78.2	Batch 2, Day 3	77.4	Batch 2, Day 5	75.7	Batch 2, Day 7	75.8	<u>Observations</u> <ul style="list-style-type: none"> <li>○ No considerable effect of the initial moisture content on the drying kinetics</li> <li>○ Time for complete drying between 10 and 20 minutes</li> </ul>
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<u>General information</u>	
<b>Type of data</b>	Kinetics of natural drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample placed in 1 L plastic bucket
<b>Analysed parameters</b>	Moisture content
<b>Employed method</b>	Weighing the sample before and after drying at 105°C in the laboratory oven for 24 hours (SOP 8.7.1.1)
<u>Publications</u>	
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<u>General information</u>	
<b>Type of data</b>	Drying time
<b>Place of experimentation</b>	Chemical Engineering & Applied Chemistry, University of Toronto (Canada)
<b>Dates of the experiments</b>	2012
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Ontario, Canada
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Environmental chamber
<b>Drying time</b>	Several hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 28°C</li> <li>○ Air flowrate: 2100 L/min (air velocities of 4.6 m/s)</li> <li>○ Relative humidity: 85%</li> </ul>
<b>Sample form in the dryer</b>	Thin layer of 110 x 110 x 2 mm
<b>Analysed parameters</b>	Moisture content
<b>Employed methods</b>	Gravimetric method (determined through the measurement of the sample mass variation)
<u>Publications</u>	
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<u>Data source files</u>																																				
<a href="https://www.dropbox.com/s/hloxql9ixp462re/2012%20Drying%20Kinetics%20of%20Human%20faeces_Toronto%20University.xlsx?dl=0">https://www.dropbox.com/s/hloxql9ixp462re/2012%20Drying%20Kinetics%20of%20Human%20faeces_Toronto%20University.xlsx?dl=0</a>																																				
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<u>Description of Data</u>																																				
<u>Moisture content after 24 hours of drying as a function of the sample thickness and relative humidity</u>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Decrease of final moisture content by decreasing the thickness of the sample</li> <li>○ Below 3 mm thickness, same final moisture content (25-30%wt, which could be the equilibrium moisture content)</li> </ul>																																			
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<u>General information</u>	
<b>Type of data</b>	Drying time
<b>Place of experimentation</b>	Chemical Engineering & Applied Chemistry, University of Toronto (Canada)
<b>Dates of the experiments</b>	2012
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Ontario, Canada
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 55%wt moisture content
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: 28°C</li> <li>○ Air flowrate: 900 – 2100 L/min (air velocities of 1.9 – 4.6 m/s)</li> <li>○ Relative humidity: 50 and 85%</li> </ul>
<b>Sample form in the dryer</b>	Thin layer of 1 to 8 mm thickness
<b>Analysed parameters</b>	Drying time
<b>Employed methods</b>	Measurement of time
<u>Publications</u>	
-	

<u>Data source files</u>																															
<a href="https://www.dropbox.com/s/hloxql9ixp462re/2012%20Drying%20Kinetics%20of%20Human%20faeces_Toronto%20University.xlsx?dl=0">https://www.dropbox.com/s/hloxql9ixp462re/2012%20Drying%20Kinetics%20of%20Human%20faeces_Toronto%20University.xlsx?dl=0</a>																															
<u>Additional Notes</u>																															
Fresh faeces collected from voluntary and anonymous donations																															
<u>Description of Data</u>																															
<u>Drying time to reduce the moisture content from 83 (initial value) to 55%wt (final value) as a function of the sample thickness and relative humidity</u>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Increase of drying time by increasing the thickness of the sample</li> </ul>																														
<p>The scatter plot illustrates the relationship between sample thickness and drying time under two different relative humidity (RH) conditions: 85%RH and 55%RH. The x-axis represents Thickness (mm), ranging from 0 to 9. The y-axis represents Time (h), ranging from 0 to 24. The data points show that for a fixed thickness, the drying time is longer at 85%RH compared to 55%RH. Additionally, the drying time increases exponentially with sample thickness for both conditions.</p> <table border="1"> <thead> <tr> <th>Thickness (mm)</th> <th>Time (h) at 85%RH</th> <th>Time (h) at 55%RH</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>~0.5</td> </tr> <tr> <td>2</td> <td>~1.5</td> <td>~1.5</td> </tr> <tr> <td>3</td> <td>~4</td> <td>~3</td> </tr> <tr> <td>4</td> <td>~7</td> <td>~5</td> </tr> <tr> <td>5</td> <td>~12</td> <td>~8</td> </tr> <tr> <td>6</td> <td>~17</td> <td>~12</td> </tr> <tr> <td>7</td> <td>~23</td> <td>~16</td> </tr> <tr> <td>8</td> <td>-</td> <td>~21</td> </tr> </tbody> </table>	Thickness (mm)	Time (h) at 85%RH	Time (h) at 55%RH	0	0	0	1	0	~0.5	2	~1.5	~1.5	3	~4	~3	4	~7	~5	5	~12	~8	6	~17	~12	7	~23	~16	8	-	~21	
Thickness (mm)	Time (h) at 85%RH	Time (h) at 55%RH																													
0	0	0																													
1	0	~0.5																													
2	~1.5	~1.5																													
3	~4	~3																													
4	~7	~5																													
5	~12	~8																													
6	~17	~12																													
7	~23	~16																													
8	-	~21																													

# PHYSIOCHEMICAL PROPERTIES

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until completely dry
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Volatile solids
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

<u>Data source files</u>											
<a href="https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0</a>											
<u>Additional Notes</u>											
-											
<u>Description of Data</u>											
<p>Volatile solids content as a function of temperature</p> <table border="1"><thead><tr><th>Temperature (°C)</th><th>Volatile solids content (g/g db)</th></tr></thead><tbody><tr><td>50</td><td>~0.75</td></tr><tr><td>105</td><td>~0.78</td></tr><tr><td>150</td><td>~0.73</td></tr><tr><td>200</td><td>~0.64</td></tr></tbody></table>	Temperature (°C)	Volatile solids content (g/g db)	50	~0.75	105	~0.78	150	~0.73	200	~0.64	<p>Observations:</p> <ul style="list-style-type: none"><li>○ No effect of temperature</li><li>○ Lower volatile solid content at 200°C (possible thermal degradation)</li></ul>
Temperature (°C)	Volatile solids content (g/g db)										
50	~0.75										
105	~0.78										
150	~0.73										
200	~0.64										

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, South Africa
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Volatile solids
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

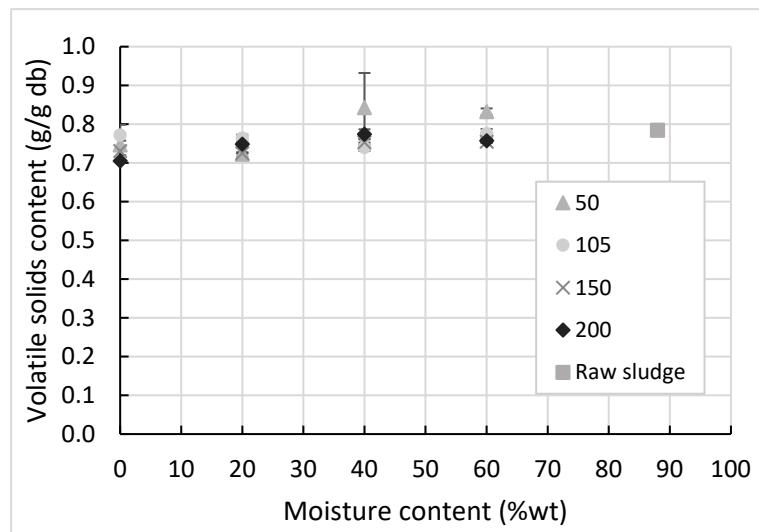
[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

#### Additional Notes

-

#### Description of Data

##### Volatile solids content as a function of moisture content and temperature



##### Observations:

- Volatile solid content constant as sludge dried
- No effect of drying temperature

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, South Africa
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from a urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until completely dry
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Volatile solids
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

<u>Data source files</u>											
<a href="https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0</a>											
<u>Additional Notes</u>											
-											
<u>Description of Data</u>											
<p>Volatile solids content as a function of temperature</p> <table border="1"><thead><tr><th>Temperature (°C)</th><th>Volatile solids content (g/g db)</th></tr></thead><tbody><tr><td>50</td><td>~0.58</td></tr><tr><td>100</td><td>~0.57</td></tr><tr><td>150</td><td>~0.56</td></tr><tr><td>200</td><td>~0.45</td></tr></tbody></table>	Temperature (°C)	Volatile solids content (g/g db)	50	~0.58	100	~0.57	150	~0.56	200	~0.45	<p>Observations:</p> <ul style="list-style-type: none"><li>○ Volatile solids constant between 50 and 150°C</li><li>○ Lower volatile solid content at 200°C (possible thermal degradation)</li></ul>
Temperature (°C)	Volatile solids content (g/g db)										
50	~0.58										
100	~0.57										
150	~0.56										
200	~0.45										

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Volatile solids
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

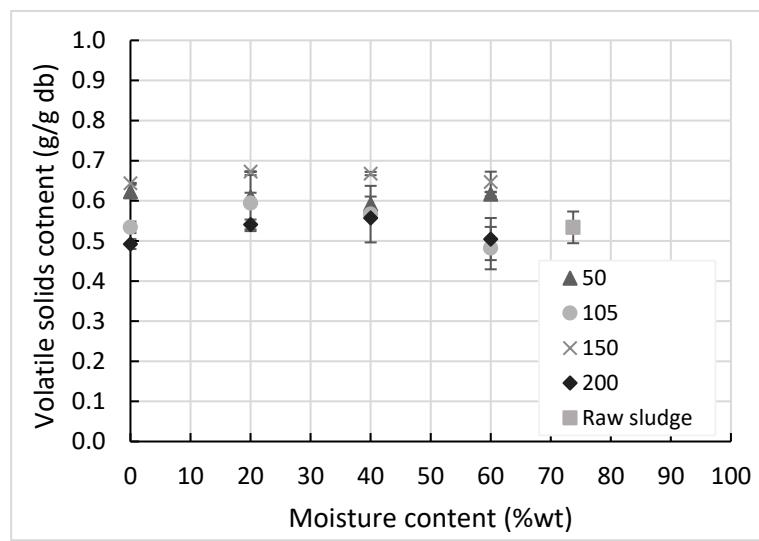
[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

#### Additional Notes

-

#### Description of Data

##### Volatile solids content as a function of moisture content and temperature



##### Observations:

- Volatile solid content constant as sludge dried
- No effect of drying temperature

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, Durban South Africa
<b>Dates of the experiments</b>	2014-2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 70% db
<b>Ash content</b>	~ 30% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	0, 4, 9, 13, 17, 25, 40 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3, 5 and 6.5 kW (corresponding to ~ 85, 135 and 215°C respectively)</li> <li>○ Distance between the emitters and the sample: 115 mm</li> <li>○ Air stream flowrate: 18.3 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10, 12 and 14 mm diameter
<b>Analysed parameters</b>	Volatile solids/ash content
<b>Employed methods</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
Mirara, S.W. (2017). Drying and Pasteurisation of VIP Latrine Faecal Sludge using a Bench Scale Medium Infrared Machine. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

Septien, S., Mirara, S.W., Singh, A., Velkushanova, K., & Buckley, C. (2018). Characterisation of On-Site Sanitation Material and Products: VIP Latrines and Pour-Flush Toilets. WRC project final report. South Africa.

Septien, S., Mirara, S. W., Makununika, B., Singh, A., Pocock, J., Velkushanova, K., & Buckley, C. A. (2019). Effect of drying on the physical and chemical properties of faecal sludge for its reuse. Journal of Environmental Chemical Engineering, 103652.

#### Data source files

<https://www.dropbox.com/s/qbqkf45sx5ysk25/2014-2015%20VIP%20composition%20analysis.xlsx?dl=0>

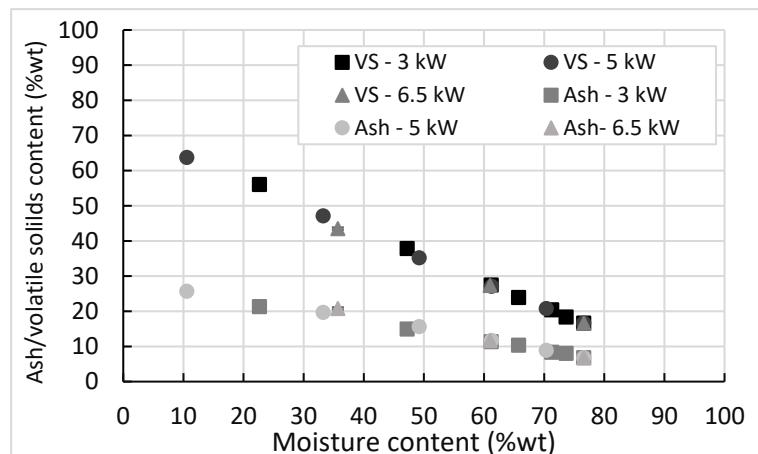
#### Additional Notes

- Volatile solids content + Ash content = 1

#### Description of Data

Ash and volatile solids (VS) content versus moisture content as a function of the MIR emitter power

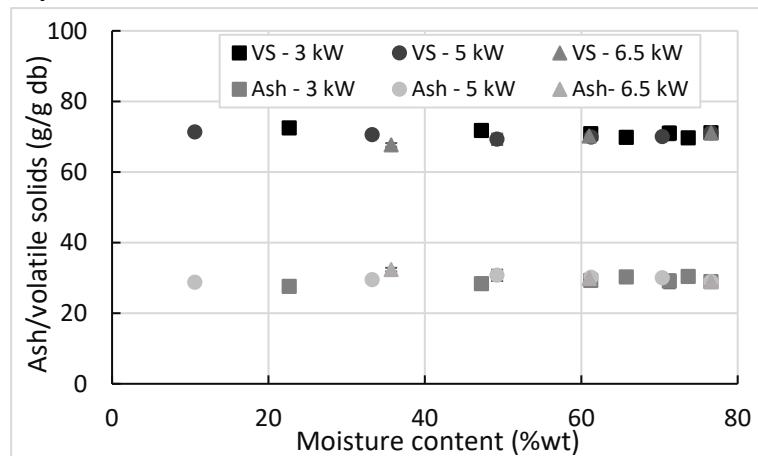
##### **Wet basis**

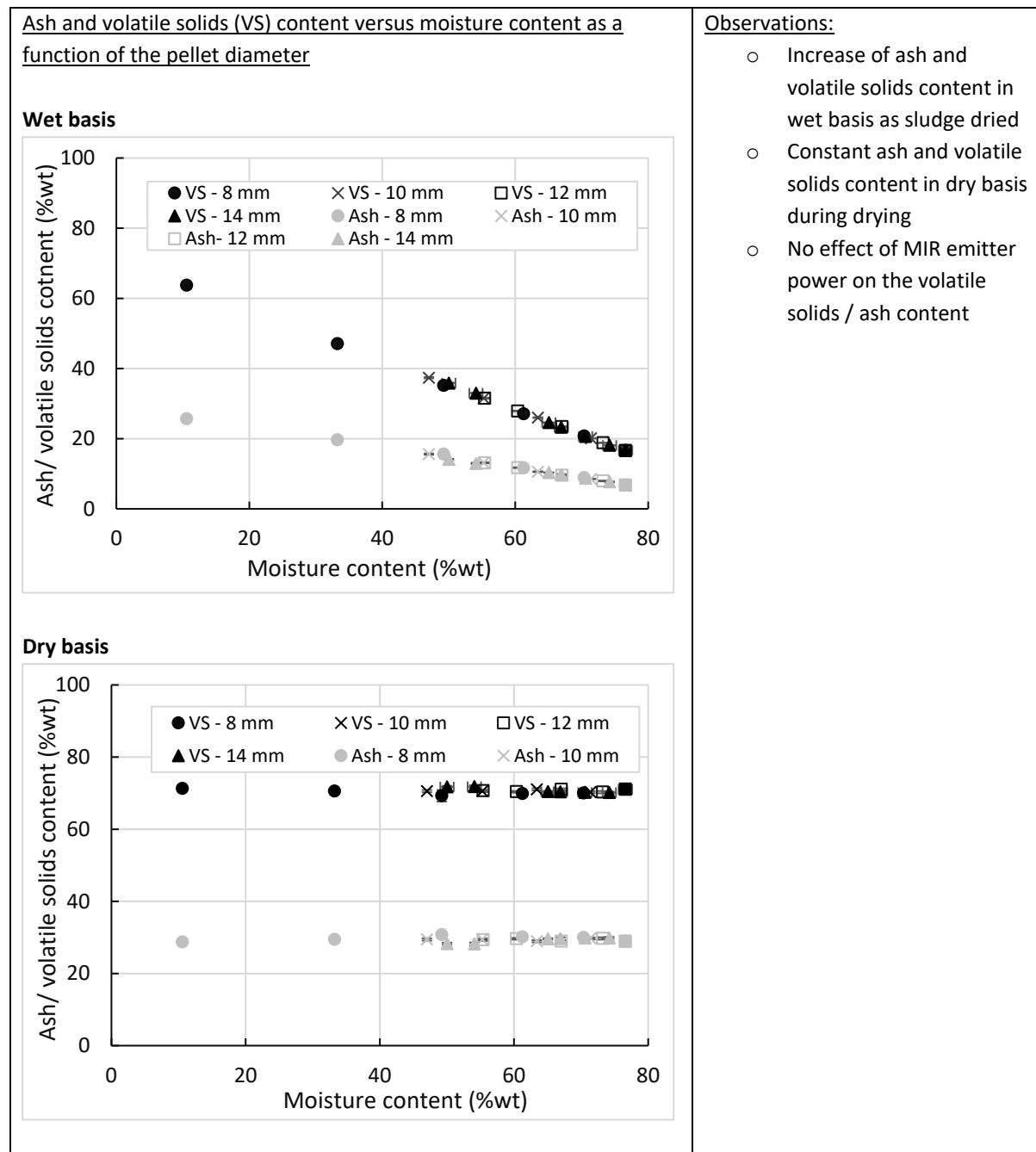


##### Observations:

- Increase of ash and volatile solids content in wet basis as sludge dried
- Constant ash and volatile solids content in dry basis during drying
- No effect of MIR emitter power on the volatile solids / ash content

##### **Dry basis**





<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge collected from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 50% db
<b>Ash content</b>	~ 50% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom design convective drying rig
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0%</li> <li>○ Air velocity: 0.06 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8 mm diameter
<b>Analysed parameters</b>	<ol style="list-style-type: none"> <li>(1) Moisture/total solids</li> <li>(2) Volatile solids/ash content</li> </ol>
<b>Employed methods</b>	<ol style="list-style-type: none"> <li>(1) Weighing the sample before and after drying at 105°C for 24 h (SOP 8.7.1.1)</li> <li>(2) Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)</li> </ol>

Publications																
Makununiika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.																
Data source files																
<a href="https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0">https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0</a>																
Additional Notes																
<ul style="list-style-type: none"> <li>○ Moisture content + Total Solids content = 1</li> <li>○ Volatile Solids content + Ash content = 1</li> </ul>																
Description of Data																
<u>Moisture and total solids content as a function of temperature</u> <table border="1"> <caption>Data for Moisture and Total Solids content as a function of temperature</caption> <thead> <tr> <th>Temperature</th> <th>Moisture (% wt)</th> <th>Total Solids (% wt)</th> </tr> </thead> <tbody> <tr> <td>Raw sludge</td> <td>~80</td> <td>~20</td> </tr> <tr> <td>40°C</td> <td>~10</td> <td>~88</td> </tr> <tr> <td>60°C</td> <td>~8</td> <td>~92</td> </tr> <tr> <td>80°C</td> <td>~5</td> <td>~95</td> </tr> </tbody> </table>	Temperature	Moisture (% wt)	Total Solids (% wt)	Raw sludge	~80	~20	40°C	~10	~88	60°C	~8	~92	80°C	~5	~95	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Lower moisture content achieved after drying at the highest temperature (80°C)</li> <li>○ Not complete drying achieved</li> <li>○ No effect of drying temperature on the volatile solid and ash content</li> </ul>
Temperature	Moisture (% wt)	Total Solids (% wt)														
Raw sludge	~80	~20														
40°C	~10	~88														
60°C	~8	~92														
80°C	~5	~95														
<u>Ash and volatile solids content as a function of temperature</u> <table border="1"> <caption>Data for Ash and volatile solids content as a function of temperature</caption> <thead> <tr> <th>Temperature</th> <th>Moisture (% wt)</th> <th>Total Solids (% wt)</th> </tr> </thead> <tbody> <tr> <td>Raw sludge</td> <td>~80</td> <td>~20</td> </tr> <tr> <td>40°C</td> <td>~12</td> <td>~88</td> </tr> <tr> <td>60°C</td> <td>~10</td> <td>~92</td> </tr> <tr> <td>80°C</td> <td>~5</td> <td>~95</td> </tr> </tbody> </table>	Temperature	Moisture (% wt)	Total Solids (% wt)	Raw sludge	~80	~20	40°C	~12	~88	60°C	~10	~92	80°C	~5	~95	
Temperature	Moisture (% wt)	Total Solids (% wt)														
Raw sludge	~80	~20														
40°C	~12	~88														
60°C	~10	~92														
80°C	~5	~95														

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 40%db
<b>Ash content</b>	~ 60%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Volatile solids
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

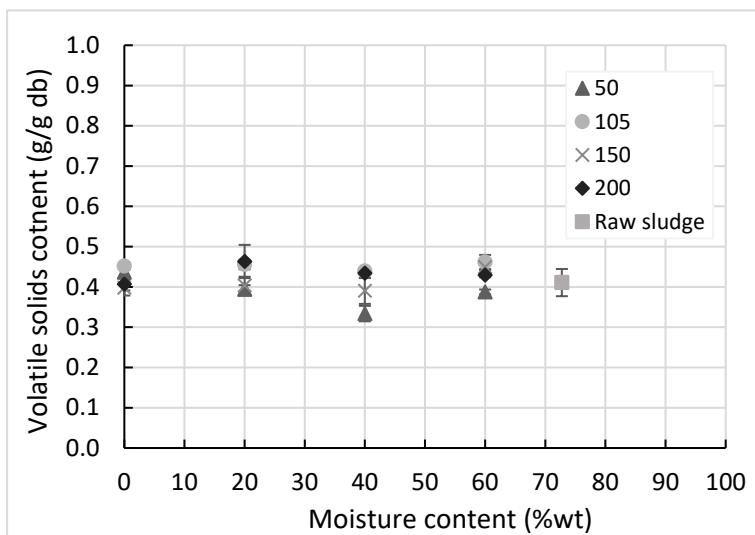
[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

#### Additional Notes

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#### Description of Data

##### Volatile solids content as a function of moisture content and temperature



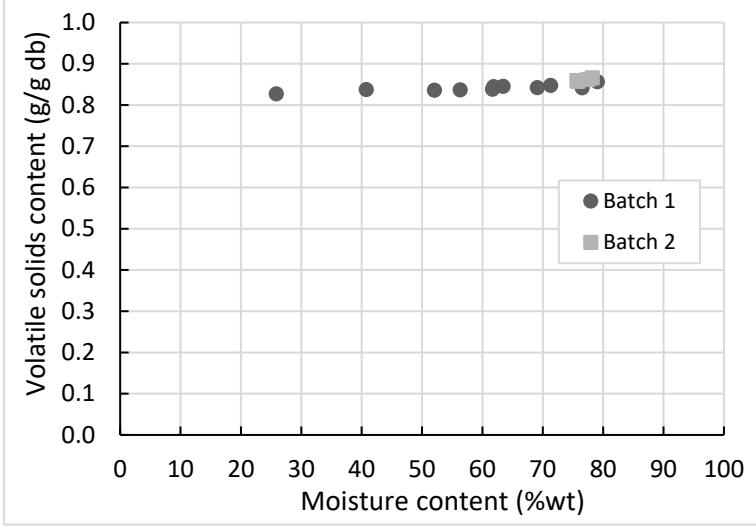
##### Observations:

- Volatile solid content constant as sludge dried
- No effect of drying temperature

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 0, 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Volatile solids
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
-	

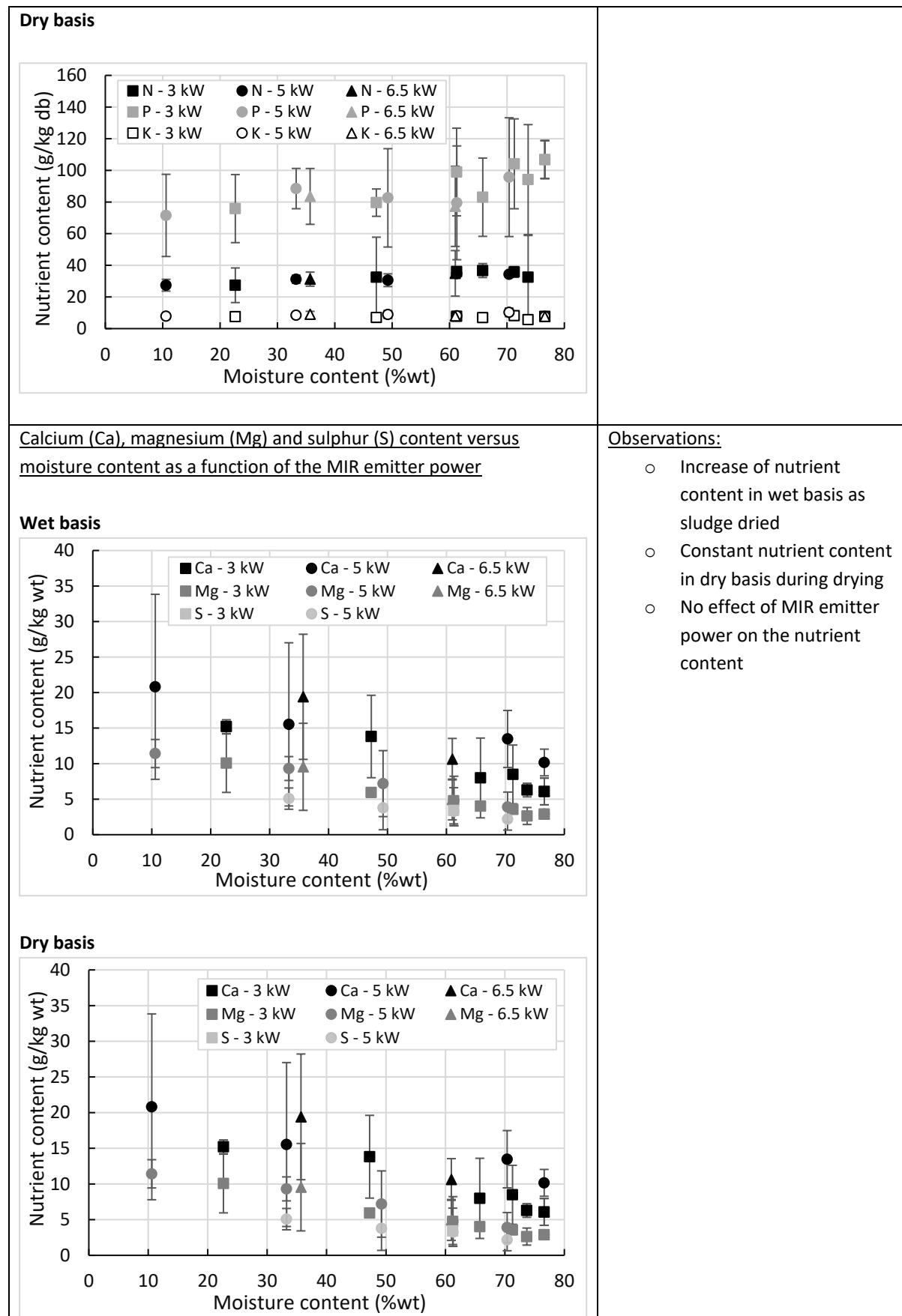
<u>Data source files</u>																																				
<a href="https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0</a>																																				
<u>Additional Notes</u>																																				
Fresh faeces collected from voluntary and anonymous donations																																				
<u>Description of Data</u>																																				
<u>Volatile solids as a function of moisture content of the faeces and temperature</u>	<p><b>Observations:</b></p> <ul style="list-style-type: none"><li>○ Lower volatile solid content of dried sludge compared to raw material</li><li>○ No effect of temperature</li></ul>																																			
<p>The scatter plot illustrates the relationship between volatile solids content (g/g db) on the Y-axis and moisture content (%) on the X-axis. The Y-axis ranges from 0.0 to 1.0 with increments of 0.1. The X-axis ranges from 0 to 90 with increments of 10. Five data series are plotted: 50 (open triangle), 105 (solid circle), 150 (cross), 200 (diamond), and Initial sample (square). All series show a general downward trend as moisture content increases. The data points for different temperatures are closely grouped, indicating no significant effect of temperature on volatile solids content.</p> <table border="1"><thead><tr><th>Moisture content (%)</th><th>50 (g/g db)</th><th>105 (g/g db)</th><th>150 (g/g db)</th><th>200 (g/g db)</th><th>Initial sample (g/g db)</th></tr></thead><tbody><tr><td>0</td><td>0.85</td><td>0.85</td><td>0.85</td><td>0.85</td><td>0.85</td></tr><tr><td>20</td><td>0.85</td><td>0.90</td><td>0.85</td><td>0.90</td><td>0.85</td></tr><tr><td>40</td><td>0.85</td><td>0.90</td><td>0.85</td><td>0.90</td><td>0.85</td></tr><tr><td>60</td><td>0.85</td><td>0.95</td><td>0.85</td><td>0.95</td><td>0.85</td></tr><tr><td>80</td><td>0.85</td><td>-</td><td>0.85</td><td>-</td><td>0.85</td></tr></tbody></table>	Moisture content (%)	50 (g/g db)	105 (g/g db)	150 (g/g db)	200 (g/g db)	Initial sample (g/g db)	0	0.85	0.85	0.85	0.85	0.85	20	0.85	0.90	0.85	0.90	0.85	40	0.85	0.90	0.85	0.90	0.85	60	0.85	0.95	0.85	0.95	0.85	80	0.85	-	0.85	-	0.85
Moisture content (%)	50 (g/g db)	105 (g/g db)	150 (g/g db)	200 (g/g db)	Initial sample (g/g db)																															
0	0.85	0.85	0.85	0.85	0.85																															
20	0.85	0.90	0.85	0.90	0.85																															
40	0.85	0.90	0.85	0.90	0.85																															
60	0.85	0.95	0.85	0.95	0.85																															
80	0.85	-	0.85	-	0.85																															

<u>General information</u>	
<b>Type of data</b>	Composition
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample placed in 1 L plastic bucket
<b>Analysed parameters</b>	Volatile solids content
<b>Employed method</b>	Weighing the sample before and after calcination at 550°C (SOP 8.7.1.2)
<u>Publications</u>	
-	

<u>Data source files</u>																																		
<a href="https://www.dropbox.com/s/xbv6su0jxsiok/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PR_G.xlsx?dl=0">https://www.dropbox.com/s/xbv6su0jxsiok/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PR_G.xlsx?dl=0</a>																																		
<u>Additional Notes</u>																																		
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ Containers with sample placed in a ventilated area</li> <li>○ Mesh placed at the opening of the container to avoid the development of maggots</li> <li>○ Samples from batch 1 analysed in a weekly basis for 16 weeks</li> <li>○ Samples from batch 2 analysed at days 0, 3, 5 and 7 during one week</li> </ul>	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Constant volatile solid content during drying</li> </ul>																																	
<u>Description of Data</u>																																		
<u>Volatile solids content as a function of moisture content for the samples from batch 1 and 2</u>  <table border="1"> <caption>Data points estimated from the scatter plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Batch 1 (g/g db)</th> <th>Batch 2 (g/g db)</th> </tr> </thead> <tbody> <tr><td>28</td><td>0.83</td><td></td></tr> <tr><td>40</td><td>0.84</td><td></td></tr> <tr><td>52</td><td>0.84</td><td></td></tr> <tr><td>55</td><td>0.84</td><td></td></tr> <tr><td>58</td><td>0.85</td><td></td></tr> <tr><td>60</td><td>0.84</td><td></td></tr> <tr><td>65</td><td>0.85</td><td></td></tr> <tr><td>68</td><td>0.85</td><td></td></tr> <tr><td>70</td><td>0.85</td><td></td></tr> <tr><td>78</td><td>0.86</td><td>0.86</td></tr> </tbody> </table>	Moisture content (%wt)	Batch 1 (g/g db)	Batch 2 (g/g db)	28	0.83		40	0.84		52	0.84		55	0.84		58	0.85		60	0.84		65	0.85		68	0.85		70	0.85		78	0.86	0.86	
Moisture content (%wt)	Batch 1 (g/g db)	Batch 2 (g/g db)																																
28	0.83																																	
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70	0.85																																	
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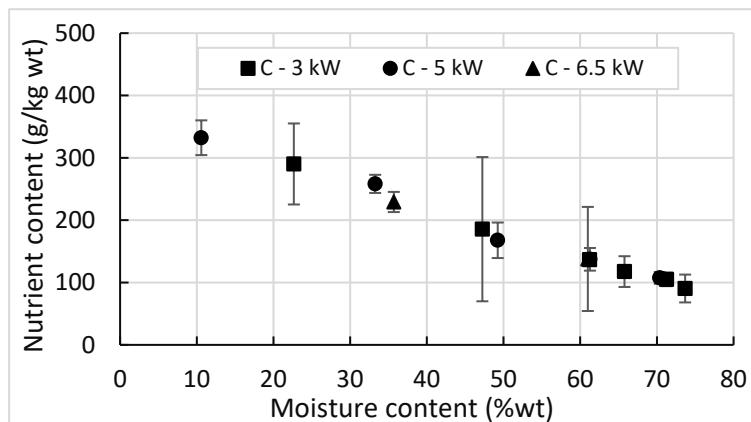
<u>General information</u>	
<b>Type of data</b>	Elemental nutrient content
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 70% db
<b>Ash content</b>	~ 30% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	0, 4, 9, 13, 17, 25, 40 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3, 5 and 6.5 kW (corresponding to ~ 85, 135 and 215°C respectively)</li> <li>○ Distance between the emitters and the sample: 115 mm</li> <li>○ Air stream flowrate: 18.3 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8 and 14 mm diameter
<b>Analysed parameters</b>	Carbon (C), nitrogen (N), sulphur (S), Phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg)
<b>Employed methods</b>	<ol style="list-style-type: none"> <li>(1) Use of CNS analyzer (SOP 8.7.7.2)</li> <li>(2) Use of microwave plasma – atomic emission spectroscopy (SOP 8.7.7.1)</li> </ol>

Publications																																																																																											
Mirara, S.W. (2017). Drying and Pasteurisation of VIP Latrine Faecal Sludge using a Bench Scale Medium Infrared Machine. Master thesis. University of KwaZulu-Natal, Durban, South Africa.																																																																																											
Septien, S., Mirara, S.W., Singh, A., Velkushanova, K., & Buckley, C. (2018). Characterisation of On-Site Sanitation Material and Products: VIP Latrines and Pour-Flush Toilets. WRC project final report. South Africa.																																																																																											
Septien, S., Mirara, S. W., Makununika, B., Singh, A., Pocock, J., Velkushanova, K., & Buckley, C. A. (2019). Effect of drying on the physical and chemical properties of faecal sludge for its reuse. Journal of Environmental Chemical Engineering, 103652.																																																																																											
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<p><u>Nitrogen (N), phosphorous (P) and potassium (K) content versus moisture content as a function of the MIR emitter power</u></p> <p><b>Wet basis</b></p> <table border="1"> <caption>Data extracted from the scatter plot (approximate values)</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>N - 3 kW (g/kg wt)</th> <th>N - 5 kW (g/kg wt)</th> <th>N - 6.5 kW (g/kg wt)</th> <th>P - 3 kW (g/kg wt)</th> <th>P - 5 kW (g/kg wt)</th> <th>P - 6.5 kW (g/kg wt)</th> <th>K - 3 kW (g/kg wt)</th> <th>K - 5 kW (g/kg wt)</th> <th>K - 6.5 kW (g/kg wt)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>25</td> <td>25</td> <td>25</td> <td>65</td> <td>65</td> <td>65</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>20</td> <td>22</td> <td>22</td> <td>22</td> <td>60</td> <td>60</td> <td>60</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>30</td> <td>20</td> <td>20</td> <td>20</td> <td>62</td> <td>62</td> <td>62</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>40</td> <td>20</td> <td>20</td> <td>20</td> <td>58</td> <td>58</td> <td>58</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>50</td> <td>18</td> <td>18</td> <td>18</td> <td>45</td> <td>45</td> <td>45</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>60</td> <td>15</td> <td>15</td> <td>15</td> <td>38</td> <td>38</td> <td>38</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>70</td> <td>10</td> <td>10</td> <td>10</td> <td>30</td> <td>30</td> <td>30</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>75</td> <td>10</td> <td>10</td> <td>10</td> <td>28</td> <td>28</td> <td>28</td> <td>5</td> <td>5</td> <td>5</td> </tr> </tbody> </table>	Moisture content (%wt)	N - 3 kW (g/kg wt)	N - 5 kW (g/kg wt)	N - 6.5 kW (g/kg wt)	P - 3 kW (g/kg wt)	P - 5 kW (g/kg wt)	P - 6.5 kW (g/kg wt)	K - 3 kW (g/kg wt)	K - 5 kW (g/kg wt)	K - 6.5 kW (g/kg wt)	10	25	25	25	65	65	65	5	5	5	20	22	22	22	60	60	60	5	5	5	30	20	20	20	62	62	62	5	5	5	40	20	20	20	58	58	58	5	5	5	50	18	18	18	45	45	45	5	5	5	60	15	15	15	38	38	38	5	5	5	70	10	10	10	30	30	30	5	5	5	75	10	10	10	28	28	28	5	5	5	<p><b>Observations:</b></p> <ul style="list-style-type: none"> <li>○ Increase of nutrient content in wet basis as sludge dried</li> <li>○ Constant nutrient content in dry basis during drying</li> <li>○ No effect of MIR emitter power on the nutrient content</li> </ul>
Moisture content (%wt)	N - 3 kW (g/kg wt)	N - 5 kW (g/kg wt)	N - 6.5 kW (g/kg wt)	P - 3 kW (g/kg wt)	P - 5 kW (g/kg wt)	P - 6.5 kW (g/kg wt)	K - 3 kW (g/kg wt)	K - 5 kW (g/kg wt)	K - 6.5 kW (g/kg wt)																																																																																		
10	25	25	25	65	65	65	5	5	5																																																																																		
20	22	22	22	60	60	60	5	5	5																																																																																		
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40	20	20	20	58	58	58	5	5	5																																																																																		
50	18	18	18	45	45	45	5	5	5																																																																																		
60	15	15	15	38	38	38	5	5	5																																																																																		
70	10	10	10	30	30	30	5	5	5																																																																																		
75	10	10	10	28	28	28	5	5	5																																																																																		

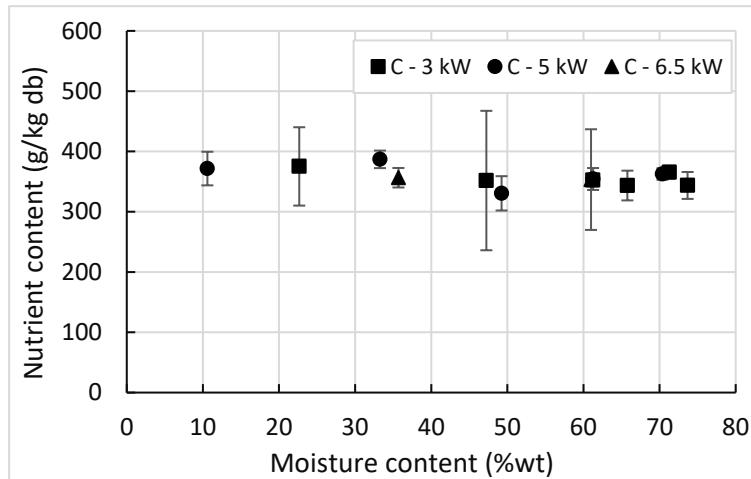


Carbon (C) content versus moisture content as a function of the MIR emitter power

**Wet basis**

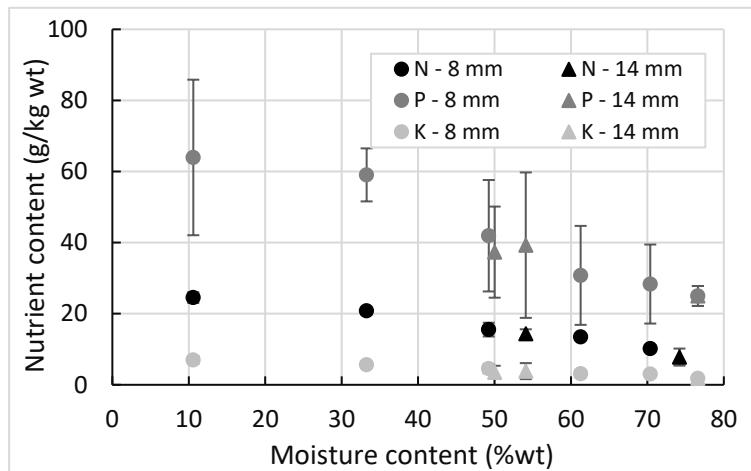


**Dry basis**



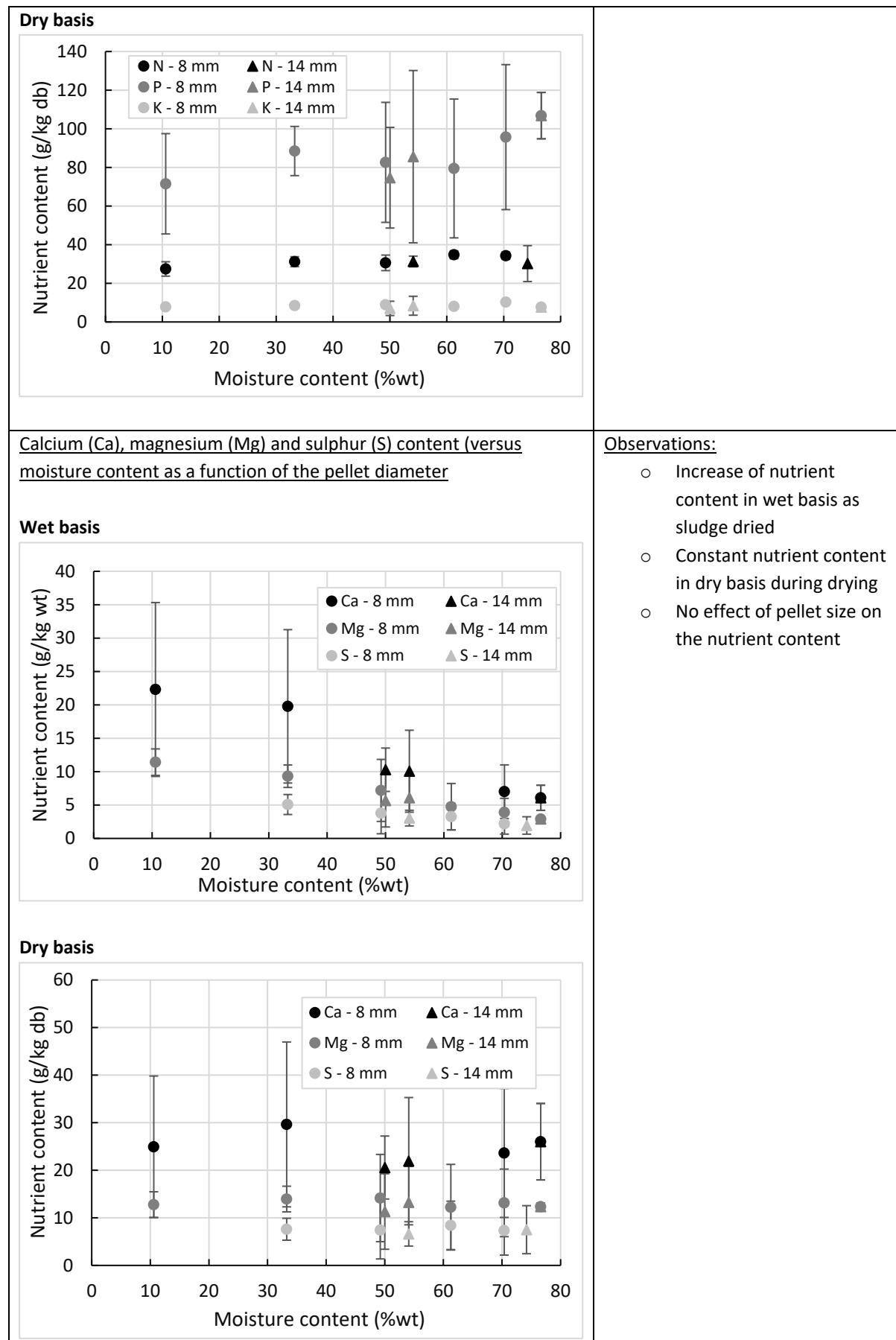
Nitrogen (N), phosphorous (P) and potassium (K) content versus moisture content as a function of the pellet diameter

**Wet basis**



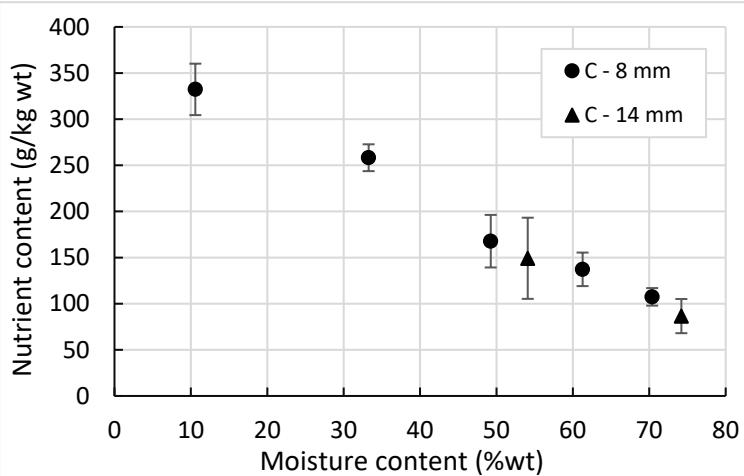
**Observations:**

- Increase of nutrient content in wet basis as sludge dried
- Constant nutrient content in dry basis during drying
- No effect of pellet size on the nutrient content

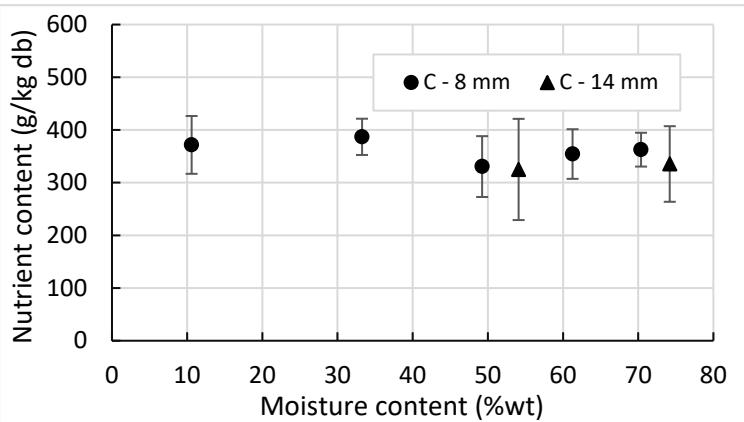


Carbon (C) content versus moisture content as a function of the pellet diameter

**Wet basis**



**Dry basis**



<u>General information</u>	
<b>Type of data</b>	Elemental nutrient content
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge collected from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 50% db
<b>Ash content</b>	~ 50% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom design convective drying rig
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0%</li> <li>○ Air velocity: 0.06 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10 and 14 mm diameter
<b>Analysed parameters</b>	Carbon (C), nitrogen (N), sulphur (S), Phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg)
<b>Employed methods</b>	<ol style="list-style-type: none"> <li>(1) Use of CNS analyzer (SOP 8.7.7.2)</li> <li>(2) Use of microwave plasma – atomic emission spectroscopy (SOP 8.7.7.1)</li> </ol>
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from vip latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

Septien, S., Mirara, S. W., Makununika, B., Singh, A., Pocock, J., Velkushanova, K., & Buckley, C. A. (2019). Effect of drying on the physical and chemical properties of faecal sludge for its reuse. Journal of Environmental Chemical Engineering, 103652.

### Data source files

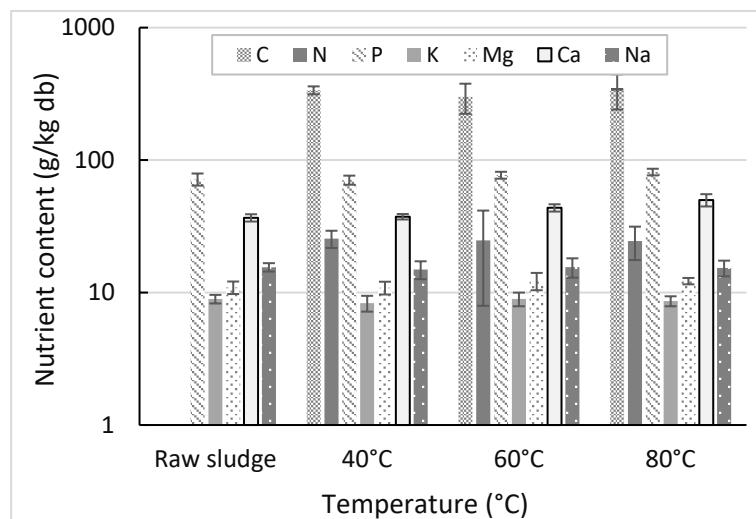
<https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0>

### Additional Notes

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### Description of Data

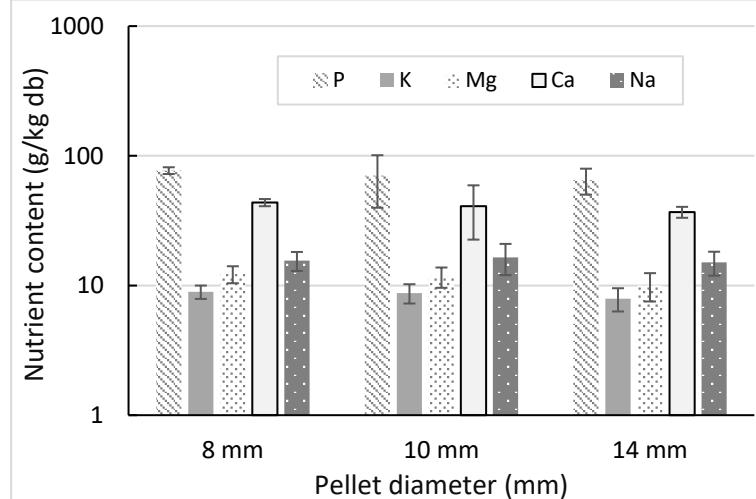
#### Nutrient content (in dry basis) as a function of temperature



#### Observations:

- Same nutrient content in dry basis between the raw and dried sludge
- No effect of drying temperature on the nutrient content

#### Nutrient content (in dry basis) as a function of pellet diameter



#### Observations:

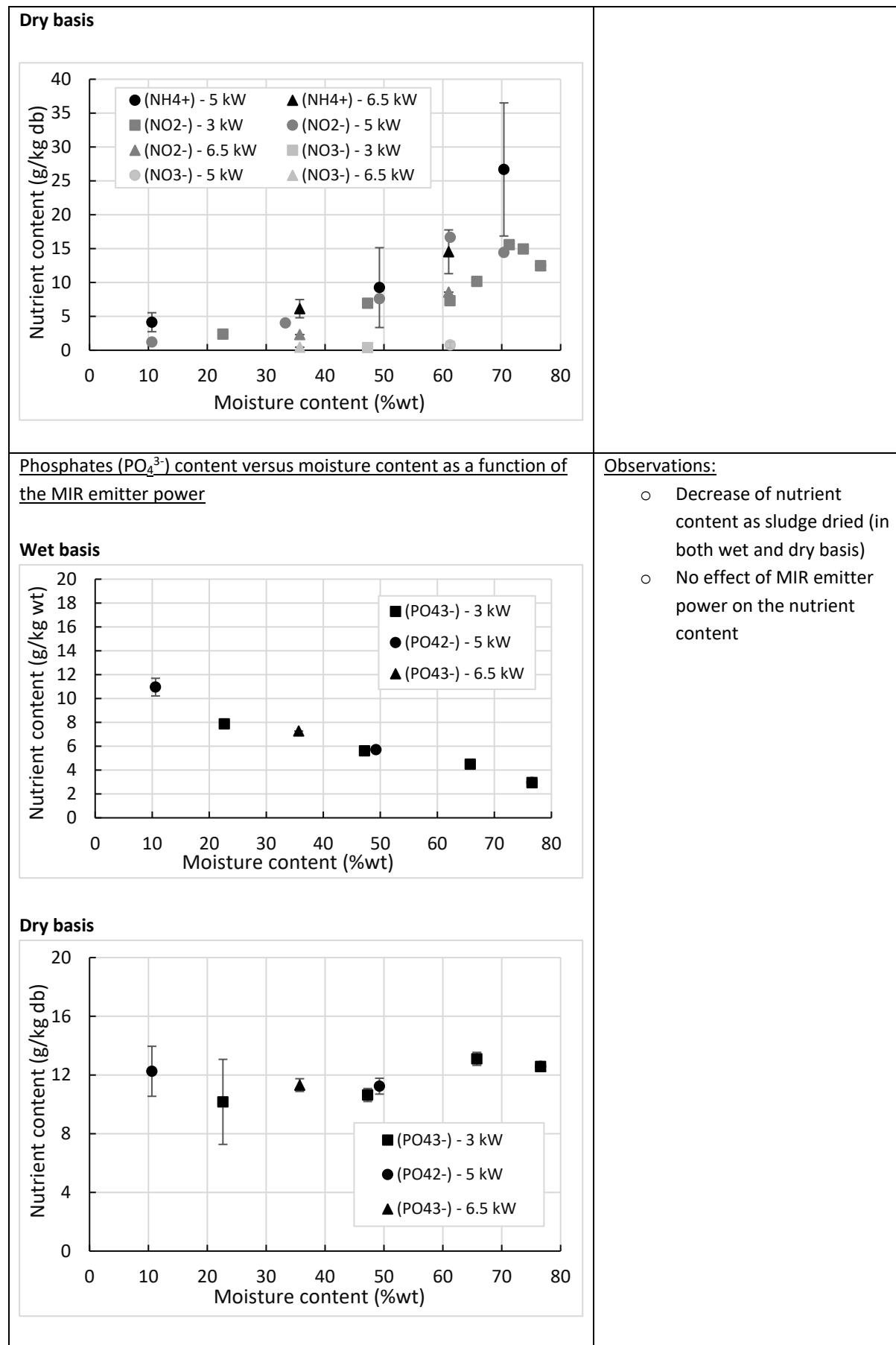
- Same nutrient content in dry basis between the raw and dried sludge
- No effect of pellet size on the nutrient content

<u>General information</u>	
<b>Type of data</b>	Elemental nutrient content
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, Durban South Africa
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 85% db
<b>Ash content</b>	~ 15% db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample placed in 1 L plastic bucket
<b>Analysed parameters</b>	Carbon (C), nitrogen (N), sulphur (S)
<b>Employed methods</b>	Use of CNS analyzer (SOP 8.7.7.2)
<u>Publications</u>	
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Moisture content (%wt)	Batch 1, Carbon (C) (g/g wt)	Batch 2, Carbon (C) (g/g wt)	Batch 1, Nitrogen (N) (g/g wt)	Batch 2, Nitrogen (N) (g/g wt)	Batch 1, Sulphur (S) (g/g wt)	Batch 2, Sulphur (S) (g/g wt)																																																																																																																									
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<u>General information</u>	
<b>Type of data</b>	Molecular nutrient content
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few years ago
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 70% db
<b>Ash content</b>	~ 30% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	0, 4, 9, 13, 17, 25, 40 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3, 5 and 6.5 kW (corresponding to ~ 85, 135 and 215°C respectively)</li> <li>○ Distance between the emitters and the sample: 115 mm</li> <li>○ Air stream flowrate: 18.3 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8 and 14 mm diameter
<b>Analysed parameters</b>	Ammonium (NH <sub>4</sub> <sup>+</sup> ), nitrites (NO <sub>2</sub> <sup>-</sup> ), nitrates (NO <sub>3</sub> <sup>-</sup> ), phosphates (PO <sub>4</sub> <sup>3-</sup> )
<b>Employed methods</b>	Use of spectrophotometer after blending the sample, centrifugation and recovery of the supernatant for analysis (SOP 8.7.5.1; 8.7.5.4; 8.7.5.10)

Publications																																																																
Mirara, S.W. (2017). Drying and Pasteurisation of VIP Latrine Faecal Sludge using a Bench Scale Medium Infrared Machine. Master thesis. University of KwaZulu-Natal, Durban, South Africa.																																																																
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Moisture content (%wt)	(NH4+) - 5 kW (g/kg wt)	(NH4+) - 6.5 kW (g/kg wt)	(NO2-) - 3 kW (g/kg wt)	(NO2-) - 5 kW (g/kg wt)	(NO3-) - 3 kW (g/kg wt)	(NO3-) - 5 kW (g/kg wt)																																																										
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<u>General information</u>	
<b>Type of data</b>	Molecular nutrient content
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 50% db
<b>Ash content</b>	~ 50% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom design convective drying rig
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0%</li> </ul> Air velocity: 0.06 cm/s
<b>Sample form in the dryer</b>	Pellets of 8 mm diameter
<b>Analysed parameters</b>	Ammonium ( $\text{NH}_4^+$ ), nitrites ( $\text{NO}_2^-$ ), nitrates ( $\text{NO}_3^-$ ), phosphates ( $\text{PO}_4^{3-}$ )
<b>Employed methods</b>	Use of spectrophotometer after blending the sample, centrifugation and recovery of the supernatant for analysis (SOP 8.7.5.1; 8.7.5.4; 8.7.5.10)
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

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#### Data source files

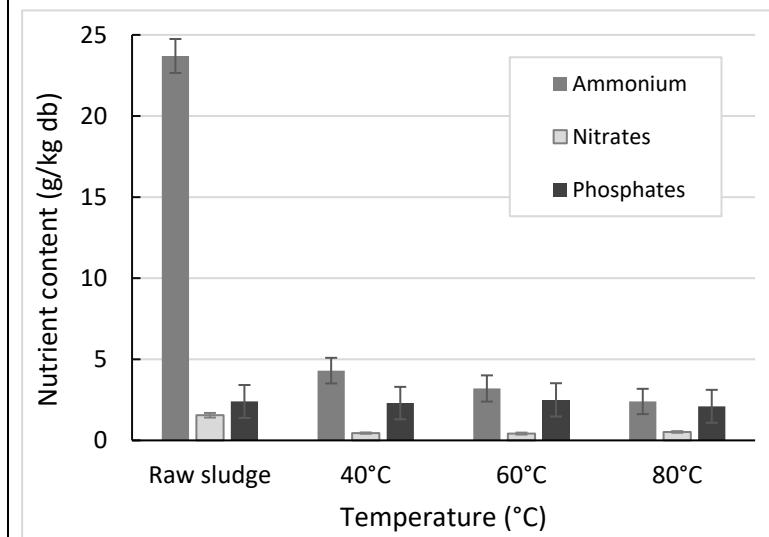
<https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0>

#### Additional Notes

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#### Description of Data

Ammonium ( $\text{NH}_4^+$ ), nitrates ( $\text{NO}_2^-$ ) and phosphates ( $\text{PO}_4^{3-}$ ) as a function of temperature



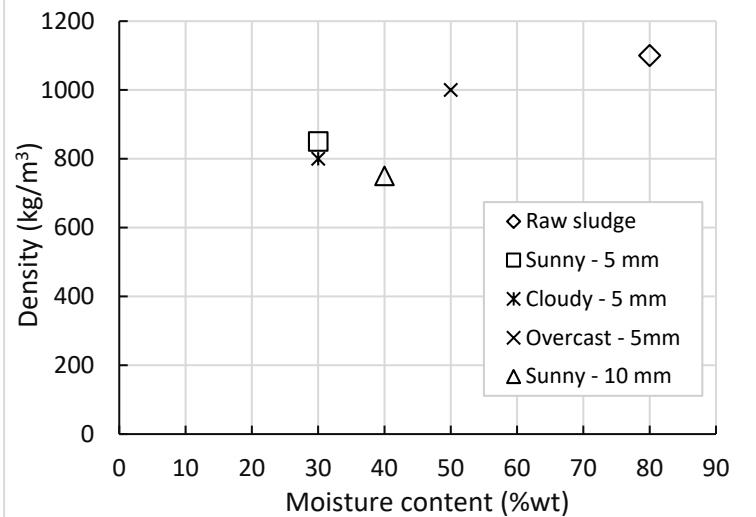
#### Observations:

- Decrease of  $\text{NH}_4^+$  and  $\text{NO}_2^-$  content in the dried sludge with respect to the raw material
- Same  $\text{PO}_4^{3-}$  content between the raw and dried sludge
- No effect of drying temperature on the nutrient content

<u>General information</u>	
<b>Type of data</b>	Molecular nutrient content
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 85% db
<b>Ash content</b>	~ 15% db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g sample in 1 L plastic bucket
<b>Analysed parameters</b>	Ammonium ( $\text{NH}_4^+$ ) and nitrates ( $\text{NO}_3^-$ )
<b>Employed methods</b>	Use of spectrophotometer after blending the sample (SOP 8.7.5.6 and 8.7.5.10)
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Moisture content (%wt)	Batch 1 Ammonia (NH4+) (g/g wt)	Batch 1 Nitrate (NO3-) (g/g wt)	Batch 2 Ammonia (NH4+) (g/g wt)	Batch 2 Nitrate (NO3-) (g/g wt)																																																																																																	
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<u>General information</u>	
<b>Type of data</b>	Density
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	3 to 5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: from 75 to 1000 W/m<sup>2</sup> (from overcast to sunny conditions)</li> <li>○ Air flowrate: 0.5 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 and 1 m/s)</li> <li>○ Air temperature: ambient (~20°C)</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form in the dryer</b>	Thin layer of 5 and 10 mm thickness, and 60 mm diameter
<b>Analysed parameters</b>	Density and Moisture content
<b>Employed method</b>	<ol style="list-style-type: none"> <li>(1) Measurement of the volume (through the measurement of dimensions) and weight of the sample (SOP 8.8.2.1)</li> <li>(2) Weighing the sample before and after oven drying at 105°C for 24 h (SOP 8.7.1.1)</li> </ol>

Publications																			
Mugauri, T.R. (2019). <i>Drying of faecal sludge from ventilated improved pit latrines (VIP latrines) using solar thermal energy</i> . MSc thesis, University of KwaZulu-Natal, South Africa.																			
Septien, S., Mugauri, T.R., Singh, A., Inambao, F. (2018). <i>Solar drying of faecal sludge from on-site sanitation facilities</i> . 5 <sup>th</sup> Southern Africa Solar Thermal Energy Conference, Durban, South Africa, 25-27 June.																			
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Data source files																			
<a href="https://www.dropbox.com/s/ssumqzociucjaj2/Shrinkage%20of%20VIP%20sludge%20%282017-2018%29.xlsx?dl=0">https://www.dropbox.com/s/ssumqzociucjaj2/Shrinkage%20of%20VIP%20sludge%20%282017-2018%29.xlsx?dl=0</a>																			
Additional Notes																			
<ul style="list-style-type: none"> <li>○ Low precision of the current method (rough estimation)</li> </ul>																			
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<u>Density versus the moisture content obtained after drying at the different conditions</u>  <table border="1"> <caption>Data points estimated from the scatter plot</caption> <thead> <tr> <th>Condition</th> <th>Moisture content (%wt)</th> <th>Density (kg/m³)</th> </tr> </thead> <tbody> <tr> <td>Raw sludge</td> <td>~80</td> <td>~1100</td> </tr> <tr> <td>Sunny - 5 mm</td> <td>~30</td> <td>~850</td> </tr> <tr> <td>Cloudy - 5 mm</td> <td>~30</td> <td>~800</td> </tr> <tr> <td>Overcast - 5mm</td> <td>~50</td> <td>~1000</td> </tr> <tr> <td>Sunny - 10 mm</td> <td>~40</td> <td>~750</td> </tr> </tbody> </table>	Condition	Moisture content (%wt)	Density (kg/m³)	Raw sludge	~80	~1100	Sunny - 5 mm	~30	~850	Cloudy - 5 mm	~30	~800	Overcast - 5mm	~50	~1000	Sunny - 10 mm	~40	~750	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Decrease of density as sample dried at lower moisture content</li> </ul>
Condition	Moisture content (%wt)	Density (kg/m³)																	
Raw sludge	~80	~1100																	
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<u>General information</u>	
<b>Type of data</b>	Density
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory scale solar convective drying rig
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: 800 – 1300 W/m<sup>2</sup> (sunny conditions)</li> <li>○ Air flowrate: 0.5 and 1 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 and 1 m/s)</li> <li>○ Air temperature: ambient (~20°C), 40 and 80°C</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form</b>	Thin layer of 5 mm thickness and 110 mm diameter
<b>Analysed parameters</b>	Density
<b>Employed method</b>	Measurement of the volume (through the measurement of dimensions) and weight of the sample (SOP 8.8.2.1)
<u>Publications</u>	
-	

<u>Data source files</u>																																											
<a href="https://www.dropbox.com/s/gscuvzvus55zfsr/2019-2020%20VIP%20Shrinkage%20data.xlsx?dl=0">https://www.dropbox.com/s/gscuvzvus55zfsr/2019-2020%20VIP%20Shrinkage%20data.xlsx?dl=0</a>																																											
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Moisture content (%wt)	0.5m/s ambient temp (kg/m³)	0.5m/s 40deg C (kg/m³)	0.5m/s 80 degC (kg/m³)	1m/s ambient temp (kg/m³)	1m/s 40 deg C (kg/m³)	1m/s 80deg C (kg/m³)																																					
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<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until completely dry
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

<u>Data source files</u>											
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<u>Additional Notes</u>											
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<u>Description of Data</u>											
<p>Gross calorific value as a function of temperature</p> <table border="1"><thead><tr><th>Temperature (°C)</th><th>Calorific value (MJ/kg db)</th></tr></thead><tbody><tr><td>50</td><td>~18.5</td></tr><tr><td>100</td><td>~17.0</td></tr><tr><td>150</td><td>~18.5</td></tr><tr><td>200</td><td>~14.5</td></tr></tbody></table>	Temperature (°C)	Calorific value (MJ/kg db)	50	~18.5	100	~17.0	150	~18.5	200	~14.5	<p>Observations:</p> <ul style="list-style-type: none"><li>○ Similar gross calorific value between 50 and 150°C</li><li>○ Significant decrease at 200°C (possible thermal degradation)</li></ul>
Temperature (°C)	Calorific value (MJ/kg db)										
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<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

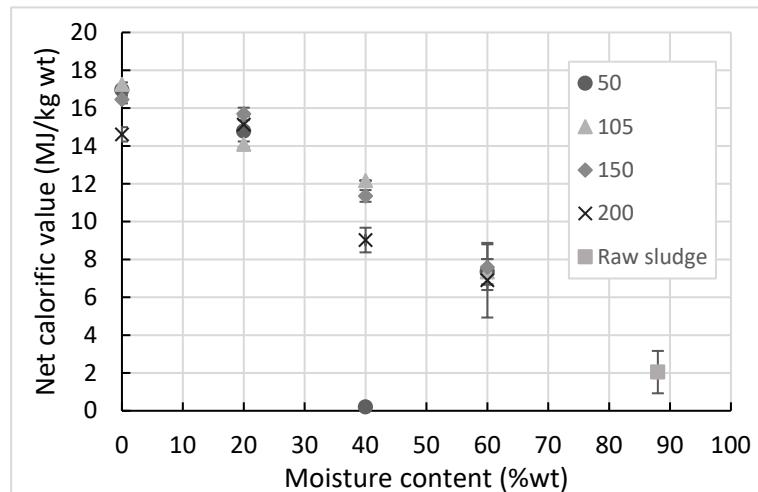
#### Additional Notes

-

#### Description of Data

##### Calorific value as a function of moisture content and temperature

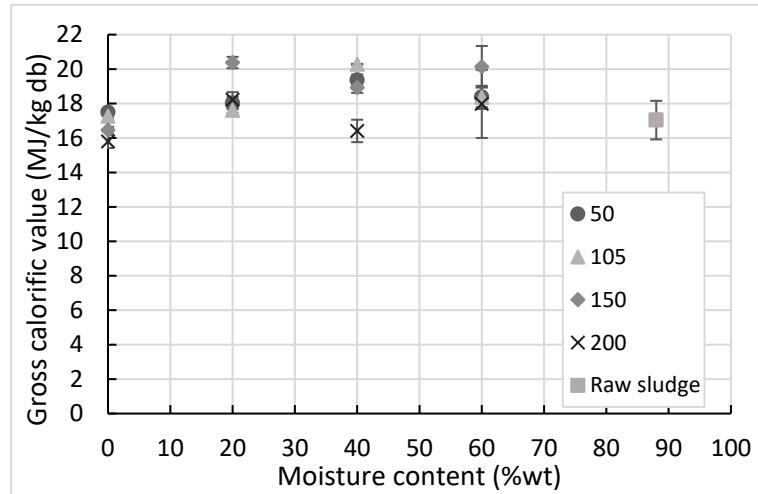
###### **Wet basis**



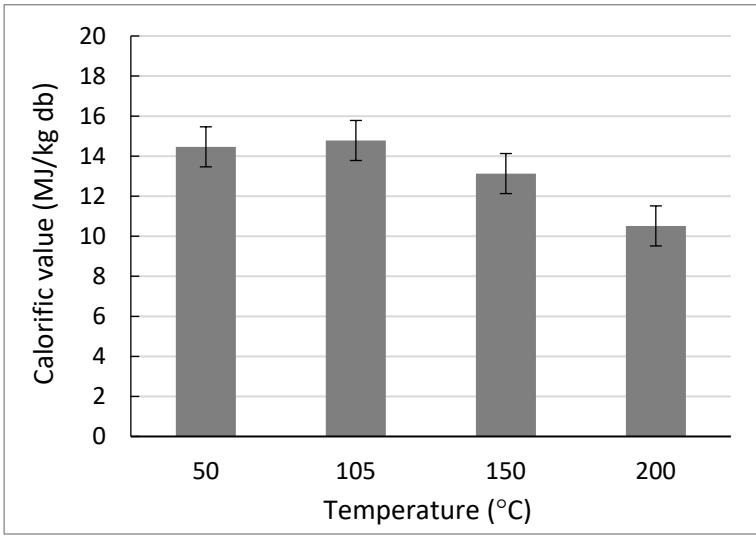
###### Observations:

- Increase of net calorific value as sludge dried
- Constant gross calorific value as sludge dried
- No effect of temperature

###### **Dry basis**



<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until completely dry
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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<u>Description of Data</u>											
Gross calorific value as a function of temperature	<p>Observations:</p> <ul style="list-style-type: none"><li>○ Similar gross calorific value between 50 and 150°C</li><li>○ Significant decrease at 200°C (possible thermal degradation)</li></ul>										
 <table border="1"><caption>Data extracted from the bar chart</caption><thead><tr><th>Temperature (°C)</th><th>Calorific value (MJ/kg db)</th></tr></thead><tbody><tr><td>50</td><td>~14.5</td></tr><tr><td>105</td><td>~14.8</td></tr><tr><td>150</td><td>~13.2</td></tr><tr><td>200</td><td>~10.5</td></tr></tbody></table>	Temperature (°C)	Calorific value (MJ/kg db)	50	~14.5	105	~14.8	150	~13.2	200	~10.5	
Temperature (°C)	Calorific value (MJ/kg db)										
50	~14.5										
105	~14.8										
150	~13.2										
200	~10.5										

<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

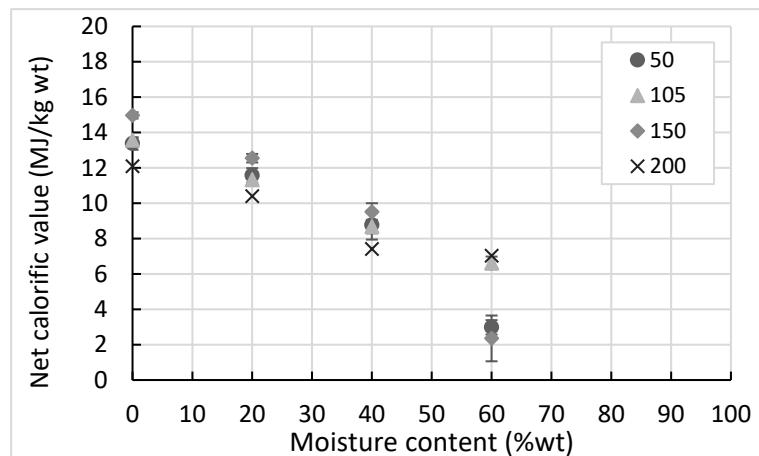
#### Additional Notes

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#### Description of Data

##### Calorific value as a function of moisture content and temperature

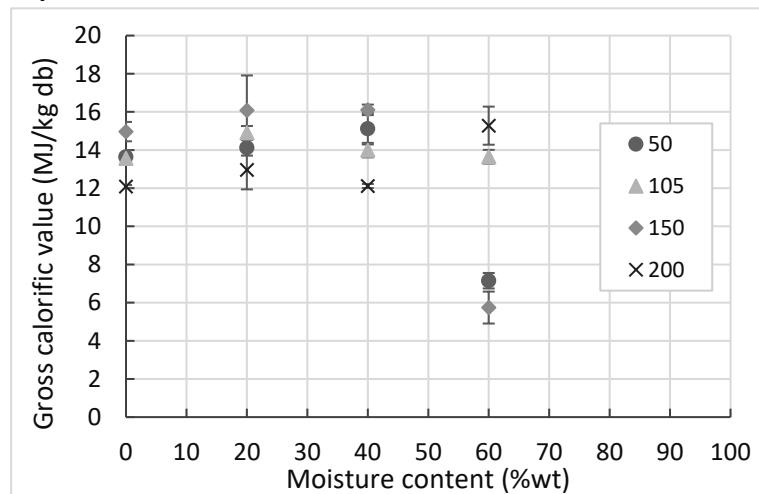
###### **Wet basis**



###### **Observations:**

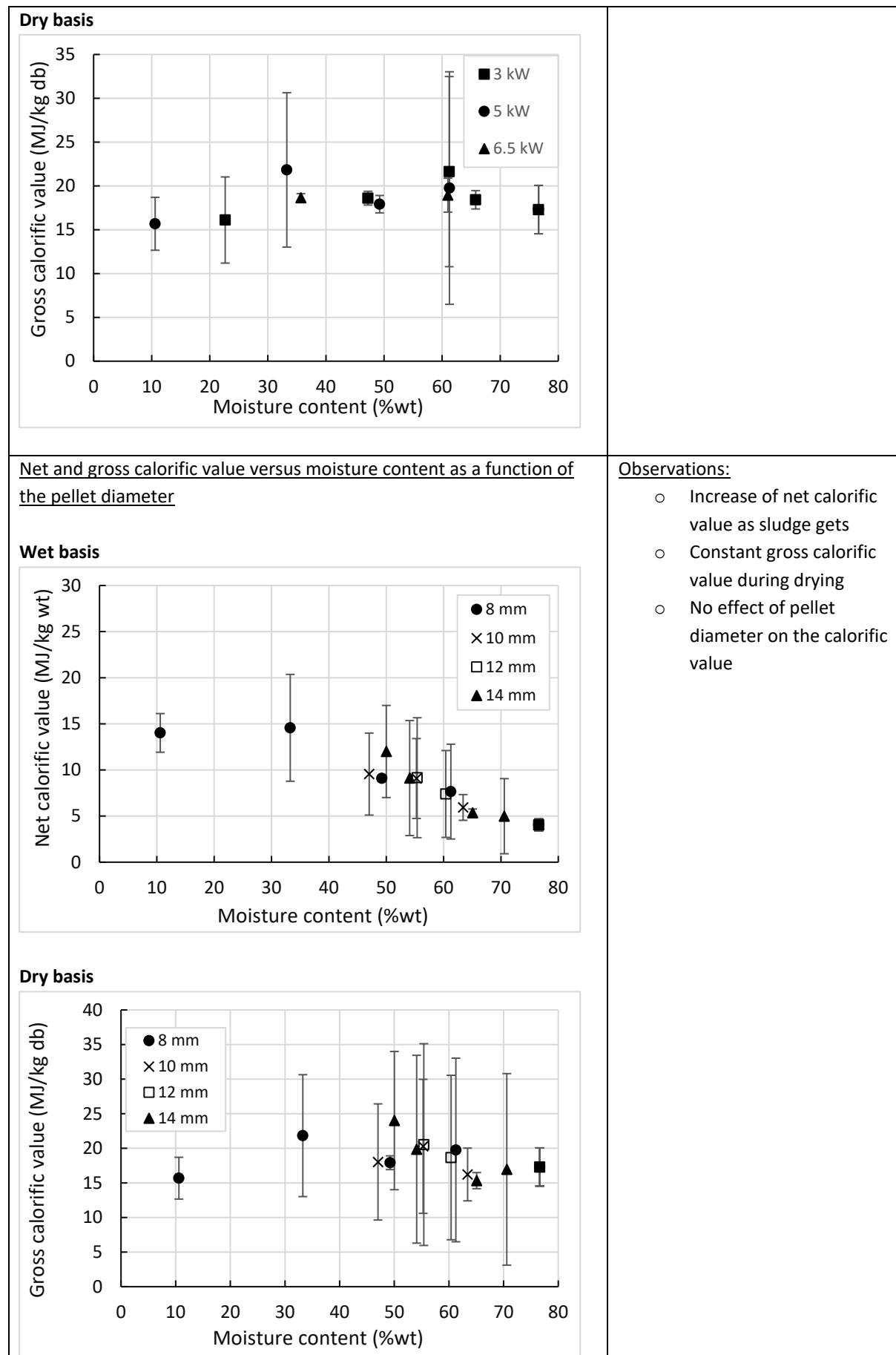
- Increase of net calorific value as sludge dried
- Constant gross calorific value as sludge dried
- No effect of temperature
- Possible experimental error for 60%wt sample at 50 and 150°C

###### **Dry basis**



<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80% wt
<b>Total solids content</b>	~ 20% wt
<b>Volatile solids content</b>	~ 70% db
<b>Ash content</b>	~ 30% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	0, 4, 9, 13, 17, 25, 40 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3, 5 and 6.5 kW (corresponding to ~ 85, 135 and 215°C respectively)</li> <li>○ Distance between the emitters and the sample: 115 mm</li> <li>○ Air stream flowrate: 18.3 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10, 12 and 14 mm diameter
<b>Analysed parameters</b>	Calorific Value
<b>Employed methods</b>	Use of calorimeter (SOP 8.8.1.1)

<u>Publications</u>																													
Mirara, S.W. (2017). Drying and Pasteurisation of VIP Latrine Faecal Sludge using a Bench Scale Medium Infrared Machine. Master thesis. University of KwaZulu-Natal, Durban, South Africa.																													
Septien, S., Mirara, S.W., Singh, A., Velkushanova, K., & Buckley, C. (2018). Characterisation of On-Site Sanitation Material and Products: VIP Latrines and Pour-Flush Toilets. WRC project final report. South Africa.																													
Septien, S., Mirara, S. W., Makununika, B., Singh, A., Pocock, J., Velkushanova, K., & Buckley, C. A. (2019). Effect of drying on the physical and chemical properties of faecal sludge for its reuse. Journal of Environmental Chemical Engineering, 103652.																													
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<u>Description of Data</u>																													
<u>Calorific value (wet and dry basis respectively) versus moisture content as a function of the MIR emitter power</u> <p><b>Wet basis</b></p> <table border="1"> <caption>Estimated data points from the scatter plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>3 kW (Net calorific value MJ/kg wt)</th> <th>5 kW (Net calorific value MJ/kg wt)</th> <th>6.5 kW (Net calorific value MJ/kg wt)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>12.5</td> <td>14.0</td> <td>-</td> </tr> <tr> <td>25</td> <td>12.5</td> <td>-</td> <td>-</td> </tr> <tr> <td>35</td> <td>-</td> <td>14.5</td> <td>12.0</td> </tr> <tr> <td>50</td> <td>10.0</td> <td>9.5</td> <td>-</td> </tr> <tr> <td>60</td> <td>8.0</td> <td>8.5</td> <td>-</td> </tr> <tr> <td>75</td> <td>4.0</td> <td>-</td> <td>-</td> </tr> </tbody> </table>	Moisture content (%wt)	3 kW (Net calorific value MJ/kg wt)	5 kW (Net calorific value MJ/kg wt)	6.5 kW (Net calorific value MJ/kg wt)	10	12.5	14.0	-	25	12.5	-	-	35	-	14.5	12.0	50	10.0	9.5	-	60	8.0	8.5	-	75	4.0	-	-	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Increase of net calorific value as sludge dried</li> <li>○ Constant gross calorific value during drying</li> <li>○ No effect of MIR emitter power on the calorific value</li> </ul>
Moisture content (%wt)	3 kW (Net calorific value MJ/kg wt)	5 kW (Net calorific value MJ/kg wt)	6.5 kW (Net calorific value MJ/kg wt)																										
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<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal Durban, South Africa
<b>Dates of the experiments</b>	2015-2016
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom design convective drying rig
<b>Drying time</b>	Until mass stabilisation
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0%</li> <li>○ Air velocity: 0.06 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10 and 14 mm diameter
<b>Analysed parameters</b>	Calorific Value
<b>Employed methods</b>	Use of calorimeter (SOP 8.8.1.1)
<u>Publications</u>	
-	

<u>Data source files</u>									
<a href="https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0">https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0</a>									
<u>Additional Notes</u>									
<ul style="list-style-type: none"><li>○ Sludge almost completely dried</li></ul>									
<u>Description of Data</u>									
<p>Calorific value as a function of temperature</p> <table border="1"><thead><tr><th>Temperature (°C)</th><th>Calorific Value (kJ/kg)</th></tr></thead><tbody><tr><td>40°C</td><td>~12.5</td></tr><tr><td>60°C</td><td>~13.2</td></tr><tr><td>80°C</td><td>~13.5</td></tr></tbody></table>	Temperature (°C)	Calorific Value (kJ/kg)	40°C	~12.5	60°C	~13.2	80°C	~13.5	<p>Observations:</p> <ul style="list-style-type: none"><li>○ No effect of temperature and pellet size on the calorific value</li></ul>
Temperature (°C)	Calorific Value (kJ/kg)								
40°C	~12.5								
60°C	~13.2								
80°C	~13.5								
<p>Calorific value as a function of pellet diameter</p> <table border="1"><thead><tr><th>Pellet diameter (mm)</th><th>Calorific Value (kJ/kg)</th></tr></thead><tbody><tr><td>8 mm</td><td>~12.2</td></tr><tr><td>10 mm</td><td>~11.8</td></tr><tr><td>14 mm</td><td>~8.5</td></tr></tbody></table>	Pellet diameter (mm)	Calorific Value (kJ/kg)	8 mm	~12.2	10 mm	~11.8	14 mm	~8.5	
Pellet diameter (mm)	Calorific Value (kJ/kg)								
8 mm	~12.2								
10 mm	~11.8								
14 mm	~8.5								

<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 40%db
<b>Ash content</b>	~ 60%db
<b>Presence of trash?</b>	Yes (mainly hair extensions and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

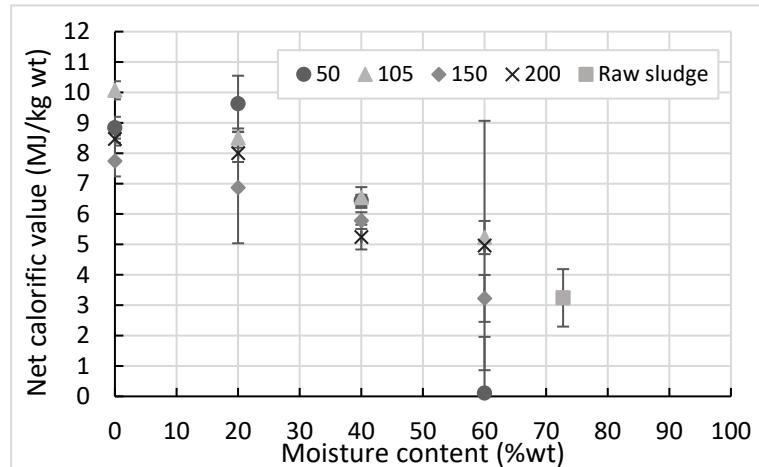
#### Additional Notes

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#### Description of Data

##### Calorific value as a function of moisture content and temperature

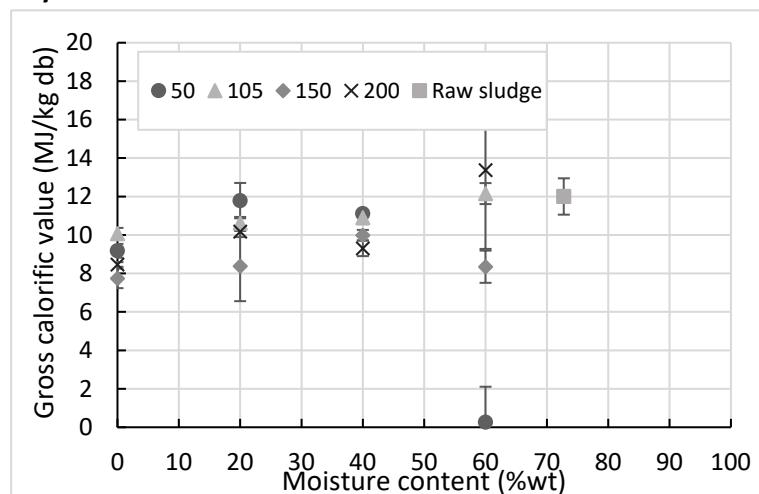
###### **Wet basis**



###### Observations:

- Increase of net calorific value as sludge dried
- Constant gross calorific value as sludge dried
- No effect of temperature
- Possible experimental error for 60%wt sample at 50°C

###### **Dry basis**



<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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<a href="https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0</a>											
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-											
<u>Description of Data</u>											
<p>Gross calorific value as a function of temperature</p> <table border="1"><caption>Data extracted from the bar chart</caption><thead><tr><th>Temperature (°C)</th><th>Calorific value (MJ/kg db)</th></tr></thead><tbody><tr><td>50</td><td>~15.5</td></tr><tr><td>105</td><td>~15.2</td></tr><tr><td>150</td><td>~14.5</td></tr><tr><td>200</td><td>~10.5</td></tr></tbody></table>	Temperature (°C)	Calorific value (MJ/kg db)	50	~15.5	105	~15.2	150	~14.5	200	~10.5	<p>Observations:</p> <ul style="list-style-type: none"><li>○ Similar gross calorific value between 50 and 150°C</li><li>○ Significant decrease at 200°C (possible thermal degradation)</li></ul>
Temperature (°C)	Calorific value (MJ/kg db)										
50	~15.5										
105	~15.2										
150	~14.5										
200	~10.5										

<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1)
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-	

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Moisture content (%)	50°C (MJ/kg wt)	105°C (MJ/kg wt)	150°C (MJ/kg wt)	200°C (MJ/kg wt)	Initial sample (MJ/kg wt)																																																																				
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60	15.5	16.0	14.5	16.0	21.5																																																																				
80	-	-	-	-	21.0																																																																				

<u>General information</u>	
<b>Type of data</b>	Calorific value
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample in 1 L plastic bucket
<b>Analysed parameters</b>	Calorific value
<b>Employed method</b>	Use of calorimeter bomb <i>Parr 6200</i> (SOP 8.8.1.1.)
<u>Publications</u>	
-	

Data source files																																																													
<a href="https://www.dropbox.com/s/xbv6su0jxsiok/2019-2020Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PR_G.xlsx?dl=0">https://www.dropbox.com/s/xbv6su0jxsiok/2019-2020Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PR_G.xlsx?dl=0</a>																																																													
Additional Notes																																																													
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ Containers with the sample placed in a ventilated area</li> <li>○ Mesh placed at the opening of the container to avoid the development of maggots</li> <li>○ Samples from batch 1 analysed in a weekly basis for 16 weeks</li> <li>○ Samples from batch 2 analysed at days 0, 3, 5 and 7 during one week</li> </ul>																																																													
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<p><u>Calorific value as a function of moisture content of the faeces for the samples from batch 1 and 2</u></p> <p><b>Wet basis</b></p> <table border="1"> <caption>Data points estimated from the wet basis plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Batch 1 (MJ/kg wt)</th> <th>Batch 2 (MJ/kg wt)</th> </tr> </thead> <tbody> <tr><td>28</td><td>16.0</td><td></td></tr> <tr><td>40</td><td>13.0</td><td></td></tr> <tr><td>50</td><td>10.0</td><td></td></tr> <tr><td>55</td><td>9.5</td><td></td></tr> <tr><td>60</td><td>8.5</td><td></td></tr> <tr><td>65</td><td>7.5</td><td></td></tr> <tr><td>70</td><td>6.5</td><td></td></tr> <tr><td>75</td><td>5.5</td><td>5.5</td></tr> <tr><td>78</td><td>5.0</td><td>5.0</td></tr> </tbody> </table> <p><b>Dry basis</b></p> <table border="1"> <caption>Data points estimated from the dry basis plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Batch 1 (MJ/kg db)</th> <th>Batch 2 (MJ/kg db)</th> </tr> </thead> <tbody> <tr><td>28</td><td>22.0</td><td></td></tr> <tr><td>40</td><td>22.0</td><td></td></tr> <tr><td>50</td><td>21.0</td><td></td></tr> <tr><td>55</td><td>22.5</td><td></td></tr> <tr><td>60</td><td>21.5</td><td></td></tr> <tr><td>65</td><td>21.5</td><td></td></tr> <tr><td>70</td><td>21.5</td><td></td></tr> <tr><td>75</td><td>22.5</td><td>22.5</td></tr> <tr><td>78</td><td>21.5</td><td>22.5</td></tr> </tbody> </table>	Moisture content (%wt)	Batch 1 (MJ/kg wt)	Batch 2 (MJ/kg wt)	28	16.0		40	13.0		50	10.0		55	9.5		60	8.5		65	7.5		70	6.5		75	5.5	5.5	78	5.0	5.0	Moisture content (%wt)	Batch 1 (MJ/kg db)	Batch 2 (MJ/kg db)	28	22.0		40	22.0		50	21.0		55	22.5		60	21.5		65	21.5		70	21.5		75	22.5	22.5	78	21.5	22.5	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Increase of net calorific value by decreasing the moisture content during drying</li> <li>○ Constant gross calorific value during drying</li> </ul>
Moisture content (%wt)	Batch 1 (MJ/kg wt)	Batch 2 (MJ/kg wt)																																																											
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<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

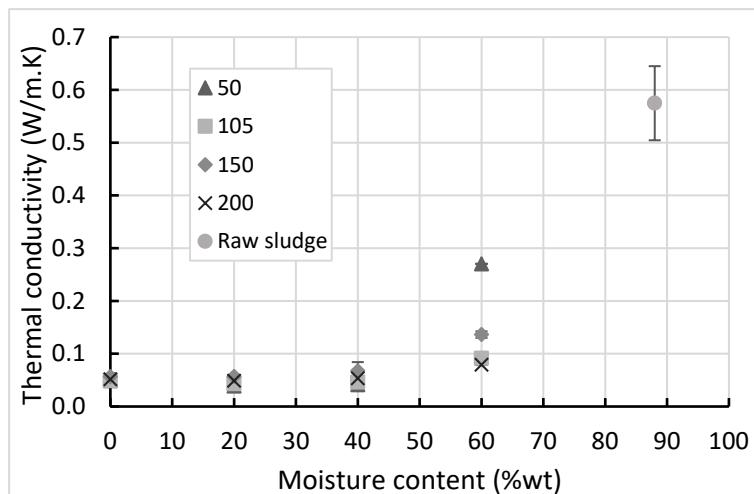
[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

#### Additional Notes

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#### Description of Data

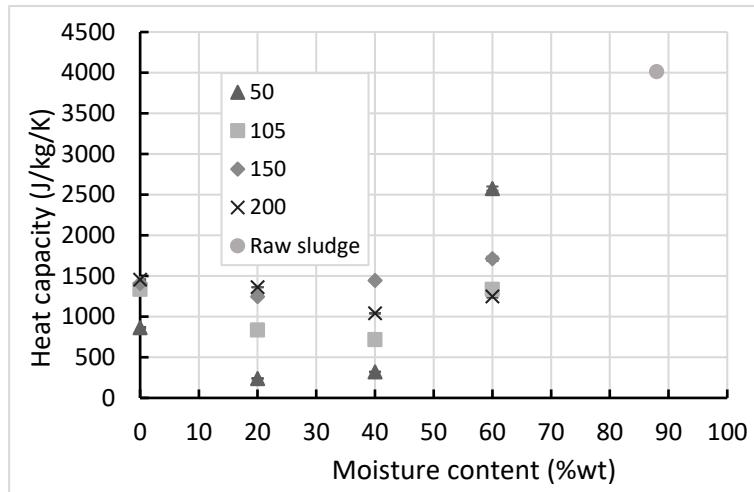
##### Thermal conductivity as a function of moisture content and temperature



##### Observations:

- Decrease of the thermal conductivity as sludge dried until achieving 40%wt moisture content
- Stabilization of thermal conductivity below 40%wt
- No clear trend with the heat capacity
- No effect of temperature on the thermal conductivity and heat capacity

##### Heat capacity as a function of moisture content and temperature



<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

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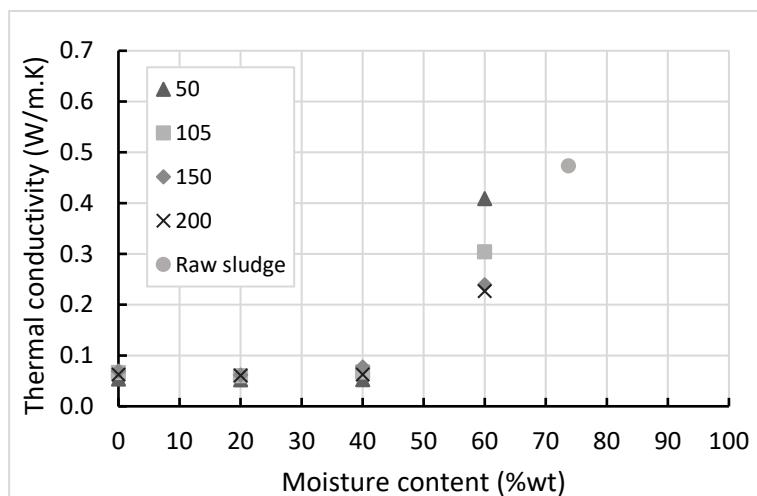
[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

#### Additional Notes

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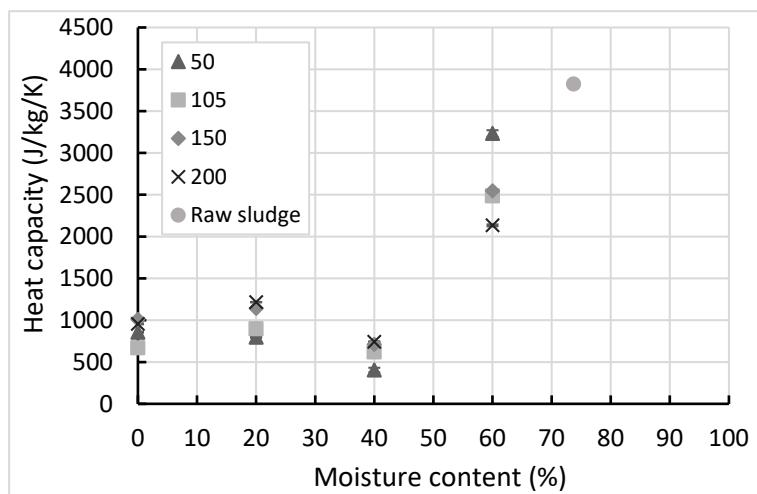
##### Thermal conductivity as a function of moisture content and temperature



##### Observations:

- Decrease of the thermal conductivity and heat capacity as sludge dried until achieving 40%wt moisture content
- Stabilization below 40%wt
- No effect of temperature

##### Heat capacity as a function of moisture content and temperature



<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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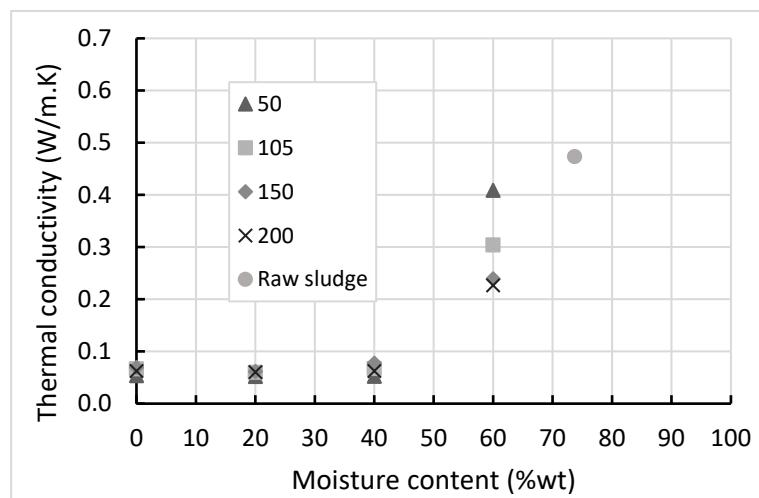
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#### Additional Notes

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#### Description of Data

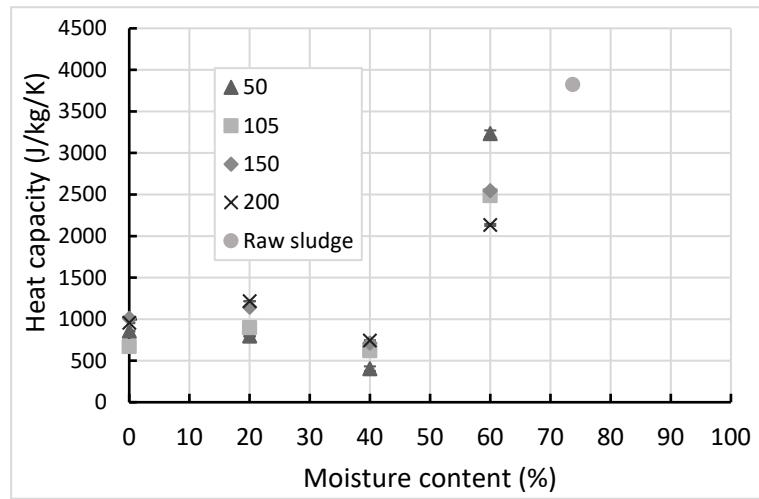
##### Thermal conductivity as a function of moisture content and temperature



##### Observations:

- Decrease of the thermal conductivity and heat capacity as sludge dried until achieving 40%wt moisture content
- Stabilization below 40%wt
- No effect of temperature

##### Heat capacity as a function of moisture content and temperature



<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

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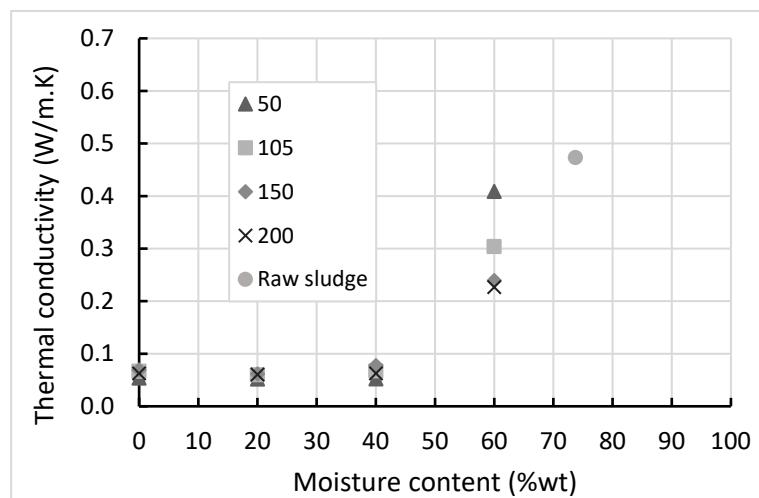
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#### Additional Notes

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#### Description of Data

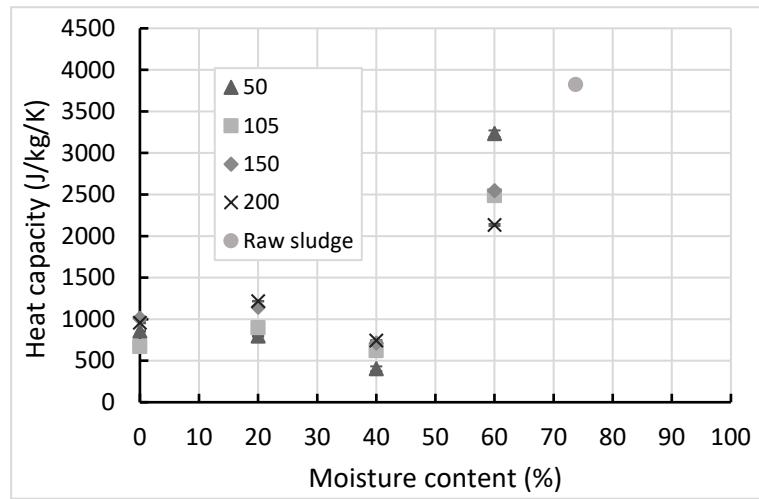
##### Thermal conductivity as a function of moisture content and temperature



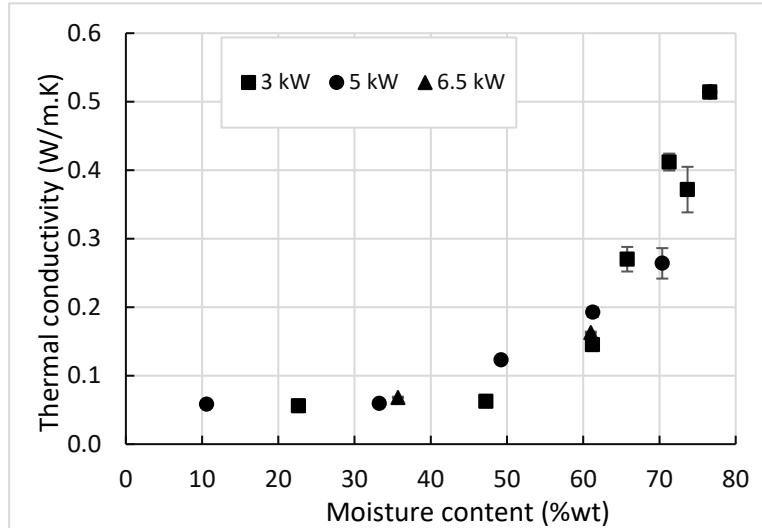
##### Observations:

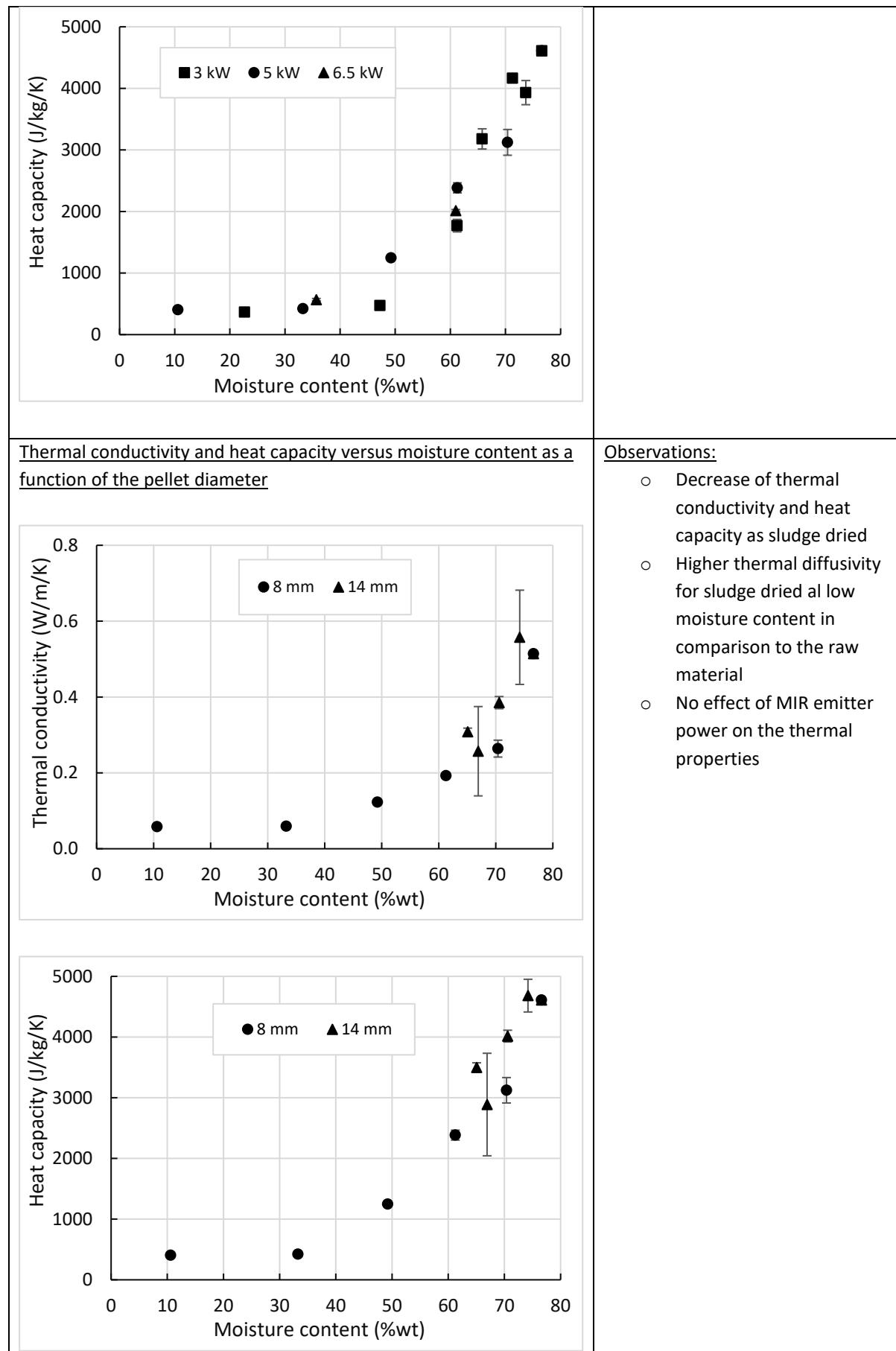
- Decrease of the thermal conductivity and heat capacity as sludge dried until achieving 40%wt moisture content
- Stabilization below 40%wt
- No effect of temperature

##### Heat capacity as a function of moisture content and temperature



<u>General information</u>	
<b>Type of data</b>	Thermal properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2015-2016
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~80% wt
<b>Total solids content</b>	~20% wt
<b>Volatile solids content</b>	~70% db
<b>Ash content</b>	~30% db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	0, 4, 9, 13, 17, 25, 40 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3, 5 and 6.5 kW (corresponding to ~ 85, 135 and 215°C respectively)</li> <li>○ Distance between the emitters and the sample: 115 mm</li> <li>○ Air stream flowrate: 18.3 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8 and 14 mm diameter
<b>Analysed parameters</b>	Thermal properties
<b>Employed methods</b>	Use of a modified transient plane source technique analyser C-Therm TCi (SOP 8.8.6.1)

Publications																																									
Mirara, S.W. (2017). Drying and Pasteurisation of VIP Latrine Faecal Sludge using a Bench Scale Medium Infrared Machine. Master thesis. University of KwaZulu-Natal, Durban, South Africa.																																									
Septien, S., Mirara, S.W., Singh, A., Velkushanova, K., & Buckley, C. (2018). Characterisation of On-Site Sanitation Material and Products: VIP Latrines and Pour-Flush Toilets. WRC project final report. South Africa.																																									
Septien, S., Mirara, S. W., Makununika, B., Singh, A., Pocock, J., Velkushanova, K., & Buckley, C. A. (2019). Effect of drying on the physical and chemical properties of faecal sludge for its reuse. Journal of Environmental Chemical Engineering, 103652.																																									
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<u>Thermal conductivity and heat capacity versus moisture content as a function of the MIR emitter power</u>  <table border="1"> <caption>Data extracted from the scatter plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>3 kW (W/m.K)</th> <th>5 kW (W/m.K)</th> <th>6.5 kW (W/m.K)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>~0.05</td> <td>~0.06</td> <td>-</td> </tr> <tr> <td>25</td> <td>~0.06</td> <td>-</td> <td>-</td> </tr> <tr> <td>35</td> <td>-</td> <td>~0.06</td> <td>~0.07</td> </tr> <tr> <td>50</td> <td>~0.07</td> <td>~0.12</td> <td>-</td> </tr> <tr> <td>60</td> <td>~0.15</td> <td>~0.18</td> <td>-</td> </tr> <tr> <td>65</td> <td>~0.27</td> <td>~0.27</td> <td>-</td> </tr> <tr> <td>70</td> <td>~0.42</td> <td>~0.27</td> <td>-</td> </tr> <tr> <td>75</td> <td>~0.38</td> <td>~0.27</td> <td>-</td> </tr> <tr> <td>78</td> <td>~0.52</td> <td>-</td> <td>-</td> </tr> </tbody> </table>	Moisture content (%wt)	3 kW (W/m.K)	5 kW (W/m.K)	6.5 kW (W/m.K)	10	~0.05	~0.06	-	25	~0.06	-	-	35	-	~0.06	~0.07	50	~0.07	~0.12	-	60	~0.15	~0.18	-	65	~0.27	~0.27	-	70	~0.42	~0.27	-	75	~0.38	~0.27	-	78	~0.52	-	-	<u>Observations:</u> <ul style="list-style-type: none"> <li>Decrease of thermal conductivity and heat capacity as sludge dried</li> <li>Higher thermal diffusivity for sludge dried at low moisture content in comparison to the raw material</li> <li>No effect of MIR emitter power on the thermal properties</li> </ul>
Moisture content (%wt)	3 kW (W/m.K)	5 kW (W/m.K)	6.5 kW (W/m.K)																																						
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<u>General information</u>	
<b>Type of data</b>	Thermal properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2015-2016
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom design convective drying rig
<b>Drying time</b>	(1) Until mass stabilization (2) Stopped at different moisture contents (8, 32, 58, 75%wt)
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0%</li> <li>○ Air velocity: 0.06 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 12 and 14 mm diameter
<b>Analysed parameters</b>	Thermal properties
<b>Employed methods</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

Septien, S., Mirara, S. W., Makununika, B., Singh, A., Pocock, J., Velkushanova, K., & Buckley, C. A. (2019). Effect of drying on the physical and chemical properties of faecal sludge for its reuse. Journal of Environmental Chemical Engineering, 103652.

#### Data source files

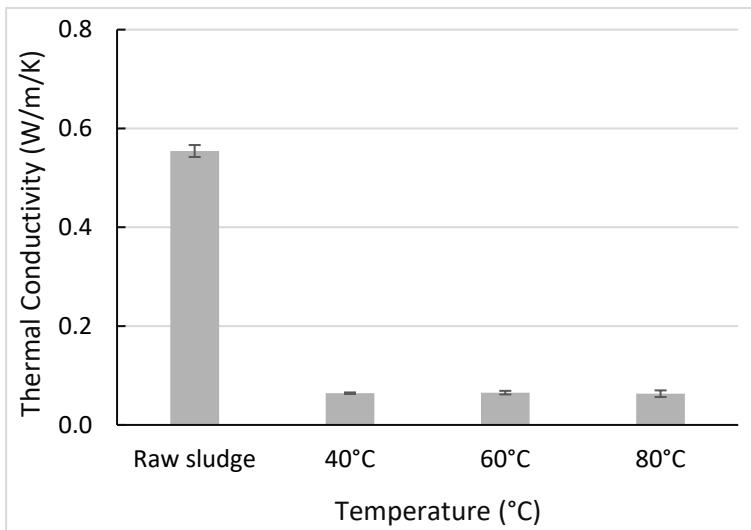
<https://www.dropbox.com/s/2dg6xp8s0m5pfse/2014-2015%20VIP%20Physicochemical%20properties.xlsx?dl=0>

#### Additional Notes

-

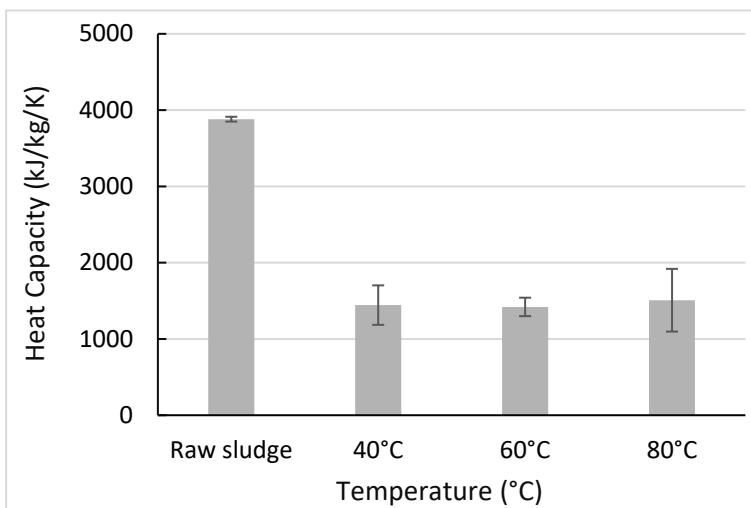
#### Description of Data

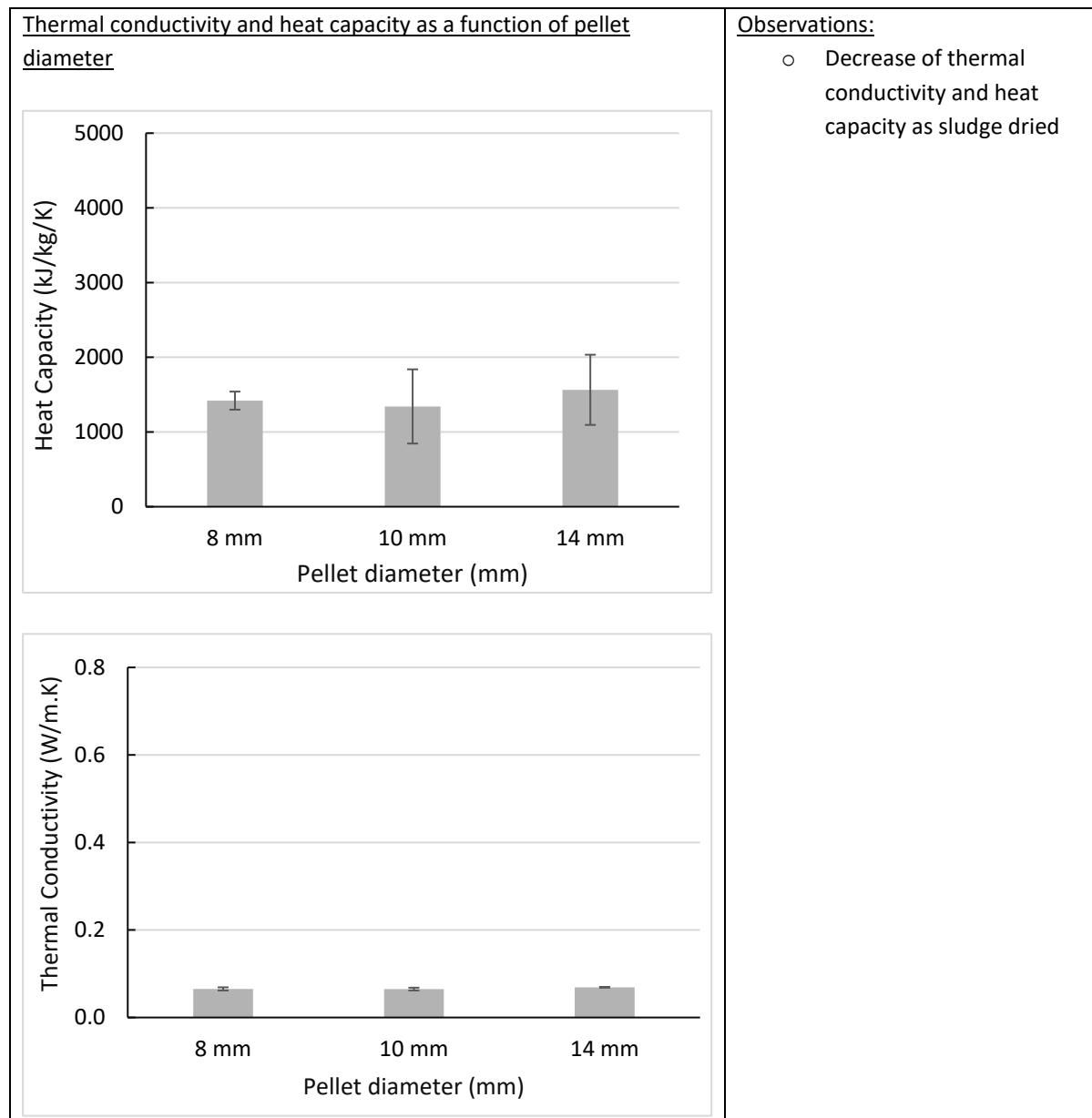
##### Thermal conductivity and heat capacity as a function of temperature

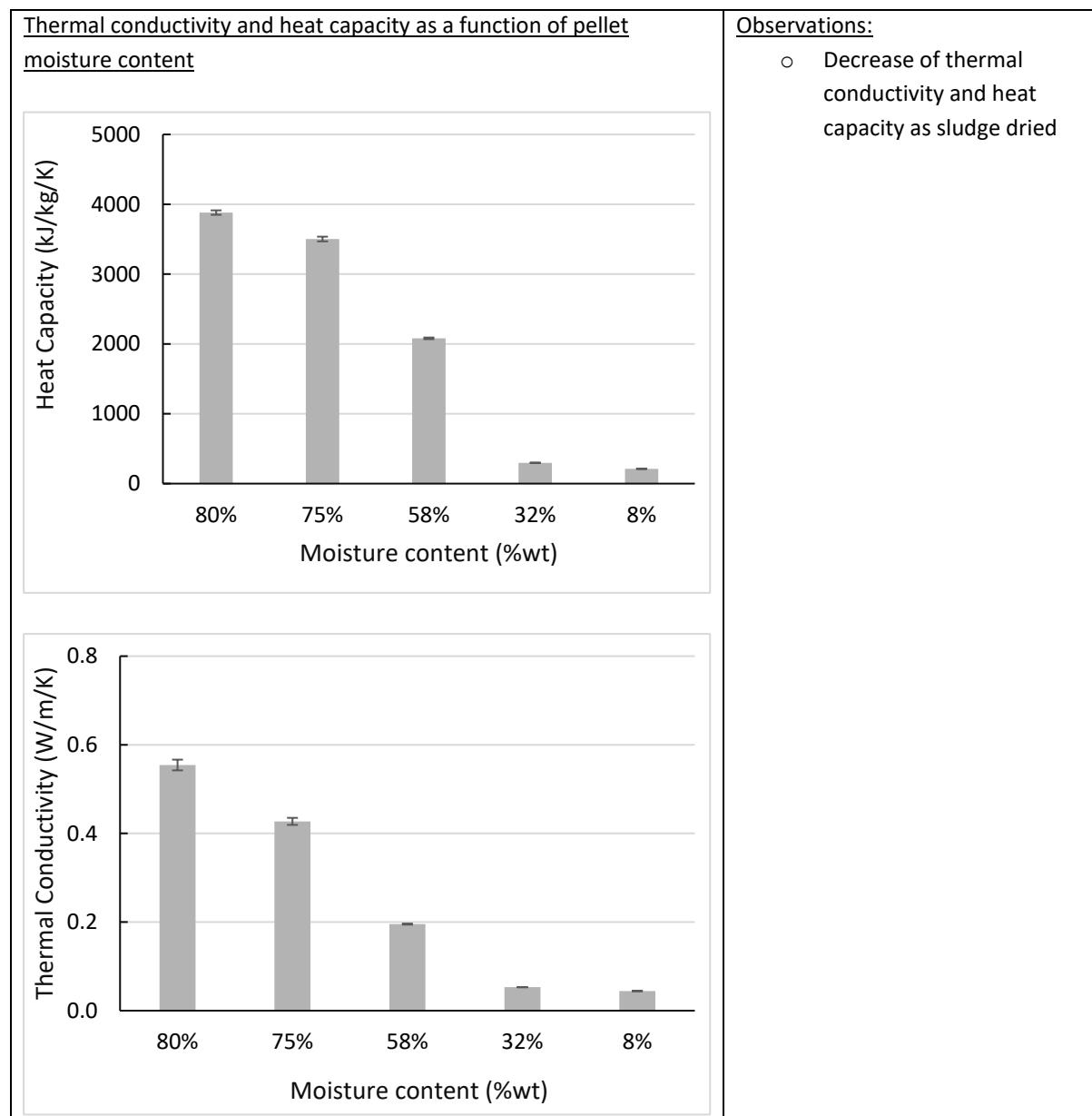


##### Observations:

- Decrease of thermal conductivity and heat capacity in the dried sludge with respect to the raw material
- No effect of temperature on the thermal properties







<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 40%db
<b>Ash content</b>	~ 60%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
Getahun, S., Septien, S., Mata, J., Somorin, T., Mabbett, I., & Buckley, C. (2020). Drying characteristics of faecal sludge from different on-site sanitation facilities. <i>Journal of Environmental Management</i> , 261, 110267.	

Getahun, S., Septien, S., Buckley, C.A. (2019). Effect of Drying Temperature and Moisture Content on The Enduse of Faecal Sludge as a Solid Fuel. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.

#### Data source files

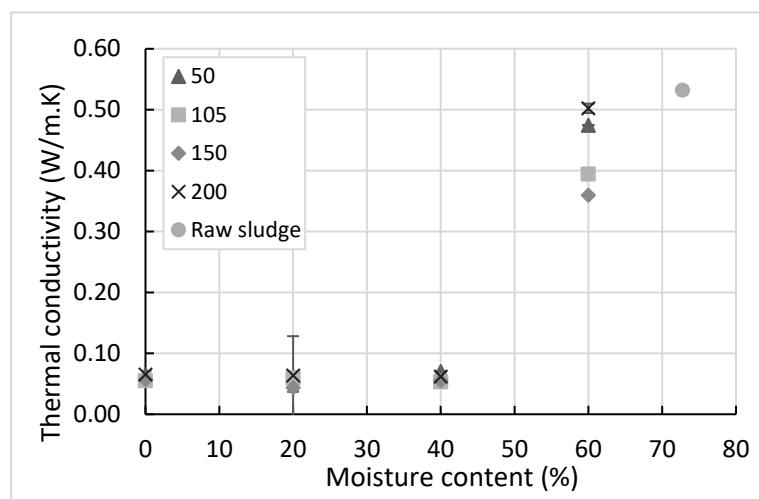
[https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests\\_PRG.xlsx?dl=0](https://www.dropbox.com/s/qo53unswsdmvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0)

#### Additional Notes

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#### Description of Data

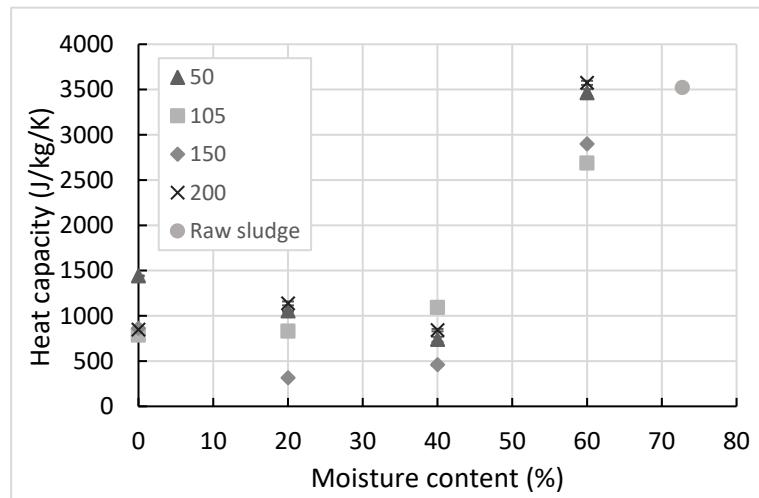
##### Thermal conductivity as a function of moisture content and temperature



##### Observations:

- Decrease of the thermal conductivity and heat capacity as sludge dried until achieving 40%wt moisture content
- Stabilization below 40%wt
- No effect of temperature

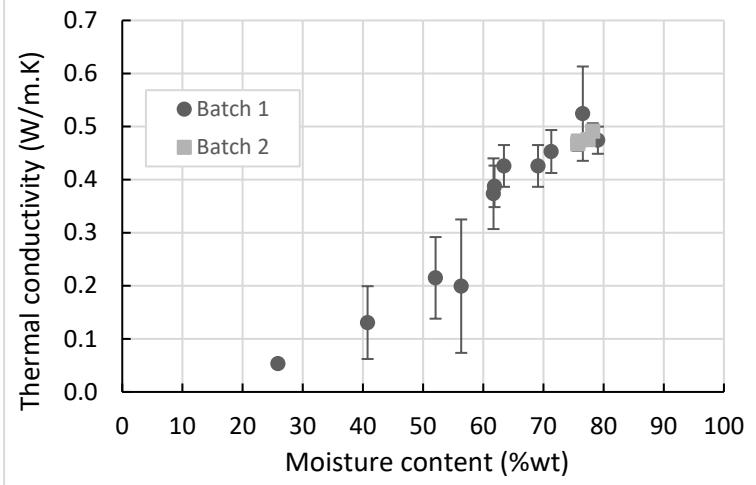
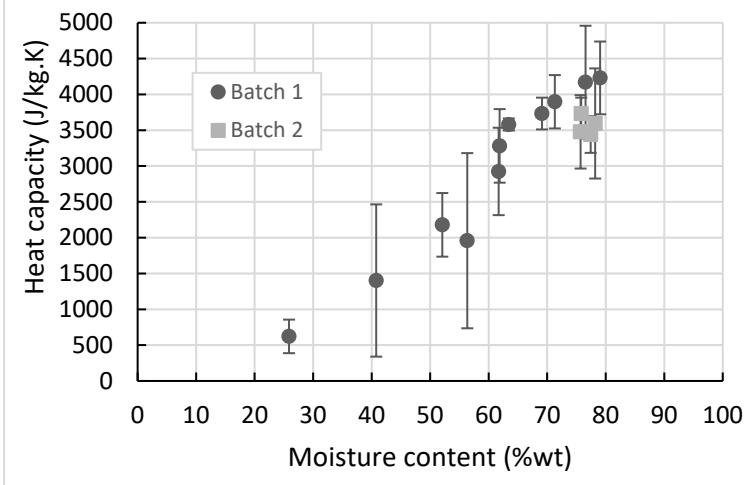
##### Heat capacity as a function of moisture content and temperature



<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 0, 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-Therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
-	

Data source files																																					
<a href="https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0</a>																																					
Additional Notes																																					
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Description of Data																																					
<u>Thermal conductivity as a function of moisture content and temperature</u> <table border="1"> <caption>Data extracted from Thermal Conductivity Plot</caption> <thead> <tr> <th>Moisture content (%)</th> <th>50 (W/m.K)</th> <th>105 (W/m.K)</th> <th>150 (W/m.K)</th> <th>200 (W/m.K)</th> <th>Initial sample (W/m.K)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0.07</td> <td>0.09</td> <td>0.06</td> <td>0.06</td> <td>0.06</td> </tr> <tr> <td>20</td> <td>0.07</td> <td>0.08</td> <td>0.05</td> <td>0.06</td> <td>0.05</td> </tr> <tr> <td>40</td> <td>0.25</td> <td>0.26</td> <td>0.24</td> <td>0.11</td> <td>0.24</td> </tr> <tr> <td>60</td> <td>0.34</td> <td>0.38</td> <td>0.36</td> <td>0.34</td> <td>0.38</td> </tr> <tr> <td>80</td> <td>0.36</td> <td>0.50</td> <td>-</td> <td>-</td> <td>0.50</td> </tr> </tbody> </table>	Moisture content (%)	50 (W/m.K)	105 (W/m.K)	150 (W/m.K)	200 (W/m.K)	Initial sample (W/m.K)	0	0.07	0.09	0.06	0.06	0.06	20	0.07	0.08	0.05	0.06	0.05	40	0.25	0.26	0.24	0.11	0.24	60	0.34	0.38	0.36	0.34	0.38	80	0.36	0.50	-	-	0.50	<u>Observations:</u> <ul style="list-style-type: none"> <li>Decrease of the thermal conductivity and heat capacity as sludge dried until achieving 20%wt moisture content</li> <li>Stabilization below 20%wt</li> <li>No effect of temperature</li> </ul>
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60	3200	3400	3200	3200	3400																																
80	4500	-	-	-	4500																																

<u>General information</u>	
<b>Type of data</b>	Thermal Properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Temperature: ambient (~ 20°C)</li> <li>○ Relative humidity: ambient (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g in 1 L plastic bucket
<b>Analysed parameters</b>	Thermal conductivity and heat capacity
<b>Employed method</b>	Use of a modified transient plane source technique analyser <i>C-therm TCi</i> (SOP 8.8.6.1)
<u>Publications</u>	
-	

Data source files																															
<a href="https://www.dropbox.com/s/xbv6su0jxsirok/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PR_G.xlsx?dl=0">https://www.dropbox.com/s/xbv6su0jxsirok/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PR_G.xlsx?dl=0</a>																															
Additional Notes																															
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ Containers with sample placed in a ventilated area</li> <li>○ Mesh placed at the opening of the container to avoid the development of maggots</li> <li>○ Samples from batch 1 analysed in a weekly basis for 16 weeks</li> <li>○ Samples from batch 2 analysed at days 0, 3, 5 and 7 within initial week</li> </ul>																															
Description of Data																															
<p><u>Thermal conductivity as a function of the moisture content for the samples from batch 1 and 2</u></p>  <table border="1"> <caption>Data extracted from the Thermal conductivity plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Batch 1 (W/m.K)</th> <th>Batch 2 (W/m.K)</th> </tr> </thead> <tbody> <tr><td>26</td><td>0.05</td><td></td></tr> <tr><td>40</td><td>0.12</td><td></td></tr> <tr><td>52</td><td>0.21</td><td></td></tr> <tr><td>55</td><td>0.20</td><td></td></tr> <tr><td>58</td><td>0.38</td><td></td></tr> <tr><td>62</td><td>0.42</td><td>0.43</td></tr> <tr><td>65</td><td>0.43</td><td>0.44</td></tr> <tr><td>68</td><td>0.44</td><td>0.45</td></tr> <tr><td>75</td><td>0.53</td><td>0.48</td></tr> </tbody> </table>	Moisture content (%wt)	Batch 1 (W/m.K)	Batch 2 (W/m.K)	26	0.05		40	0.12		52	0.21		55	0.20		58	0.38		62	0.42	0.43	65	0.43	0.44	68	0.44	0.45	75	0.53	0.48	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Decrease of the thermal conductivity and heat capacity by decreasing the moisture content</li> <li>○ Initial values of the thermal conductivity and heat capacity close to those from pure water</li> </ul>
Moisture content (%wt)	Batch 1 (W/m.K)	Batch 2 (W/m.K)																													
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<p><u>Heat capacity as a function of the moisture content</u></p>  <table border="1"> <caption>Data extracted from the Heat capacity plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Batch 1 (J/kg.K)</th> <th>Batch 2 (J/kg.K)</th> </tr> </thead> <tbody> <tr><td>26</td><td>600</td><td></td></tr> <tr><td>40</td><td>1400</td><td></td></tr> <tr><td>52</td><td>2100</td><td></td></tr> <tr><td>55</td><td>2000</td><td></td></tr> <tr><td>58</td><td>2700</td><td></td></tr> <tr><td>62</td><td>3200</td><td>3500</td></tr> <tr><td>65</td><td>3300</td><td>3600</td></tr> <tr><td>68</td><td>3600</td><td>3700</td></tr> <tr><td>75</td><td>4100</td><td>3800</td></tr> </tbody> </table>	Moisture content (%wt)	Batch 1 (J/kg.K)	Batch 2 (J/kg.K)	26	600		40	1400		52	2100		55	2000		58	2700		62	3200	3500	65	3300	3600	68	3600	3700	75	4100	3800	
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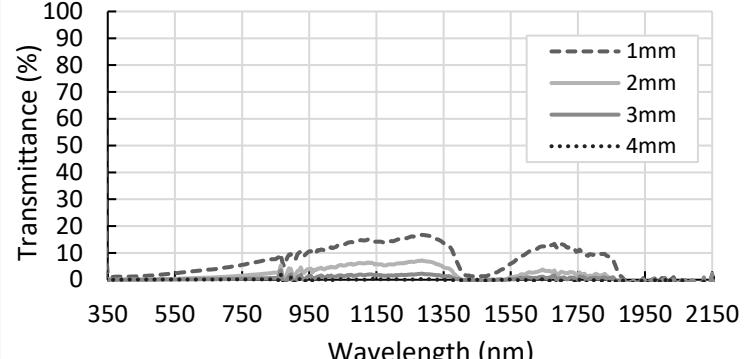
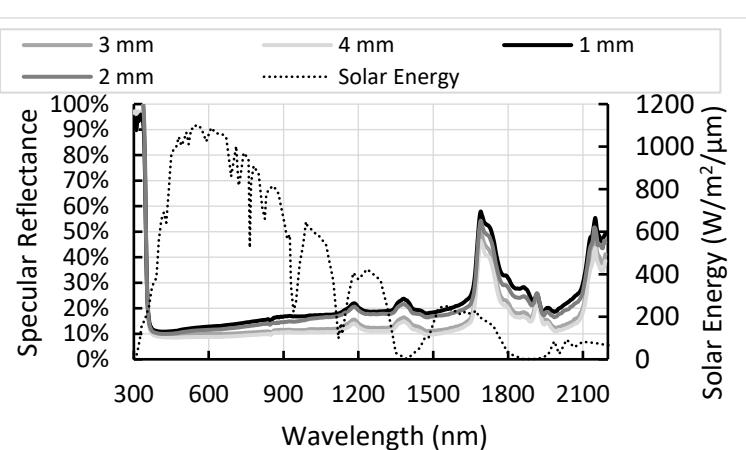
<u>General information</u>	
<b>Type of data</b>	Radiative properties
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Transmittance and reflectance
<b>Employed method</b>	Use of an UV-Vis-NIR spectrophotometer <i>Perkin Elmer Lambda 750S</i>
<u>Publications</u>	
-	

Data source files	
<b>Reflectance</b> <a href="https://www.dropbox.com/s/fatpciqrc1rxb1o/Swansea%20University%20ABR%20sludge%20Reflectance%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/fatpciqrc1rxb1o/Swansea%20University%20ABR%20sludge%20Reflectance%20%282018-2020%29.xlsx?dl=0</a>	
<b>Transmittance</b> <a href="https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Sample couriered from South Africa</li> <li>○ Analysis for different faecal sludge thickness: 1, 2, 3 and 4 mm</li> <li>○ Measurement of the transmittance and reflectance by the analyser</li> <li>○ Determination of the absorbance by difference (absorbance <math>\approx 1 - \text{reflectance}</math>)</li> <li>○ Data Collection range: 2500-250 nm</li> <li>○ Data collection interval: 5.00 nm</li> <li>○ Scan Speed: 1196.19 nm/minute</li> <li>○ Lamp: D2</li> </ul>	
Description of Data	
<u>Transmittance of 1, 2, 3 and 4 mm thickness samples</u> <p>The graph shows transmittance values ranging from 0 to 100% on the y-axis and wavelength from 350 to 2150 nm on the x-axis. Four data series are plotted: 1mm (dashed line), 2mm (solid line), 3mm (long-dashed line), and 4mm (dotted line). All series show very low transmittance, with values generally below 10% across the entire wavelength range.</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low transmittance for all thickness (&lt; 5%)</li> <li>○ Decrease of the transmittance by increasing the thickness</li> </ul>
<u>Reflectance of 1, 2, 3 and 4 mm thickness samples and comparison to the solar spectrum (ASTM E903)</u> <p>The graph displays two sets of data: Specular Reflectance (%) on the left y-axis (0% to 100%) and Solar Energy (W/m<sup>2</sup>/μm) on the right y-axis (-500 to 1500) against wavelength from 300 to 2100 nm. It includes five data series: 3 mm (solid line), 4 mm (dashed line), 1 mm (long-dashed line), 2 mm (short-dashed line), and Solar Energy (dotted line). Reflectance peaks are visible around 300 nm, 600 nm, 1200 nm, and 1800 nm. The solar energy curve shows a broad peak between 1000 and 1500 nm.</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low reflectance in the visible light spectrum (400 – 700 nm) in average (~ 10%)</li> <li>○ Medium reflectance in the near infrared spectrum (700 – 2500 nm) in average (~ 40%)</li> <li>○ Average reflectance value about 35% showing the potential of solar thermal drying (absorbance ~ 65%)</li> <li>○ Not a clear effect of the sample thickness</li> </ul>

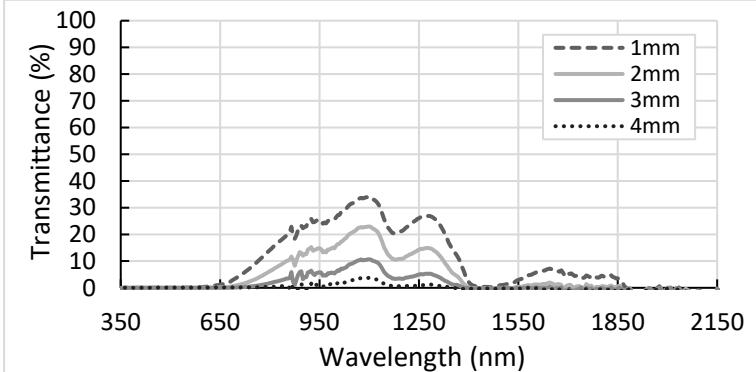
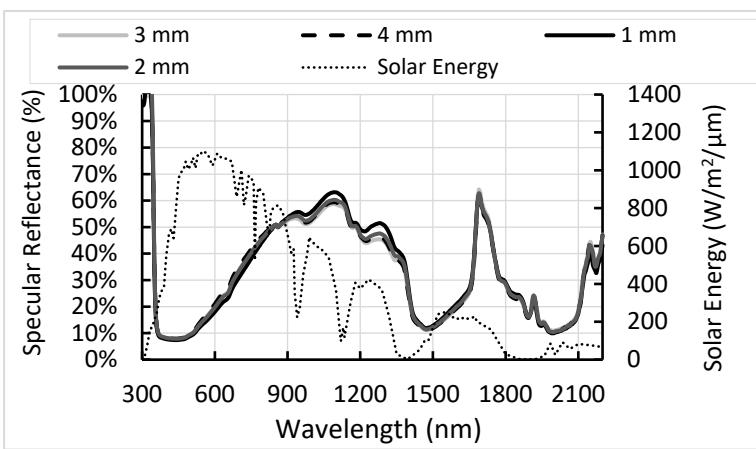
<u>General information</u>	
<b>Type of data</b>	Radiative properties
<b>Place of experimentation</b>	Materials Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Transmittance and reflectance
<b>Employed method</b>	Use of an UV-Vis-NIR spectrophotometer <i>Perkin Elmer Lambda 750S</i>
<u>Publications</u>	
-	

<u>Data source files</u>	
<b>Reflectance</b> <a href="https://www.dropbox.com/s/o5x05sc995jixjb/Swansea%20University%20UDDT%20sludge%20Reflectance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/o5x05sc995jixjb/Swansea%20University%20UDDT%20sludge%20Reflectance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
<b>Transmittance</b> <a href="https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
<u>Additional Notes</u>	
<ul style="list-style-type: none"> <li>○ Sample couriered from South Africa</li> <li>○ Analysis for different faecal sludge thickness: 1, 2, 3 and 4 mm</li> <li>○ Measurement of the transmittance and reflectance by the analyser</li> <li>○ Determination of the absorbance by difference (absorbance <math>\approx 1 - \text{reflectance}</math>)</li> <li>○ Data Collection range: 2500-250 nm</li> <li>○ Data collection interval: 5.00 nm</li> <li>○ Scan Speed: 1196.19 nm/minute</li> <li>○ Lamp: D2</li> </ul>	
<u>Description of Data</u>	
<u>Transmittance of the 1, 2, 3 and 4 mm thickness samples</u> <p>The graph plots Transmittance (%) on the y-axis (0 to 100) against Wavelength (nm) on the x-axis (350 to 2150). Four data series are shown: 1mm (dashed line), 2mm (solid line), 3mm (long-dash line), and 4mm (dotted line). All series show transmittance values very close to 0% across the entire wavelength range.</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Null transmittance for all thickness</li> </ul>
<u>Reflectance of the 1, 2, 3 and 4 mm thickness samples and comparison to the solar spectrum (ASTM E903)</u> <p>The graph has two y-axes: Specular reflectance (%) on the left (0% to 100%) and Solar energy (W/m²/μm) on the right (0 to 1400). The x-axis is Wavelength (nm) from 300 to 2100. It shows five data series: 1 mm (solid), 2 mm (long-dash), 3 mm (thin solid), 4 mm (dotted), and Solar Energy (dotted). Reflectance peaks are visible around 550 nm and 1800 nm, while the solar energy curve peaks at approximately 1400 nm.</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low reflectance in the visible light spectrum (400 – 700 nm) in average (<math>\sim 10\%</math>)</li> <li>○ Medium reflectance in the near infrared spectrum (700 – 2500 nm) in average (<math>\sim 30\%</math>)</li> <li>○ Average reflectance value about 30% showing the potential of solar thermal drying (absorbance 70%)</li> <li>○ Not a clear effect of the sample thickness</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Radiative properties
<b>Place of experimentation</b>	Materials Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Transmittance and reflectance
<b>Employed method</b>	Use of an UV-Vis-NIR spectrophotometer <i>Perkin Elmer Lambda 750S</i>
<u>Publications</u>	
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Data source files	
<b>Reflectance</b> <a href="https://www.dropbox.com/s/y9p8zg4kzpu9b3n/Swansea%20University%20VIP%20sludge%20Reflectance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/y9p8zg4kzpu9b3n/Swansea%20University%20VIP%20sludge%20Reflectance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
<b>Transmittance</b> <a href="https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Sample couriered from South Africa</li> <li>○ Analysis for different faecal sludge thickness: 1, 2, 3 and 4 mm</li> <li>○ Measurement of the transmittance and reflectance by the analyser</li> <li>○ Determination of the absorbance by difference (absorbance <math>\approx 1 - \text{reflectance}</math>)</li> <li>○ Data Collection range: 2500-250 nm</li> <li>○ Data collection interval: 5.00 nm</li> <li>○ Scan Speed: 1196.19 nm/minute</li> <li>○ Lamp: D2</li> </ul>	
Description of Data	
<u>Transmittance of 1, 2, 3 and 4 mm thickness samples</u> 	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low transmittance for all thickness (&lt; 20%)</li> <li>○ Decrease of the transmittance by increasing the thickness</li> </ul>
<u>Reflectance of 1, 2, 3 and 4 mm thickness samples and comparison to the solar spectrum (ASTM E903)</u> 	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low reflectance in the visible light spectrum (400 – 700 nm) in average (~ 10%)</li> <li>○ Medium reflectance in the near infrared spectrum (700 – 2500 nm) in average (~ 30%)</li> <li>○ Average reflectance value about 30% showing the potential of solar thermal drying (absorbance ~ 70%)</li> <li>○ Not a clear effect of the sample thickness</li> </ul>

<u>General information</u>	
<b>Type of data</b>	Radiative properties
<b>Place of experimentation</b>	Materials Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Cranfield, UK
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 60%wt
<b>Total solids content</b>	~ 40%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Transmittance and reflectance
<b>Employed method</b>	Use of an UV-Vis-NIR spectrophotometer <i>Perkin Elmer Lambda 750S</i>
<u>Publications</u>	
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Data source files	
<b>Reflectance</b> <a href="https://www.dropbox.com/s/lwhnevbpw02kdg4/Swansea%20University%20Human%20Faeces%20Reflectance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/lwhnevbpw02kdg4/Swansea%20University%20Human%20Faeces%20Reflectance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
<b>Transmittance</b> <a href="https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0">https://www.dropbox.com/s/y1dq29i47moql6/Swansea%20University%20Sludge%20UV%20Transmittance%20Properties%20%282018-2020%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Faeces obtained from anonymous and voluntary donations</li> <li>○ Analysis for different faecal sludge thickness: 1, 2, 3 and 4 mm</li> <li>○ Measurement of the transmittance and reflectance by the analyser</li> <li>○ Determination of the absorbance by difference (absorbance <math>\approx 1 - \text{reflectance}</math>)</li> <li>○ Data Collection range: 2500-250 nm</li> <li>○ Data collection interval: 5.00 nm</li> <li>○ Scan Speed: 1196.19 nm/minute</li> <li>○ Lamp: D2</li> </ul>	
Description of Data	
<u>Transmittance of the 1, 2, 3 and 4 mm thickness samples</u>  <p>The graph plots Transmittance (%) on the y-axis (0 to 100) against Wavelength (nm) on the x-axis (350 to 2150). Four curves are shown for sample thicknesses of 1mm, 2mm, 3mm, and 4mm. All curves show a peak around 1250 nm. As thickness increases, the overall transmittance decreases across the entire wavelength range.</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low to medium transmittance at 850 – 1350 nm (peak from 5 to 35%)</li> <li>○ Decrease of the transmittance by increasing the thickness</li> </ul>
<u>Reflectance of the 1, 2, 3 and 4 mm thickness samples and solar irradiance spectrum (ASTM E903)</u>  <p>The graph plots Specular Reflectance (%) on the left y-axis (0% to 100%) and Solar Energy (W/m<sup>2</sup>/μm) on the right y-axis (0 to 1400) against Wavelength (nm) on the x-axis (300 to 2100). It shows five curves: 3 mm (solid grey), 2 mm (solid black), 4 mm (dashed black), 1 mm (solid black), and Solar Energy (dotted black). Reflectance peaks are visible at approximately 550 nm and 1400 nm. The solar energy curve peaks at approximately 550 nm and 1000 nm.</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Low reflectance in the visible light spectrum (400 – 700 nm) in average (<math>\sim 15\%</math>)</li> <li>○ Medium reflectance in the near infrared spectrum (700 – 2500 nm) in average (<math>\sim 45\%</math>)</li> <li>○ Average reflectance value about 40% showing the potential of solar thermal drying (absorbance <math>\sim 60\%</math>)</li> <li>○ Not a clear effect of the sample thickness</li> </ul>

# MORPHOLOGICAL CHARACTERISTICS

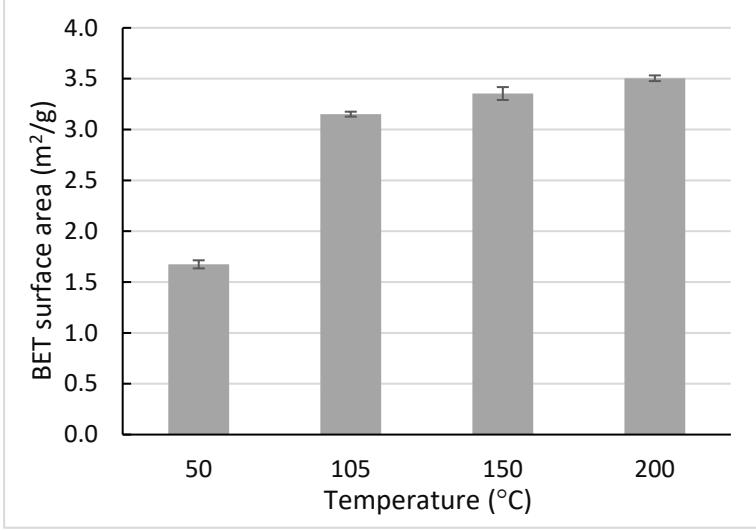
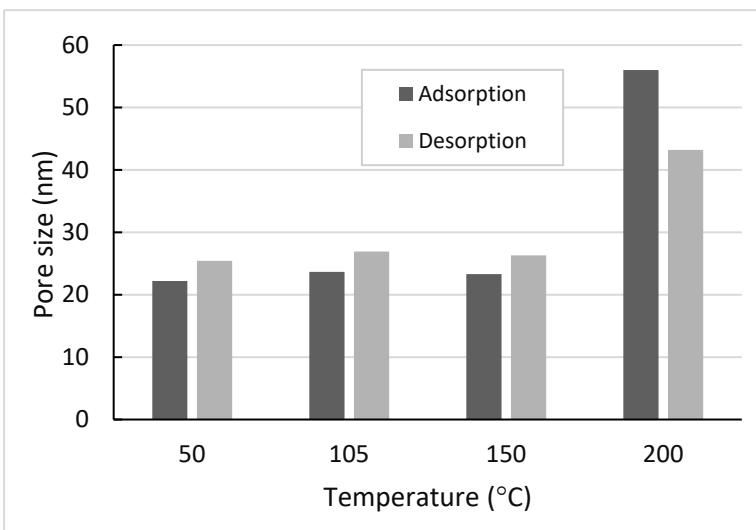
<u>General information</u>	
<b>Type of data</b>	Specific surface area and porosity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	BET specific surface area and pore size
<b>Employed method</b>	Use of BET analyser <i>Tristar II Series</i>
<u>Publications</u>	
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<u>Data source files</u>																
<a href="https://www.dropbox.com/s/qo53unsdsvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/qo53unsdsvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0</a>																
<u>Additional Notes</u>																
-																
<u>Description of Data</u>																
<p>Surface area as a function of temperature</p> <table border="1"> <caption>Data for Surface area as a function of temperature</caption> <thead> <tr> <th>Temperature (°C)</th> <th>BET specific surface area (<math>\text{m}^2/\text{g}</math>)</th> </tr> </thead> <tbody> <tr> <td>50</td> <td>~1.2</td> </tr> <tr> <td>105</td> <td>~1.65</td> </tr> <tr> <td>150</td> <td>~1.5</td> </tr> <tr> <td>200</td> <td>~1.9</td> </tr> </tbody> </table>	Temperature (°C)	BET specific surface area ( $\text{m}^2/\text{g}$ )	50	~1.2	105	~1.65	150	~1.5	200	~1.9	<p>Observations:</p> <ul style="list-style-type: none"> <li>○ No effect of temperature on the specific surface</li> <li>○ Apparent increase of the pore size by increasing the drying temperature</li> </ul>					
Temperature (°C)	BET specific surface area ( $\text{m}^2/\text{g}$ )															
50	~1.2															
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Temperature (°C)	Adsorption (nm)	Desorption (nm)														
50	~22	~26														
105	~12	~28														
150	~30	~38														
200	~62	~57														

<u>General information</u>	
<b>Type of data</b>	Specific surface area and porosity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones and textiles)
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	BET specific surface area and pore size
<b>Employed method</b>	Use of BET analyser Tristar II Series
<u>Publications</u>	
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<u>Data source files</u>																
<a href="https://www.dropbox.com/s/qo53unsdsvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/qo53unsdsvjgp/2018-2019%20ABR%2C%20UDDT%20and%20VIP%20tests_PRG.xlsx?dl=0</a>																
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<p>Surface area as a function of temperature</p> <table border="1"><caption>Data for Surface area as a function of temperature</caption><thead><tr><th>Temperature (°C)</th><th>Adsorption (m²/g)</th><th>Desorption (m²/g)</th></tr></thead><tbody><tr><td>50</td><td>~0.85</td><td>~0.85</td></tr><tr><td>105</td><td>~0.80</td><td>~0.80</td></tr><tr><td>150</td><td>~0.45</td><td>~0.45</td></tr><tr><td>200</td><td>~0.85</td><td>~0.85</td></tr></tbody></table>	Temperature (°C)	Adsorption (m²/g)	Desorption (m²/g)	50	~0.85	~0.85	105	~0.80	~0.80	150	~0.45	~0.45	200	~0.85	~0.85	<p>Observations:</p> <ul style="list-style-type: none"><li>○ No effect of temperature on the specific surface, and pore size below 200°C</li><li>○ Apparent higher pore size at 200°C</li></ul>
Temperature (°C)	Adsorption (m²/g)	Desorption (m²/g)														
50	~0.85	~0.85														
105	~0.80	~0.80														
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<p>Pore size as a function of temperature</p> <table border="1"><caption>Data for Pore size as a function of temperature</caption><thead><tr><th>Temperature (°C)</th><th>Adsorption (nm)</th><th>Desorption (nm)</th></tr></thead><tbody><tr><td>50</td><td>~28</td><td>~24</td></tr><tr><td>105</td><td>~43</td><td>~58</td></tr><tr><td>150</td><td>~44</td><td>~31</td></tr><tr><td>200</td><td>~74</td><td>~62</td></tr></tbody></table>	Temperature (°C)	Adsorption (nm)	Desorption (nm)	50	~28	~24	105	~43	~58	150	~44	~31	200	~74	~62	
Temperature (°C)	Adsorption (nm)	Desorption (nm)														
50	~28	~24														
105	~43	~58														
150	~44	~31														
200	~74	~62														

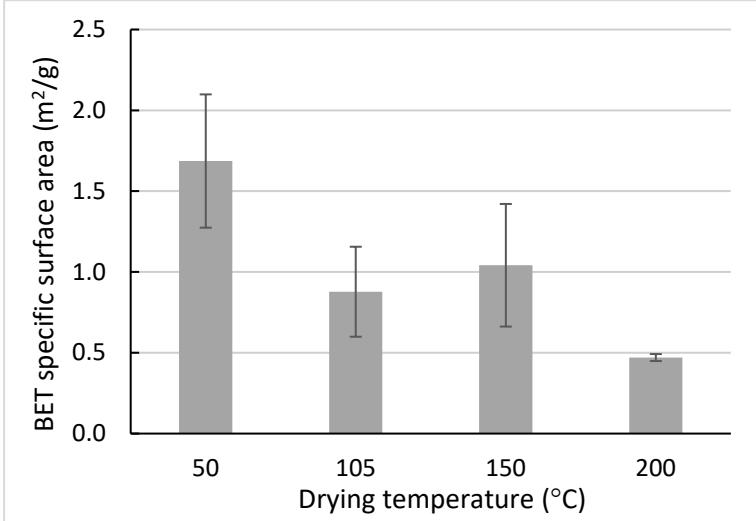
<u>General information</u>	
<b>Type of data</b>	Specific surface area and porosity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 40%db
<b>Ash content</b>	~ 60%db
<b>Presence of trash?</b>	Yes (mainly hair and stones)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	BET specific surface area and pore size
<b>Employed method</b>	Use of BET analyser <i>Tristar II Series</i>
<u>Publications</u>	
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Temperature (°C)	1	2	3	4																						
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<u>General information</u>	
<b>Type of data</b>	Specific surface area and porosity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018-2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
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<u>Publications</u>	
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-															
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<p>Surface area as a function of temperature</p> <table border="1"> <thead> <tr> <th>Temperature (°C)</th> <th>BET specific surface area (m²/g)</th> </tr> </thead> <tbody> <tr> <td>50</td> <td>~3.2</td> </tr> <tr> <td>105</td> <td>~3.8</td> </tr> <tr> <td>150</td> <td>~3.9</td> </tr> <tr> <td>200</td> <td>~6.0</td> </tr> </tbody> </table>	Temperature (°C)	BET specific surface area (m²/g)	50	~3.2	105	~3.8	150	~3.9	200	~6.0	<p>Observations:</p> <ul style="list-style-type: none"> <li>○ No effect of temperature on the specific surface below 200°C, and pore size at 50, 100 and 200°C</li> <li>○ Higher specific area at 200°C</li> <li>○ Higher pore size at 150°C</li> </ul>				
Temperature (°C)	BET specific surface area (m²/g)														
50	~3.2														
105	~3.8														
150	~3.9														
200	~6.0														
<p>Pore size as a function of temperature</p> <table border="1"> <thead> <tr> <th>Temperature (°C)</th> <th>Absorption (nm)</th> <th>Desorption (nm)</th> </tr> </thead> <tbody> <tr> <td>50</td> <td>~32</td> <td>~33</td> </tr> <tr> <td>105</td> <td>~32</td> <td>~37</td> </tr> <tr> <td>150</td> <td>~48</td> <td>~40</td> </tr> <tr> <td>200</td> <td>~30</td> <td>~22</td> </tr> </tbody> </table>	Temperature (°C)	Absorption (nm)	Desorption (nm)	50	~32	~33	105	~32	~37	150	~48	~40	200	~30	~22
Temperature (°C)	Absorption (nm)	Desorption (nm)													
50	~32	~33													
105	~32	~37													
150	~48	~40													
200	~30	~22													

<u>General information</u>	
<b>Type of data</b>	Specific surface area and porosity
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until complete drying
<b>Operating conditions</b>	Temperature: 50, 100, 150 and 200°C
<b>Sample form in the dryer</b>	250 g of sample on an aluminium tray (52 × 8.4 × 33 cm)
<b>Analysed parameters</b>	BET specific surface area and pore size
<b>Employed method</b>	Use of BET analyser <i>Tristar II Series</i>
<u>Publications</u>	
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<u>Data source files</u>											
<a href="https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0">https://www.dropbox.com/s/vpa68hptk81v4e4/2019%20Fresh%20faeces%20tests_PRG.xlsx?dl=0</a>											
<u>Additional Notes</u>											
Fresh faeces collected from voluntary and anonymous donations											
<u>Description of Data</u>											
<u>Surface area as a function of temperature</u>  <table border="1"><thead><tr><th>Drying temperature (°C)</th><th>BET specific surface area (m<sup>2</sup>/g)</th></tr></thead><tbody><tr><td>50</td><td>~1.7</td></tr><tr><td>105</td><td>~0.9</td></tr><tr><td>150</td><td>~1.0</td></tr><tr><td>200</td><td>~0.45</td></tr></tbody></table>	Drying temperature (°C)	BET specific surface area (m <sup>2</sup> /g)	50	~1.7	105	~0.9	150	~1.0	200	~0.45	<u>Observations:</u> <ul style="list-style-type: none"><li>○ Same specific surface area for samples dried at 50, 105 and 150°C</li><li>○ Lower specific surface area for sample dried at 200°C</li></ul>
Drying temperature (°C)	BET specific surface area (m <sup>2</sup> /g)										
50	~1.7										
105	~0.9										
150	~1.0										
200	~0.45										

<u>General information</u>	
<b>Type of data</b>	Visual aspects
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design convective drying rig
<b>Drying time</b>	Batch until complete drying
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0, 15 and 25%</li> <li>○ Air velocity: 0.03, 0.06 and 0.12 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8, 10, 12 and 14 mm diameter
<b>Analysed parameters</b>	Visual aspect
<b>Employed method</b>	Photograph
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

<u>Data source files</u>	
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<u>Additional Notes</u>	
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<u>Description of Data</u>	
Aspect of pellets before (left) and after (right) drying 	<u>Observations</u> <ul style="list-style-type: none"><li>○ After drying: crust and crack formation; shrinkage; loss of shiny surface; change of color (less dark)</li></ul>

<u>General information</u>	
<b>Type of data</b>	Visual aspects
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design convective drying rig
<b>Drying time</b>	Batch until complete drying
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 40, 60 and 80°C</li> <li>○ Air humidity: 0, 15 and 25%</li> <li>○ Air velocity: 0.03, 0.06 and 0.12 cm/s</li> </ul>
<b>Sample form in the dryer</b>	Thin layer on a petri dish of 70 mm diameter and 4 mm height
<b>Analysed parameters</b>	Visual aspect
<b>Employed method</b>	Photograph
<u>Publications</u>	
Makununika, B. S. N. (2016). Thermal drying of faecal sludge from VIP latrines and characterisation of dried faecal material. Master thesis. University of KwaZulu-Natal, Durban, South Africa.	

<u>Data source files</u>	
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<u>Additional Notes</u>	
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<u>Description of Data</u>	
<u>Aspect of the faecal sludge before (left) and after (right) drying</u>	<u>Observations</u> <ul style="list-style-type: none"><li>○ After drying: crust and crack formation; shrinkage; loss of shiny surface; change of color (less dark)</li></ul>
	

<u>General information</u>	
<b>Type of data</b>	Visual aspects
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	3 to 5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: from 800 to 1000 W/m<sup>2</sup> (sunny conditions)</li> <li>○ Air flowrate: 0.5 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 m/s)</li> <li>○ Air temperature: ambient (~20°C)</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form in the dryer</b>	Thin layer of 5 and 10 mm thickness, and 60 mm diameter
<b>Analysed parameters</b>	Visual aspect
<b>Employed method</b>	Photograph
<u>Publications</u>	
Mugauri, T.R. (2019). <i>Drying of faecal sludge from ventilated improved pit latrines (VIP latrines) using solar thermal energy</i> . MSc thesis, University of KwaZulu-Natal, South Africa.	

Septien, S., Mugauri, T.R., Singh, A., Inambao, F. (2018). *Solar drying of faecal sludge from on-site sanitation facilities*. 5<sup>th</sup> Southern Africa Solar Thermal Energy Conference, Durban, South Africa, 25-27 June.

Septien, S., Mugauri, T.R., Singh, A., Inambao, F. (2017). *Drying of Faecal Sludge using Solar Thermal Energy* (final report project K5/2582). Water Research Commission, South Africa.

Data source files

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Additional Notes

-

Description of Data

Aspect of sludge before (a) and after (b) drying

A



B



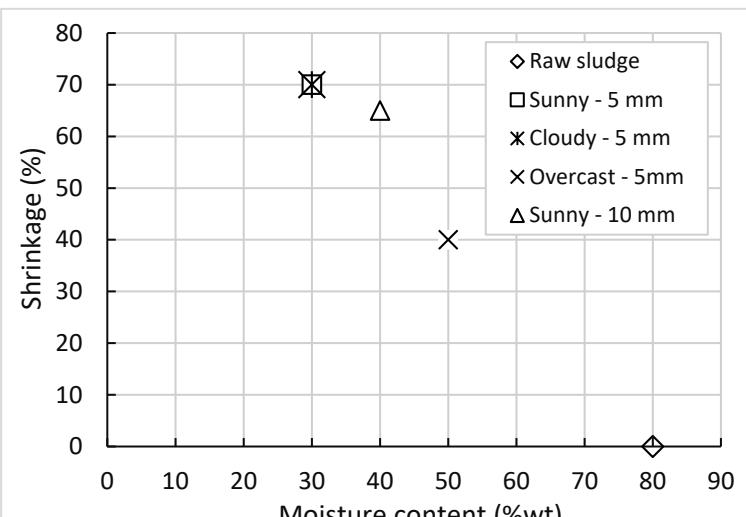
Observations

- After drying: crust and crack formation; shrinkage; loss of shiny surface

<u>General information</u>	
<b>Type of data</b>	Visual aspects
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019-2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: 800 – 1300 W/m<sup>2</sup> (sunny conditions)</li> <li>○ Air flowrate: 0.5 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 m/s)</li> <li>○ Air temperature: ambient (~20°C), 40 and 80°C</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form</b>	Thin layer of 5 mm thickness and 110 mm diameter
<b>Analysed parameters</b>	Visual aspect
<b>Employed method</b>	Photograph
<u>Publications</u>	
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<u>Data source files</u>	
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<u>Additional Notes</u>	
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<u>Description of Data</u>	
<u>Aspect of sludge before (left) and after (right) drying at ambient conditions, 40 and 80°C</u>	<u>Observations:</u> <ul style="list-style-type: none"><li>○ After drying: crust and crack formation; shrinkage; loss of shiny surface</li><li>○ Greater cracking and shrinkage at higher temperature</li></ul>
<b>A</b> 	<b>B</b> 
<b>C</b> 	<b>D</b> 

<u>General information</u>	
<b>Type of data</b>	Shrinkage
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 50%db
<b>Ash content</b>	~ 50%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	3 to 5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: from 75 to 1000 W/m<sup>2</sup> (from overcast to sunny conditions)</li> <li>○ Air flowrate: 0.5 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 m/s)</li> <li>○ Air temperature: ambient (~20°C)</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form in the dryer</b>	Thin layer of 5 and 10 mm thickness, and 60 mm diameter
<b>Analysed parameters</b>	<ol style="list-style-type: none"> <li>(1) Reduction of volume after drying</li> <li>(2) Moisture content</li> </ol>
<b>Employed method</b>	<ol style="list-style-type: none"> <li>(1) Measurement of the dimensions of the sample before and after drying (SOP 8.8.2.1)</li> <li>(2) Weighing the sample before and after oven drying at 105°C for 24 h (SOP 8.7.1.1)</li> </ol>

<u>Publications</u>																
Mugauri, T.R. (2019). <i>Drying of faecal sludge from ventilated improved pit latrines (VIP latrines) using solar thermal energy</i> . MSc thesis, University of KwaZulu-Natal, South Africa.																
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<u>Data source files</u>																
<a href="https://www.dropbox.com/s/ssumqzociucjaj2/Shrinkage%20of%20VIP%20sludge%20%282017-2018%29.xlsx?dl=0">https://www.dropbox.com/s/ssumqzociucjaj2/Shrinkage%20of%20VIP%20sludge%20%282017-2018%29.xlsx?dl=0</a>																
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-																
<u>Description of Data</u>																
<u>Shrinkage versus the moisture content obtained after drying at the different conditions</u>  <table border="1"> <caption>Data extracted from the scatter plot</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Shrinkage (%)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>80</td> <td>0</td> <td>Raw sludge</td> </tr> <tr> <td>~32</td> <td>~72</td> <td>Cloudy - 5 mm</td> </tr> <tr> <td>~38</td> <td>~65</td> <td>Sunny - 10 mm</td> </tr> <tr> <td>~48</td> <td>~40</td> <td>Overcast - 5mm</td> </tr> </tbody> </table>	Moisture content (%wt)	Shrinkage (%)	Condition	80	0	Raw sludge	~32	~72	Cloudy - 5 mm	~38	~65	Sunny - 10 mm	~48	~40	Overcast - 5mm	<u>Observations</u> <ul style="list-style-type: none"> <li>More shrinkage as sample dried at lower moisture content</li> </ul>
Moisture content (%wt)	Shrinkage (%)	Condition														
80	0	Raw sludge														
~32	~72	Cloudy - 5 mm														
~38	~65	Sunny - 10 mm														
~48	~40	Overcast - 5mm														

<u>General information</u>	
<b>Type of data</b>	Shrinkage
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Screening for trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Custom-design solar thermal drying rig
<b>Drying time</b>	5 hours
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Irradiance: 800 – 1300 W/m<sup>2</sup> (sunny conditions)</li> <li>○ Air flowrate: 0.5 and 1 m<sup>3</sup>/min (corresponding to an air velocity of 0.5 m/s)</li> <li>○ Air temperature: ambient (~20°C), 40 and 80°C</li> <li>○ Air humidity: ~10%</li> </ul>
<b>Sample form</b>	Thin layer of 5 mm thickness and 110 mm diameter
<b>Analysed parameters</b>	Reduction of volume after drying
<b>Employed method</b>	Measurement of the dimensions of the sample before and after drying (SOP 8.8.2.1)
<u>Publications</u>	
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<u>Data source files</u>																													
<a href="https://www.dropbox.com/s/gscuvzvus55zfsr/2019-2020%20VIP%20Shrinkage%20data.xlsx?dl=0">https://www.dropbox.com/s/gscuvzvus55zfsr/2019-2020%20VIP%20Shrinkage%20data.xlsx?dl=0</a>																													
<u>Additional Notes</u>																													
<ul style="list-style-type: none"><li>○ Density measured on the sample obtained at the end of a few experiments</li><li>○ Low precision of the current method (rough estimation)</li></ul>																													
<u>Description of Data</u>																													
<p><u>Shrinkage versus the moisture content at the end of a few experiments</u></p> <table border="1"><caption>Data points estimated from the scatter plot</caption><thead><tr><th>Moisture content (%wt)</th><th>Shrinkage</th><th>Symbol</th><th>Condition</th></tr></thead><tbody><tr><td>~20</td><td>~0.68</td><td>Circle</td><td>1m/s 80 degrees C</td></tr><tr><td>~25</td><td>~0.45</td><td>Cross</td><td>1m/s ambient temp</td></tr><tr><td>~30</td><td>~0.62</td><td>Cross</td><td>1m/s 40 degrees C</td></tr><tr><td>~30</td><td>~0.65</td><td>Triangle</td><td>0.5m/s 80 degrees C</td></tr><tr><td>~45</td><td>~0.50</td><td>Square</td><td>0.5m/s 40 degrees C</td></tr><tr><td>~52</td><td>~0.35</td><td>Diamond</td><td>0.5m/s ambient temp</td></tr></tbody></table>	Moisture content (%wt)	Shrinkage	Symbol	Condition	~20	~0.68	Circle	1m/s 80 degrees C	~25	~0.45	Cross	1m/s ambient temp	~30	~0.62	Cross	1m/s 40 degrees C	~30	~0.65	Triangle	0.5m/s 80 degrees C	~45	~0.50	Square	0.5m/s 40 degrees C	~52	~0.35	Diamond	0.5m/s ambient temp	<p><u>Observations:</u></p> <ul style="list-style-type: none"><li>○ Higher shrinkage as sludge dried</li></ul>
Moisture content (%wt)	Shrinkage	Symbol	Condition																										
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~52	~0.35	Diamond	0.5m/s ambient temp																										

<u>General information</u>	
<b>Type of data</b>	Shrinkage
<b>Place of experimentation</b>	Duke University Center for WaSH-AID, Durham, NC
<b>Dates of the experiments</b>	2016-2017
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	None
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Convection toaster oven
<b>Drying time</b>	Until stabilisation of the sample mass
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Air temperature: 105, 120 and 150°C</li> <li>○ Relative humidity: ambient</li> <li>○ Air velocity: none</li> </ul>
<b>Sample form in the dryer</b>	9 mm thick sample in a 100 m diameter petri dish
<b>Analysed parameters</b>	Thickness
<b>Employed method</b>	Callipers to measure the thickness at each time point (diameter assumed unchanged) (SOP 8.7.1.1)

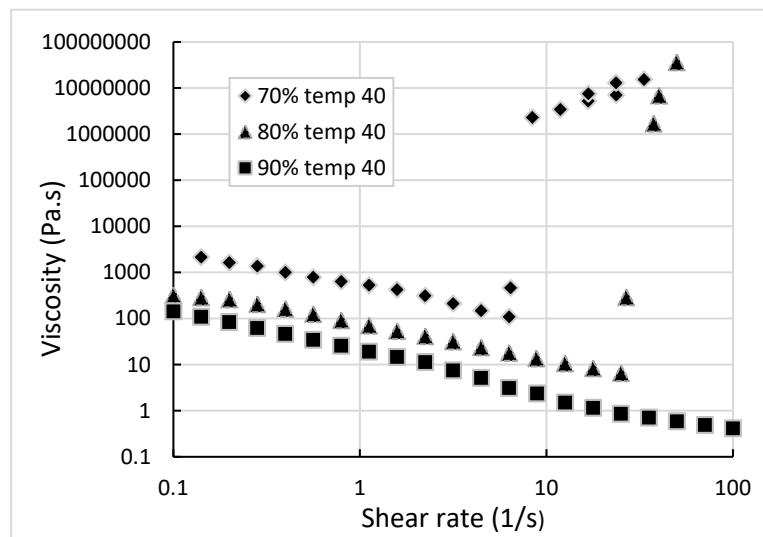
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<a href="https://www.dropbox.com/s/tgg4sehv3xjlhq/RTI%20International%20data_fresh%20faeces%20onconvective%20drying%20kinetics%20and%20shrinkage%20%282016-2017%29.xlsx?dl=0">https://www.dropbox.com/s/tgg4sehv3xjlhq/RTI%20International%20data_fresh%20faeces%20onconvective%20drying%20kinetics%20and%20shrinkage%20%282016-2017%29.xlsx?dl=0</a>																																																													
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<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> </ul>																																																													
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# MECHANICAL PROPERTIES

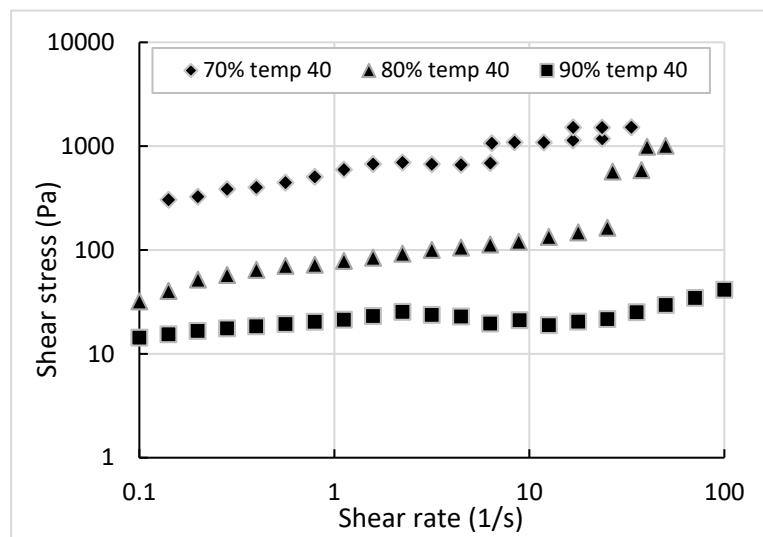
<u>General information</u>	
<b>Type of data</b>	Rheological properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 70, 80 and 90%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form</b>	Faecal sludge in a cup
<b>Analysed parameters</b>	Viscosity and shear stress at 25, 40 and 60°C
<b>Employed method</b>	Rotational test in the rheometer <i>Anton Paar MCR 72</i> (SOP 8.8.4.1)
<u>Publications</u>	
-	

Data source files																																					
<a href="https://www.dropbox.com/s/ukpo4iahlxkwnuz/2019-2020%20UDDT%20Rheological%20properties_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/ukpo4iahlxkwnuz/2019-2020%20UDDT%20Rheological%20properties_PRG-UKZN.xlsx?dl=0</a>																																					
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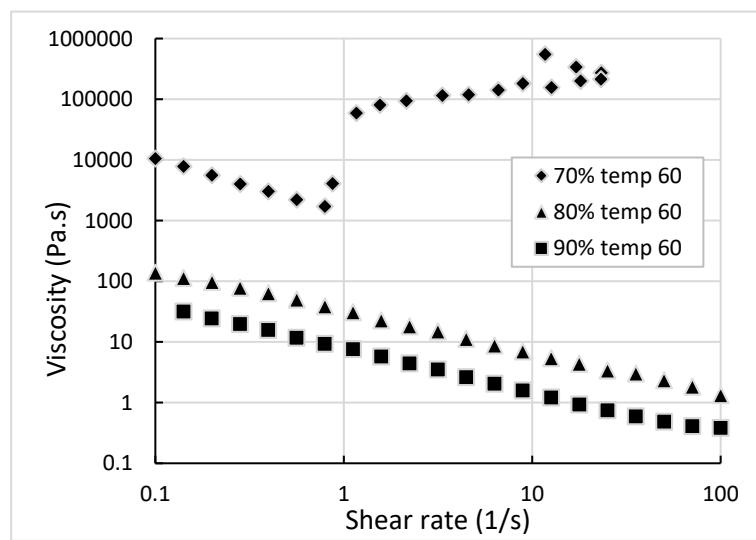
Viscosity versus shear rate as a function of moisture content (in log scale) at temperature 40°C



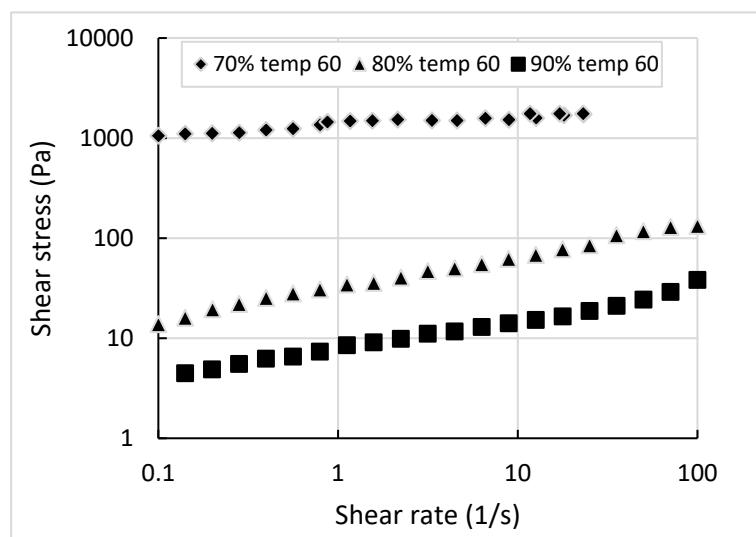
Shear stress versus shear rate as a function of moisture content (in log scale) at temperature 40°C



Viscosity versus shear rate as a function of moisture content (in log scale) at temperature 60°C



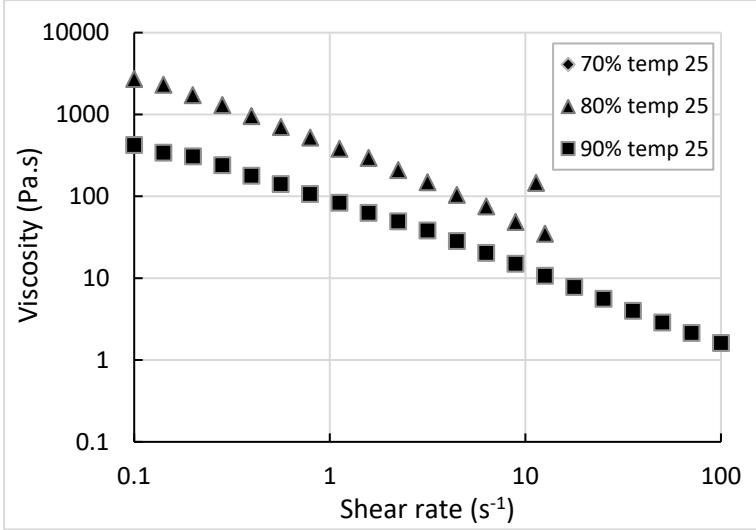
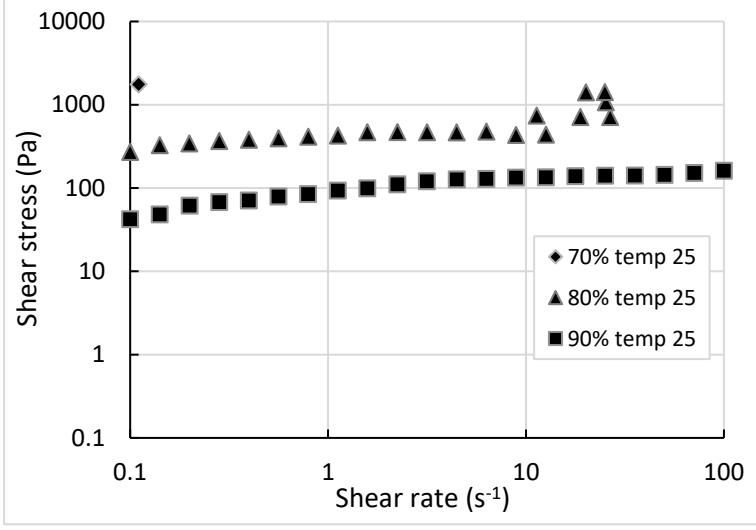
Shear stress versus shear rate as a function of moisture content (in log scale) at temperature 60°C



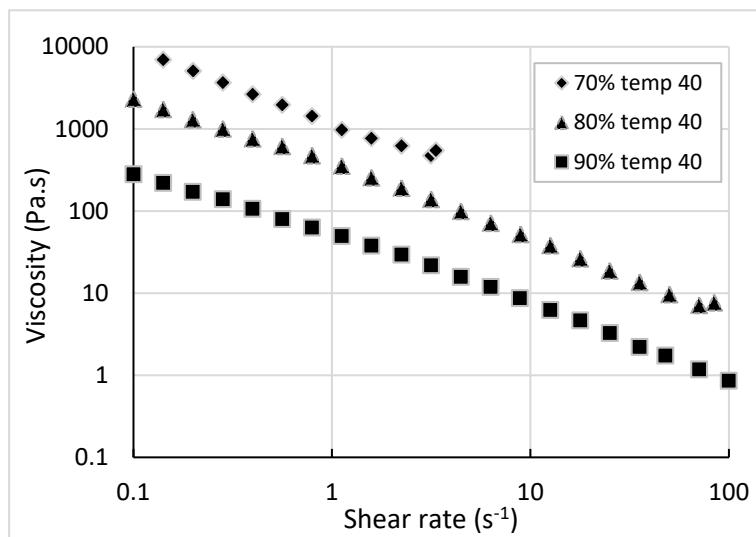
<u>General information</u>	
<b>Type of data</b>	Rheological properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 70%db
<b>Ash content</b>	~ 30%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory oven
<b>Drying time</b>	Until achieving 77%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form</b>	Sludge in a crucible
<b>Analysed parameters</b>	Viscosity and shear stress
<b>Employed method</b>	Rotational test in the rheometer <i>Anton Paar MCR 51</i> (SOP 8.8.4.1)
<u>Publications</u>	
Septien, S., Pocock, J., Teba, L., Velkushanova, K., & Buckley, C. A. (2018). Rheological characteristics of faecal sludge from VIP latrines and implications on pit emptying. <i>Journal of environmental management</i> , 228, 149-157.	

<u>Data source files</u>
<a href="https://www.dropbox.com/s/7hkn5o22aj70trs/Rheological%20properties%20of%20VIP%20FS%20%282014-2015%29.xlsx?dl=0">https://www.dropbox.com/s/7hkn5o22aj70trs/Rheological%20properties%20of%20VIP%20FS%20%282014-2015%29.xlsx?dl=0</a>
<u>Additional Notes</u>
<ul style="list-style-type: none"> <li>○ Increase of moisture content to 81, 84, 87 and 90%wt by the addition of water</li> </ul>
<u>Description of Data</u>
<p>Viscosity versus shear rate as a function of moisture content in log scale</p> <p>Observations:</p> <ul style="list-style-type: none"> <li>○ Shear thinning behavior (decrease of viscosity and increase of shear stress by increasing the shear rate)</li> <li>○ Lower shear stress and viscosity at higher moisture content</li> </ul>

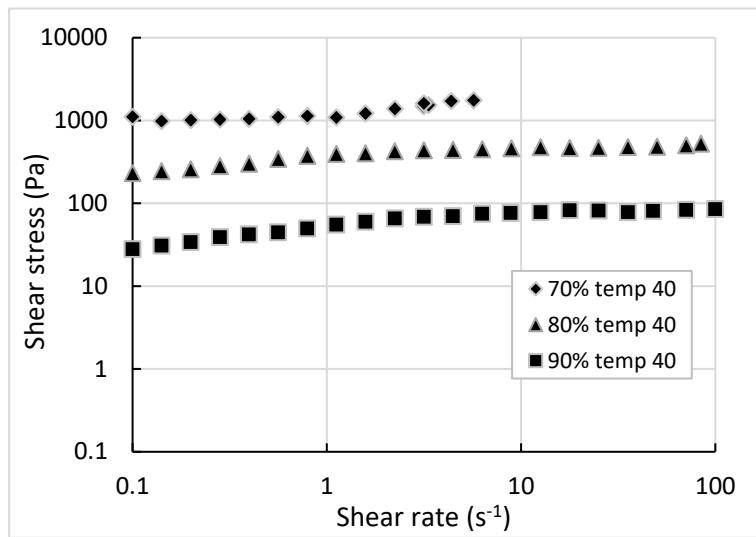
<u>General information</u>	
<b>Type of data</b>	Rheological properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine toilet (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	3 to 5 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 70, 80 and 90%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form</b>	Faecal sludge in a cup
<b>Analysed parameters</b>	Viscosity and shear stress at 25, 40 and 60°C
<b>Employed method</b>	Rotational test in the rheometer <i>Anton Paar MCR 72</i> (SOP 8.8.4.1)
<u>Publications</u>	
-	

Data source files																																					
<a href="https://www.dropbox.com/s/gor5qyq0yx0zh1y/2019-2020%20VIP%20Rheological%20Properties_PRG-UKZN%20graphs.xlsx?dl=0">https://www.dropbox.com/s/gor5qyq0yx0zh1y/2019-2020%20VIP%20Rheological%20Properties_PRG-UKZN%20graphs.xlsx?dl=0</a>																																					
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<u>Shear stress versus shear rate as a function of moisture content (in log scale) at temperature 25°C</u>  <table border="1"> <caption>Data points estimated from Shear stress vs Shear rate plot</caption> <thead> <tr> <th>Shear rate (<math>s^{-1}</math>)</th> <th>70% temp 25 (Pa)</th> <th>80% temp 25 (Pa)</th> <th>90% temp 25 (Pa)</th> </tr> </thead> <tbody> <tr><td>0.1</td><td>1500</td><td>500</td><td>300</td></tr> <tr><td>0.5</td><td>500</td><td>400</td><td>300</td></tr> <tr><td>1</td><td>500</td><td>400</td><td>300</td></tr> <tr><td>5</td><td>500</td><td>400</td><td>300</td></tr> <tr><td>10</td><td>800</td><td>600</td><td>400</td></tr> <tr><td>20</td><td>1200</td><td>800</td><td>500</td></tr> <tr><td>50</td><td>1500</td><td>1000</td><td>600</td></tr> <tr><td>100</td><td>1500</td><td>1000</td><td>600</td></tr> </tbody> </table>	Shear rate ( $s^{-1}$ )	70% temp 25 (Pa)	80% temp 25 (Pa)	90% temp 25 (Pa)	0.1	1500	500	300	0.5	500	400	300	1	500	400	300	5	500	400	300	10	800	600	400	20	1200	800	500	50	1500	1000	600	100	1500	1000	600	
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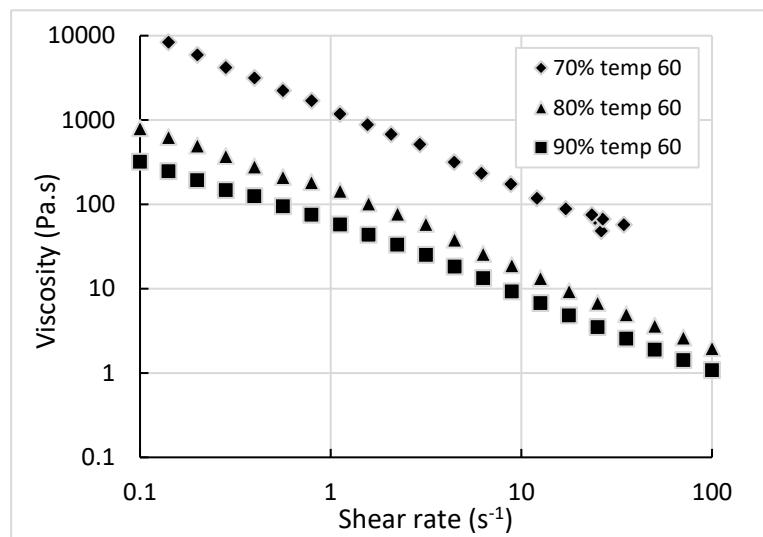
Viscosity versus shear rate as a function of moisture content (in log scale) at temperature 40°C



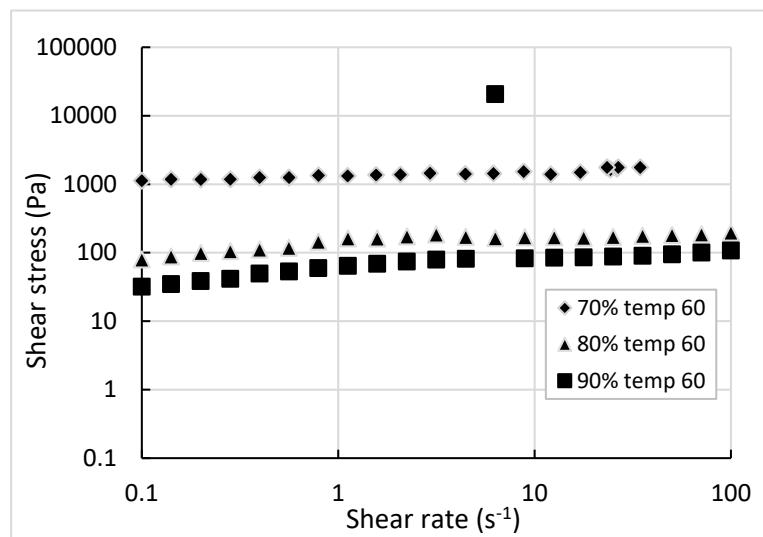
Shear stress versus shear rate as a function of moisture content (in log scale) at temperature 40°C



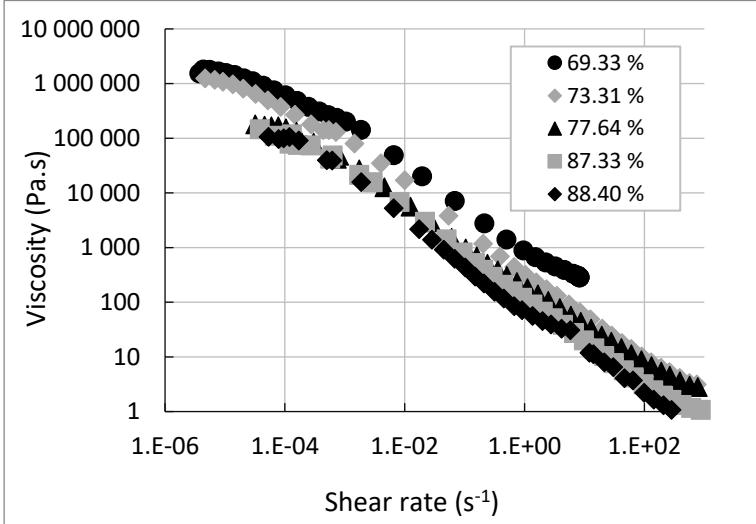
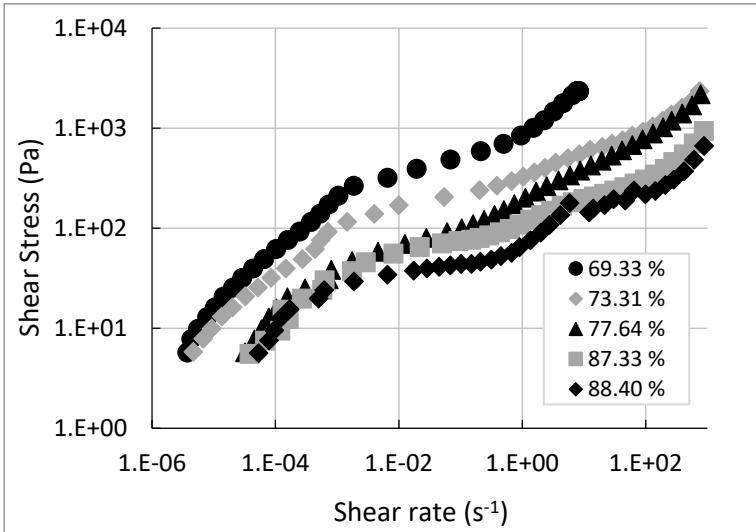
Viscosity versus shear rate as a function of moisture content (in log scale) at temperature 60°C

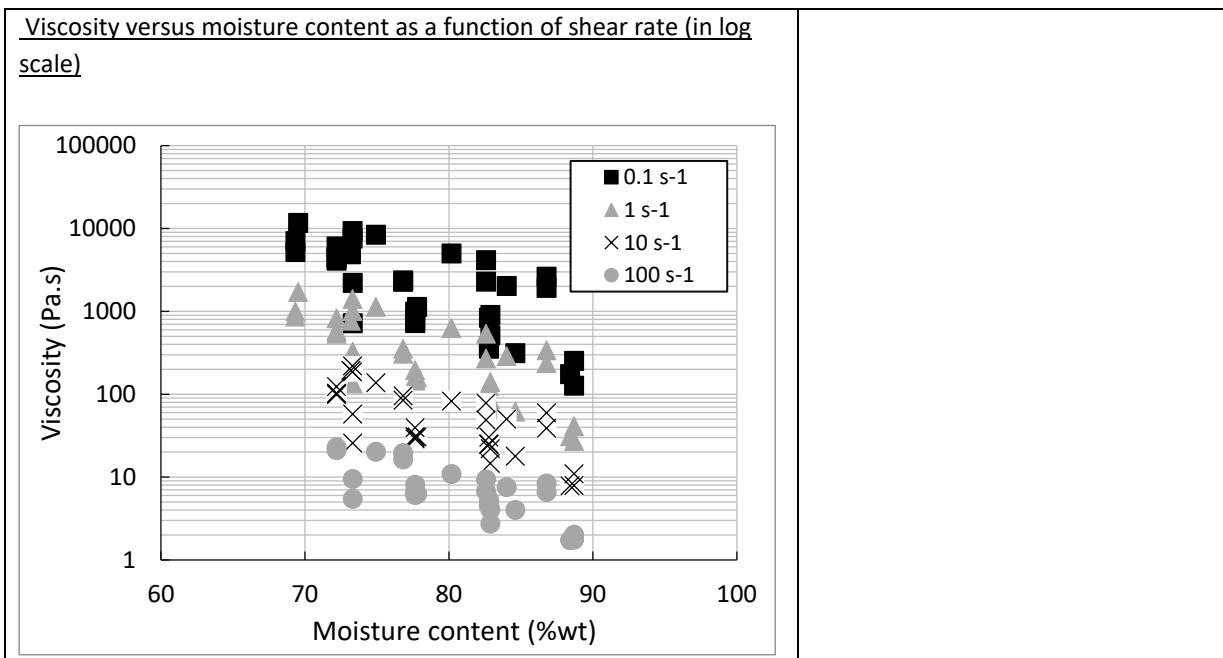


Shear stress versus shear rate as a function of moisture content (in log scale) at temperature 60°C



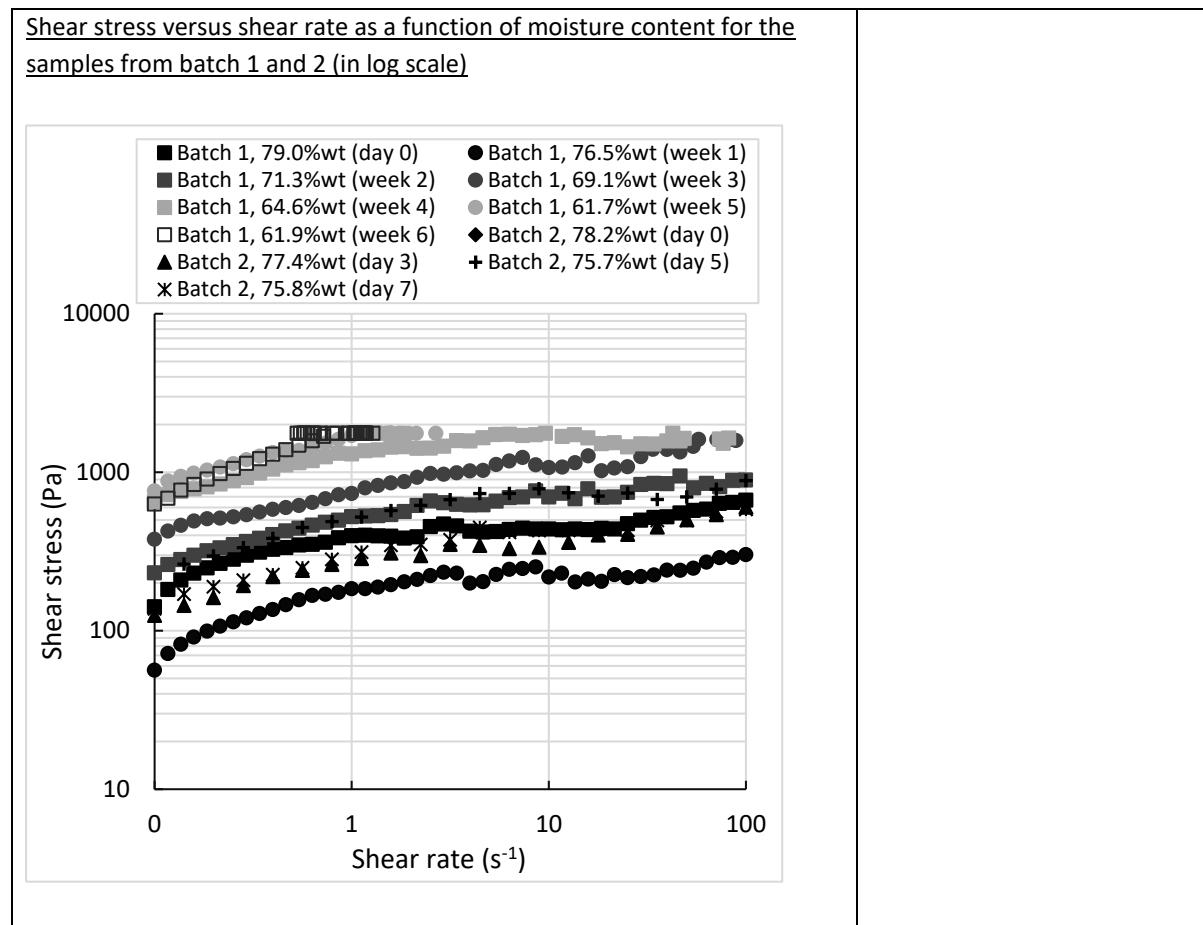
<u>General information</u>	
<b>Type of data</b>	Rheological properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2012 - 2013
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	70 to 90%wt
<b>Total solids content</b>	10 to 30%wt
<b>Volatile solids content</b>	80 to 95%db
<b>Ash content</b>	5 to 20%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	None
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	None
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample characteristics in the dryer</b>	N.A.
<b>Analysed parameters</b>	Viscosity and shear stress
<b>Employed method</b>	Rotational test in the rheometer Anton Paar MCR 51 (SOP 8.8.4.1)
<u>Publications</u>	
Woolley, S. M., Buckley, C. A., Pocock, J., & Foutch, G. L. (2014). Rheological modelling of fresh human faeces. <i>Journal of water, sanitation and hygiene for development</i> , 4(3), 484-489.	
Woolley, S. M., Cottingham, R. S., Pocock, J., & Buckley, C. A. (2014). Shear rheological properties of fresh human faeces with different moisture content. <i>Water SA</i> , 40(2), 273-276.	

<u>Data source files</u>	
<a href="https://www.dropbox.com/s/952jogm6tcfgraq/Rheological%20properties%20of%20fresh%20faeces%282012-2013%29.xlsx?dl=0">https://www.dropbox.com/s/952jogm6tcfgraq/Rheological%20properties%20of%20fresh%20faeces%282012-2013%29.xlsx?dl=0</a>	
<a href="https://www.dropbox.com/s/dzvc8huagzd1qh2/Fresh%20faeces_Viscosity%20vs%20Moisture%20content%20at%20Fixed%20Shear%20Rate%20%282012-2013%29.xlsx?dl=0">https://www.dropbox.com/s/dzvc8huagzd1qh2/Fresh%20faeces_Viscosity%20vs%20Moisture%20content%20at%20Fixed%20Shear%20Rate%20%282012-2013%29.xlsx?dl=0</a>	
<u>Additional Notes</u>	
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations from healthy young adults</li> <li>○ Rheological tests performed in each of the individual donations</li> </ul>	
<u>Description of Data</u>	
<u>Viscosity versus shear rate as a function of moisture content (in log scale)</u>  <p>The graph shows a clear shear thinning behavior, where viscosity decreases as the shear rate increases. The data points are clustered at higher shear rates (around <math>10^0</math> to <math>10^1 \text{ s}^{-1}</math>) and lower viscosities (around 100 to 1000 Pa.s). At very low shear rates (<math>10^{-6}</math> to <math>10^{-4} \text{ s}^{-1}</math>), the viscosity values are significantly higher (around 100,000 to 1,000,000 Pa.s).</p>	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Shear thinning behavior (decrease of viscosity and increase of shear stress by increasing the shear rate)</li> <li>○ Lower shear stress and viscosity at higher moisture content</li> </ul>
<u>Shear stress versus shear rate as a function of moisture content (in log scale)</u>  <p>The graph illustrates shear thickening behavior, where shear stress increases with shear rate. All data series show a similar trend, with shear stress rising sharply from very low shear rates (around <math>10^{-6}</math> to <math>10^{-4} \text{ s}^{-1}</math>) and lower shear stresses (around 10 to 100 Pa). As the shear rate increases, the shear stress also increases, reaching values between 1000 and 3000 Pa at the highest shear rates shown.</p>	



<u>General information</u>	
<b>Type of data</b>	Rheological properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~80%wt
<b>Total solids content</b>	~20%wt
<b>Volatile solids content</b>	~85%db
<b>Ash content</b>	~15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Natural drying (in the open-air)
<b>Drying time</b>	16 weeks
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Ambient temperature (~ 20°C)</li> <li>○ Ambient relative humidity (~ 60%)</li> </ul>
<b>Sample form in the dryer</b>	900 g of sample placed in 1 L plastic bucket
<b>Analysed parameters</b>	Viscosity and shear stress
<b>Employed method</b>	Rotational test in the rheometer Anton Paar MCR 51 (SOP Method 8.8.4.1)
<u>Publications</u>	
-	

Data source files	
<a href="https://www.dropbox.com/s/xbv6su0jxsiplk/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PRG.xlsx?dl=0">https://www.dropbox.com/s/xbv6su0jxsiplk/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20the%20open%20air_UKZN%20PRG.xlsx?dl=0</a>	
<a href="https://www.dropbox.com/s/a0g1023a6uoc5gk/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20open%20air%20Batch%202_%20Reological%20properties_UKZN%20PRG.xlsx?dl=0">https://www.dropbox.com/s/a0g1023a6uoc5gk/2019-2020%20Natural%20drying%20of%20fresh%20faeces%20in%20open%20air%20Batch%202_%20Reological%20properties_UKZN%20PRG.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ Containers with sample placed in a ventilated area</li> <li>○ Mesh placed at the opening of the container to avoid the development of maggots</li> <li>○ Samples from batch 1 analysed in a weekly basis for 16 weeks</li> <li>○ Samples from batch 2 analysed at days 0, 3, 5 and 7 during one week</li> </ul>	
Description of Data	
<p><u>Viscosity versus shear rate as a function of moisture content for the samples from batch 1 and 2 (in log scale)</u></p> <p>Legend:</p> <ul style="list-style-type: none"> <li>Batch 1, 76.5%wt (week 1)</li> <li>Batch 1, 71.3%wt (week 2)</li> <li>Batch 1, 64.6%wt (week 4)</li> <li>Batch 1, 61.9%wt (week 6)</li> <li>Batch 2, 77.4%wt (day 3)</li> <li>Batch 2, 75.8%wt (day 7)</li> <li>Batch 1, 79.0%wt (day 0)</li> <li>Batch 1, 69.1%wt (week 3)</li> <li>Batch 1, 61.7%wt (week 5)</li> <li>Batch 2, 78.2%wt (day 0)</li> <li>+ Batch 2, 75.7%wt (day 5)</li> </ul>	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Shear thinning behavior (decrease of viscosity and increase of shear stress by increasing the shear rate)</li> <li>○ Reduction in viscosity and shear stress in week 1</li> <li>○ Increase of shear stress and viscosity by increasing moisture content after week 1</li> <li>○ Not possible to induce a flow below 61.9 %wt moisture content (after six weeks of drying)</li> </ul>



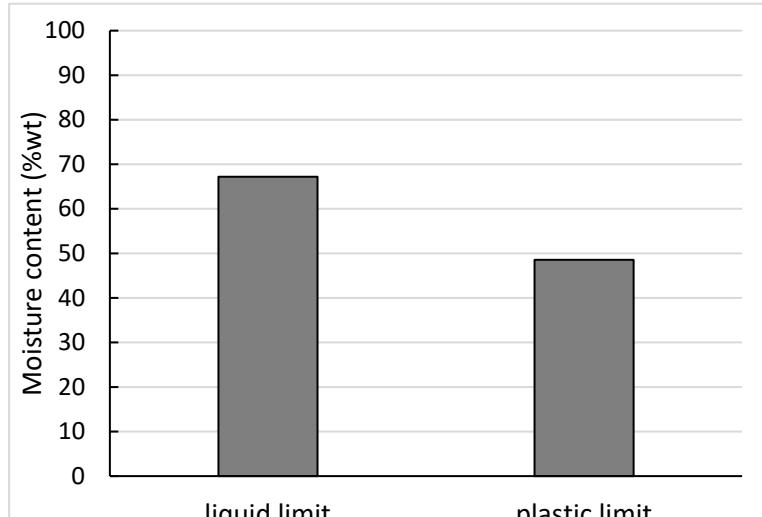
<u>General information</u>	
<b>Type of data</b>	Viscoelastic properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 70%db
<b>Ash content</b>	~ 30%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory oven
<b>Drying time</b>	Until achieving 77, 75 and 69%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form</b>	Sludge in a crucible
<b>Analysed parameters</b>	Loss and storage modulus
<b>Employed method</b>	Dynamic test in the rheometer <i>Anton Paar MCR 51</i> (SOP 8.8.4.1)
<u>Publications</u>	
-	

Data source files	
<a href="https://www.dropbox.com/s/pelvw9356fuux11/VIP%20Viscoelastic%20properties_%282014-2015%29.xlsx?dl=0">https://www.dropbox.com/s/pelvw9356fuux11/VIP%20Viscoelastic%20properties_%282014-2015%29.xlsx?dl=0</a>	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Increase of moisture content to 82 and 84%wt by the addition of water</li> <li>○ Loss and storage modulus referring to the viscous and elastic component respectively</li> </ul>	
Description of Data	
<p><u>Loss modulus versus frequency as a function of moisture content (in log scale)</u></p> <p>Loss modulus (Pa)</p> <p>Frequency (1/s)</p> <p>■ 69%wt ▲ 75%wt ■ 77%wt ▲ 81%wt □ 82%wt △ 84%wt</p>	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Linear viscoelastic region (loss and storage modulus constant across the frequency range)</li> <li>○ Sludge at rest more elastic than viscous (storage modulus &gt; loss modulus)</li> </ul>
<p><u>Storage modulus versus frequency as a function of moisture content (in log scale)</u></p> <p>storage modulus (Pa)</p> <p>Frequency (1/s)</p> <p>■ 69%wt ▲ 75%wt ■ 77%wt ▲ 81%wt □ 82%wt △ 84%wt</p>	

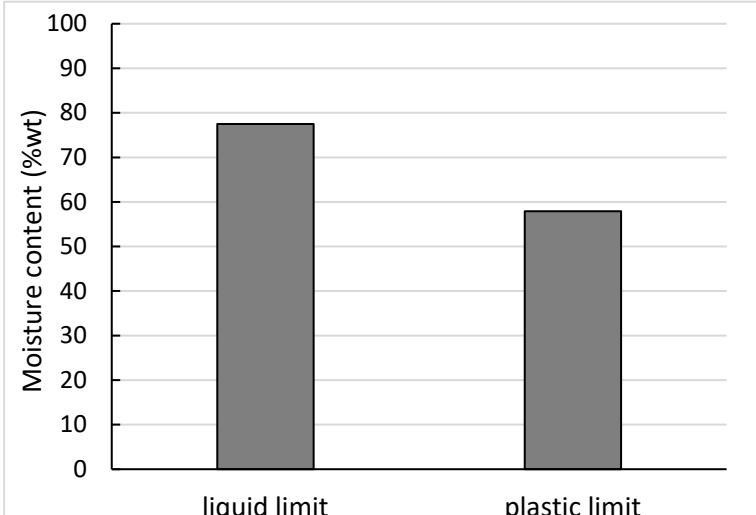
<u>General information</u>	
<b>Type of data</b>	Plastic properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 70%db
<b>Ash content</b>	~ 30%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	Screening to remove the large pieces of trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Atterberg limits (plastic and liquid limits)
<b>Employed method</b>	Penetrometer ( SOP 8.8.4.2)
<u>Publications</u>	
Septien, S., Singh, A., Mirara, S. W., Teba, L., Velkushanova, K., & Buckley, C. A. (2018). 'LaDePa' process for the drying and pasteurization of faecal sludge from VIP latrines using infrared radiation. <i>South African journal of chemical engineering</i> , 25, 147-158.	

<u>Data source files</u>									
-									
<u>Additional Notes</u>									
<ul style="list-style-type: none"><li>○ Decrease of moisture content of the sludge by adding dried sludge or wood sawdust</li></ul>									
<u>Description of Data</u>									
Moisture content of the sludge at the liquid and plastic limits	<p>Observations:</p> <ul style="list-style-type: none"><li>○ Raw sludge beyond the liquid limit</li><li>○ Faster transition to semi-solid and solid state using sawdust than dried sludge to lower moisture content (higher liquid and plastic limit)</li></ul>								
<p>A bar chart comparing the moisture content of two sludge mixtures. The y-axis represents 'Moisture content (%wt)' from 0 to 1. The x-axis shows two categories: 'FS mix with dried sludge' and 'FS mix with sawdust'. For each category, there are two bars: a light gray bar for 'Liquid limit' and a black bar for 'Plastic limit'. The 'FS mix with dried sludge' has a liquid limit of approximately 0.68%wt and a plastic limit of approximately 0.62%wt. The 'FS mix with sawdust' has a liquid limit of approximately 0.73%wt and a plastic limit of approximately 0.71%wt.</p> <table border="1"><thead><tr><th>Mix Type</th><th>Liquid limit (%wt)</th><th>Plastic limit (%wt)</th></tr></thead><tbody><tr><td>FS mix with dried sludge</td><td>~0.68</td><td>~0.62</td></tr><tr><td>FS mix with sawdust</td><td>~0.73</td><td>~0.71</td></tr></tbody></table>	Mix Type	Liquid limit (%wt)	Plastic limit (%wt)	FS mix with dried sludge	~0.68	~0.62	FS mix with sawdust	~0.73	~0.71
Mix Type	Liquid limit (%wt)	Plastic limit (%wt)							
FS mix with dried sludge	~0.68	~0.62							
FS mix with sawdust	~0.73	~0.71							

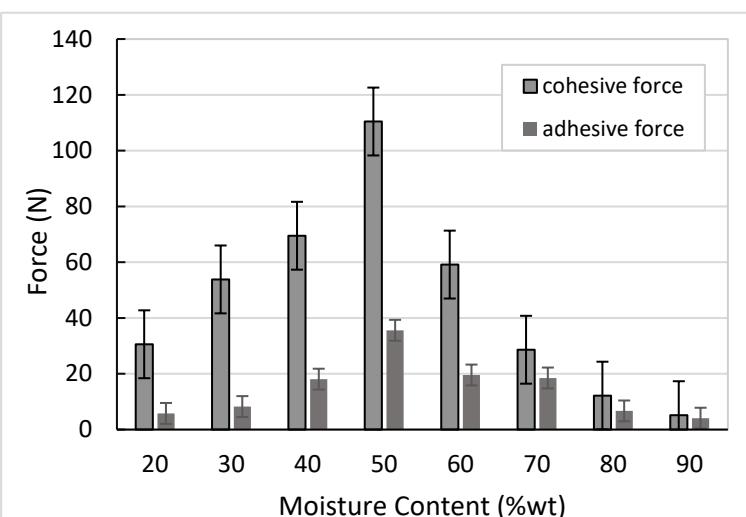
<u>General information</u>	
<b>Type of data</b>	Plastic properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 20, 30, 40, 50, 60, 70, 80 and 90%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form in the dryer</b>	Faecal sludge spread in a tray
<b>Analysed parameters</b>	Atterberg limits (plastic and liquid limits)
<b>Employed method</b>	Penetrometer (SOP 8.8.4.2)
<u>Publications</u>	
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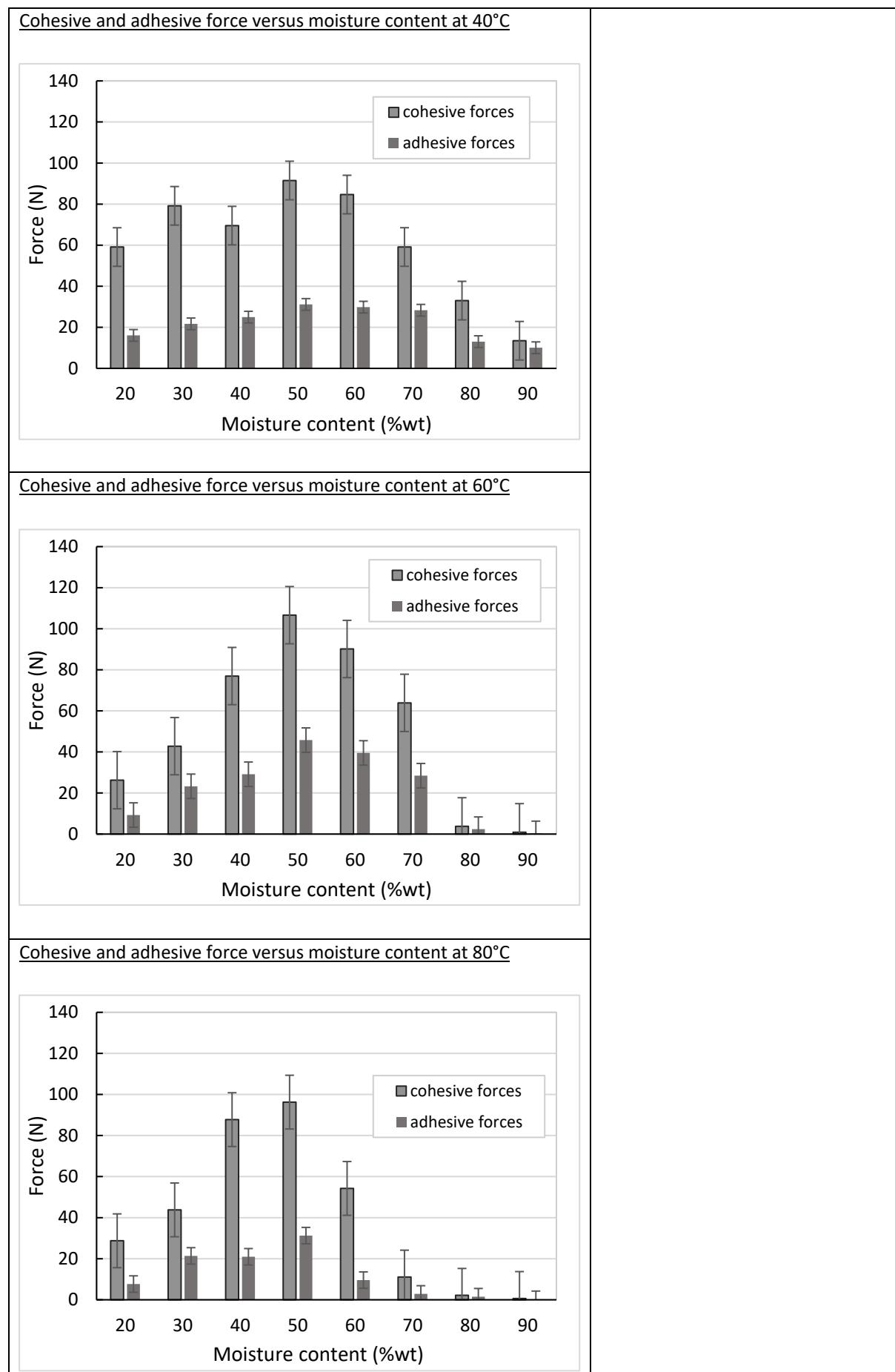
<u>Data source files</u>							
<a href="https://www.dropbox.com/s/hknu2xe8ymek4ai/2019-2020%20Cone%20 penetrometer%20tests_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/hknu2xe8ymek4ai/2019-2020%20Cone%20 penetrometer%20tests_PRG-UKZN.xlsx?dl=0</a>							
<u>Additional Notes</u>							
-							
<u>Description of Data</u>							
<p>Moisture content of the sludge at the liquid and plastic limits</p>  <p>A bar chart comparing the moisture content of sludge at two specific limits. The vertical axis represents 'Moisture content (%wt)' from 0 to 100 in increments of 10. The horizontal axis has two categories: 'liquid limit' and 'plastic limit'. The bar for the liquid limit reaches approximately 68%, while the bar for the plastic limit reaches approximately 48%. Both bars are dark grey.</p> <table border="1"><thead><tr><th>Limit</th><th>Moisture content (%wt)</th></tr></thead><tbody><tr><td>liquid limit</td><td>~68</td></tr><tr><td>plastic limit</td><td>~48</td></tr></tbody></table>	Limit	Moisture content (%wt)	liquid limit	~68	plastic limit	~48	<p><u>Observations</u></p> <ul style="list-style-type: none"><li>○ Liquid limit at around 70%wt moisture content</li><li>○ Plastic limit at around 50%wt moisture content</li></ul>
Limit	Moisture content (%wt)						
liquid limit	~68						
plastic limit	~48						

<u>General information</u>	
<b>Type of data</b>	Plastic properties
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine toilet (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 20, 30, 40, 50, 60, 70, 80 and 90%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form in the dryer</b>	Faecal sludge spread in a tray
<b>Analysed parameters</b>	Atterberg limits (plastic and liquid limits)
<b>Employed method</b>	Penetrometer (SOP 8.8.4.2)
<u>Publications</u>	
-	

<u>Data source files</u>							
<a href="https://www.dropbox.com/s/hknu2xe8ymek4ai/2019-2020%20Cone%20 penetrometer%20tests_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/hknu2xe8ymek4ai/2019-2020%20Cone%20 penetrometer%20tests_PRG-UKZN.xlsx?dl=0</a>							
<u>Additional Notes</u>							
-							
<u>Description of Data</u>							
<p>Moisture content of the sludge at the liquid and plastic limits</p>  <p>A bar chart comparing the moisture content of sludge at two specific limits. The vertical axis represents 'Moisture content (%wt)' from 0 to 100 in increments of 10. The horizontal axis shows two categories: 'liquid limit' and 'plastic limit'. Two grey bars are plotted: the 'liquid limit' bar reaches approximately 78%, and the 'plastic limit' bar reaches approximately 58%.</p> <table border="1"><thead><tr><th>Limit</th><th>Moisture content (%wt)</th></tr></thead><tbody><tr><td>liquid limit</td><td>78</td></tr><tr><td>plastic limit</td><td>58</td></tr></tbody></table>	Limit	Moisture content (%wt)	liquid limit	78	plastic limit	58	<p><u>Observations</u></p> <ul style="list-style-type: none"><li>○ Liquid limit at around 80%wt moisture content</li><li>○ Plastic limit at around 60%wt moisture content</li></ul>
Limit	Moisture content (%wt)						
liquid limit	78						
plastic limit	58						

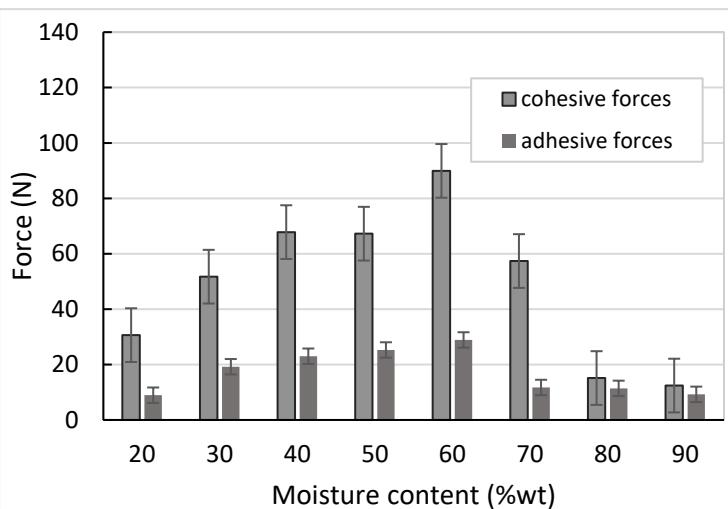
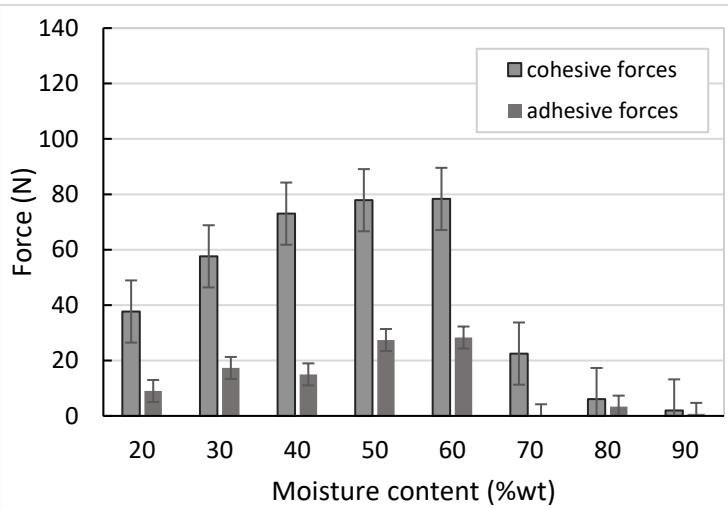
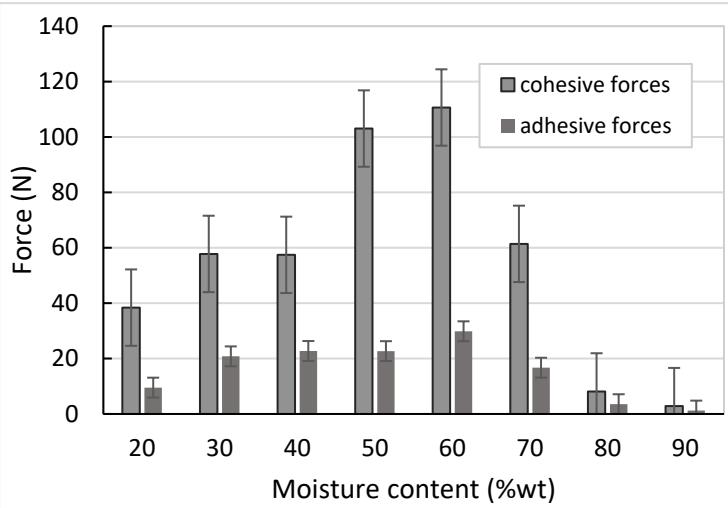
<u>General information</u>	
<b>Type of data</b>	Stickiness
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal, Durban, South Africa
<b>Dates of the experiments</b>	2019 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilet (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form</b>	Faecal sludge in a recipient
<b>Analysed parameters</b>	Adhesive and cohesive forces at 25, 40, 60 and 80°C
<b>Employed method</b>	Use of the <i>Stable microsystems TA. XT express</i> texture analyser at different temperatures (25, 40, 60 and 80°C) (SOP 8.8.4.5)
<u>Publications</u>	
-	

<u>Data source files</u>																												
<a href="https://www.dropbox.com/s/6bgaz9t6juefmbz/2019%20-%202020%20UDDT%20Stickiness_PRG.xlsx?dl=0">https://www.dropbox.com/s/6bgaz9t6juefmbz/2019%20-%202020%20UDDT%20Stickiness_PRG.xlsx?dl=0</a>																												
<a href="https://www.dropbox.com/s/ftc2fgreukf5krp/2019-2020%20UDDT%20Stickiness%20at%2040%20degrees%20C_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/ftc2fgreukf5krp/2019-2020%20UDDT%20Stickiness%20at%2040%20degrees%20C_PRG-UKZN.xlsx?dl=0</a>																												
<a href="https://www.dropbox.com/s/6q4u2o9b6ulwkw1/2019-2020%20UDDT%20Stickiness%20at%2060%20degrees%20C_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/6q4u2o9b6ulwkw1/2019-2020%20UDDT%20Stickiness%20at%2060%20degrees%20C_PRG-UKZN.xlsx?dl=0</a>																												
<a href="https://www.dropbox.com/s/rbw8oiojh6r05yn/2019-2020%20UDDT%20Stickiness%20at%2080%20degrees%20C_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/rbw8oiojh6r05yn/2019-2020%20UDDT%20Stickiness%20at%2080%20degrees%20C_PRG-UKZN.xlsx?dl=0</a>																												
<u>Additional Notes</u>																												
<ul style="list-style-type: none"> <li>○ Use of a compression plate probe for the tests in the texture analyser</li> <li>○ The moisture content of the sludge increased by adding water</li> </ul>																												
<u>Description of Data</u>																												
<u>Cohesive and adhesive force versus moisture content at 25°C</u>  <table border="1"> <caption>Data extracted from Cohesive and adhesive force versus moisture content at 25°C chart</caption> <thead> <tr> <th>Moisture Content (%wt)</th> <th>Cohesive Force (N)</th> <th>Adhesive Force (N)</th> </tr> </thead> <tbody> <tr><td>20</td><td>30</td><td>10</td></tr> <tr><td>30</td><td>55</td><td>10</td></tr> <tr><td>40</td><td>70</td><td>20</td></tr> <tr><td>50</td><td>110</td><td>35</td></tr> <tr><td>60</td><td>55</td><td>20</td></tr> <tr><td>70</td><td>30</td><td>20</td></tr> <tr><td>80</td><td>10</td><td>10</td></tr> <tr><td>90</td><td>5</td><td>5</td></tr> </tbody> </table>	Moisture Content (%wt)	Cohesive Force (N)	Adhesive Force (N)	20	30	10	30	55	10	40	70	20	50	110	35	60	55	20	70	30	20	80	10	10	90	5	5	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Sticky region between 40 and 60%wt at 25, 40, 60 and 80°C</li> <li>○ Stickiness peak achieved at 50%wt at 25, 40, 60 and 80°C</li> <li>○ Cohesive forces greater than adhesive forces</li> </ul>
Moisture Content (%wt)	Cohesive Force (N)	Adhesive Force (N)																										
20	30	10																										
30	55	10																										
40	70	20																										
50	110	35																										
60	55	20																										
70	30	20																										
80	10	10																										
90	5	5																										



<u>General information</u>	
<b>Type of data</b>	Stickiness
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2019-2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine toilet (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Small amounts of trash
<b>Pre-treatment</b>	Trash removal
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form</b>	Faecal sludge in a recipient
<b>Analysed parameters</b>	Adhesive and cohesive forces at 25, 40, 60 and 80°C
<b>Employed method</b>	Use of the <i>Stable Microsystems TA. XT express</i> texture analyser at different temperatures (25, 40, 60 and 80°C) (SOP 8.8.4.5)
<u>Publications</u>	
-	

<u>Data source files</u>																												
<a href="https://www.dropbox.com/s/lvl7yyk47okwtfn/2019%20-2020%20VIP%20Stickiness%20at%2025%20Degrees%20%28Ambient%20temp%29_PRG.xlsx?dl=0">https://www.dropbox.com/s/lvl7yyk47okwtfn/2019%20-2020%20VIP%20Stickiness%20at%2025%20Degrees%20%28Ambient%20temp%29_PRG.xlsx?dl=0</a>																												
<a href="https://www.dropbox.com/s/hudmu0dbx55rz3o/2019-2020VIP%20Stickiness%20at%2040%20degrees%20C_PRG-UKZN.xlsx?dl=0">https://www.dropbox.com/s/hudmu0dbx55rz3o/2019-2020VIP%20Stickiness%20at%2040%20degrees%20C_PRG-UKZN.xlsx?dl=0</a>																												
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<u>Additional Notes</u>																												
<ul style="list-style-type: none"> <li>○ Use of a compression plate probe for the tests in the texture analyser</li> <li>○ The moisture content of the sludge increased by adding water</li> </ul>																												
<u>Description of Data</u>																												
<u>Cohesive and adhesive force versus moisture content at 25°C</u> <table border="1"> <caption>Data extracted from the chart</caption> <thead> <tr> <th>Moisture content (%wt)</th> <th>Cohesive force (N)</th> <th>Adhesive force (N)</th> </tr> </thead> <tbody> <tr><td>20</td><td>30</td><td>10</td></tr> <tr><td>30</td><td>45</td><td>15</td></tr> <tr><td>40</td><td>60</td><td>25</td></tr> <tr><td>50</td><td>70</td><td>25</td></tr> <tr><td>60</td><td>75</td><td>30</td></tr> <tr><td>70</td><td>35</td><td>25</td></tr> <tr><td>80</td><td>15</td><td>10</td></tr> <tr><td>90</td><td>10</td><td>5</td></tr> </tbody> </table>	Moisture content (%wt)	Cohesive force (N)	Adhesive force (N)	20	30	10	30	45	15	40	60	25	50	70	25	60	75	30	70	35	25	80	15	10	90	10	5	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Sticky region between 40 and 60%wt at 25, 40, 60 and 80°C</li> <li>○ Stickiness peak achieved at 60%wt at 25, 40, 60 and 80°C</li> <li>○ Cohesive forces greater than adhesive forces</li> <li>○ Higher cohesive and adhesive forces at the sticky point at 80°C compared to lower temperatures</li> </ul>
Moisture content (%wt)	Cohesive force (N)	Adhesive force (N)																										
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90	10	5																										

Cohesive and adhesive force versus moisture content at 40°CCohesive and adhesive force versus moisture content at 60°CCohesive and adhesive force versus moisture content at 80°C

# DEWATERING

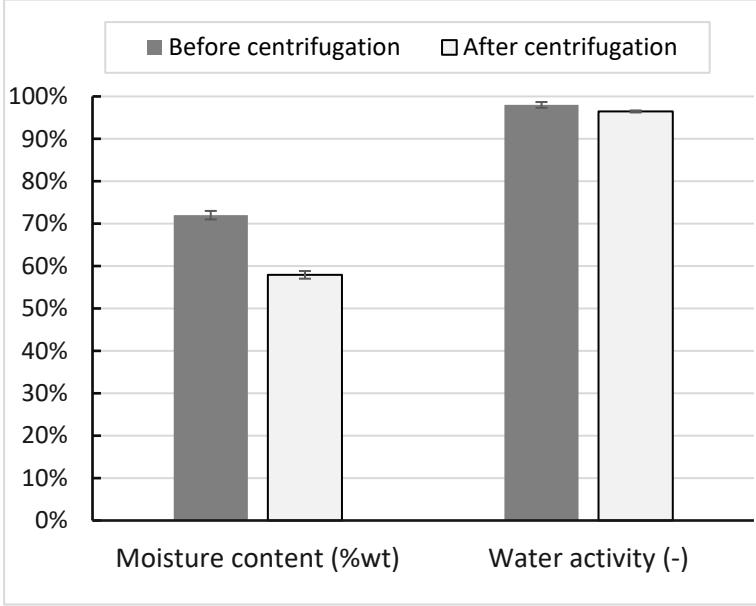
<u>General information</u>	
<b>Type of data</b>	Centrifugation
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reactor (ABR) from a decentralised wastewater treatment plant (DEWAT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 75%db
<b>Ash content</b>	~ 25%db
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Moisture content (1) and water activity (2) of the cake after centrifugation
<b>Employed methods</b>	Direct measurement by the moisture analyzer balance <i>PCE-MB Series</i> (1) (SOP 8.7.1.5) and the water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (2) (SOP 8.8.3.3)
<u>Publications</u>	
Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.	

<u>Data source files</u>														
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<ul style="list-style-type: none"> <li>○ Centrifugation done in a centrifuge <i>HERMLE Z323</i>, during 120 minutes at a rate of 5000 RPM, for 40 g of sample per centrifuge tube</li> </ul>														
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<p><u>Moisture content and water activity of the cake before and after centrifugation</u></p> <table border="1"> <caption>Data extracted from the chart</caption> <thead> <tr> <th>Parameter</th> <th>Condition</th> <th>Value (%)</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Moisture content (%wt)</td> <td>Before centrifugation</td> <td>~87</td> </tr> <tr> <td>After centrifugation</td> <td>~73</td> </tr> <tr> <td rowspan="2">Water activity (-)</td> <td>Before centrifugation</td> <td>~95</td> </tr> <tr> <td>After centrifugation</td> <td>~95</td> </tr> </tbody> </table>	Parameter	Condition	Value (%)	Moisture content (%wt)	Before centrifugation	~87	After centrifugation	~73	Water activity (-)	Before centrifugation	~95	After centrifugation	~95	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Considerable decrease of the moisture content after centrifugation</li> <li>○ Similar water activity of the sludge before and after centrifugation</li> </ul>
Parameter	Condition	Value (%)												
Moisture content (%wt)	Before centrifugation	~87												
	After centrifugation	~73												
Water activity (-)	Before centrifugation	~95												
	After centrifugation	~95												

<u>General information</u>	
<b>Type of data</b>	Centrifugation
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 55%db
<b>Ash content</b>	~ 45%db
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Moisture content (1) and water activity (2) of the cake after centrifugation
<b>Employed methods</b>	(1) Use of moisture analyzer balance <i>PCE-MB Series</i> (SOP 8.7.1.5) (2) Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
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Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.	

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<u>Description of Data</u>																													
<p>Moisture content and water activity of the cake before and after centrifugation</p> <p>The chart displays two sets of data: Moisture content (%wt) and Water Activity (-). The y-axis for both ranges from 0% to 100%. The x-axis shows four groups of bars corresponding to the centrifugation conditions. In each group, the first bar represents Raw sludge, and the subsequent three represent the treated samples.</p> <table border="1"> <thead> <tr> <th>Parameter</th> <th>Condition</th> <th>Raw Sludge</th> <th>8 000 RPM - 20 MIN</th> <th>6 000 RPM - 20 MIN</th> <th>5 000 RPM - 120 MIN</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Moisture content (%wt)</td> <td>Raw Sludge</td> <td>~73</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>8 000 RPM - 20 MIN</td> <td>-</td> <td>~64</td> <td>~71</td> <td>~68</td> </tr> <tr> <td rowspan="2">Water Activity (-)</td> <td>Raw Sludge</td> <td>~97</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>8 000 RPM - 20 MIN</td> <td>~97</td> <td>~97</td> <td>~97</td> <td>~97</td> </tr> </tbody> </table>	Parameter	Condition	Raw Sludge	8 000 RPM - 20 MIN	6 000 RPM - 20 MIN	5 000 RPM - 120 MIN	Moisture content (%wt)	Raw Sludge	~73	-	-	-	8 000 RPM - 20 MIN	-	~64	~71	~68	Water Activity (-)	Raw Sludge	~97	-	-	-	8 000 RPM - 20 MIN	~97	~97	~97	~97	<p>Observations:</p> <ul style="list-style-type: none"> <li>○ Slight decrease of moisture content after centrifugation</li> <li>○ Almost no variation of water activity after centrifugation</li> <li>○ Better dewatering at high RPM or long times</li> </ul>
Parameter	Condition	Raw Sludge	8 000 RPM - 20 MIN	6 000 RPM - 20 MIN	5 000 RPM - 120 MIN																								
Moisture content (%wt)	Raw Sludge	~73	-	-	-																								
	8 000 RPM - 20 MIN	-	~64	~71	~68																								
Water Activity (-)	Raw Sludge	~97	-	-	-																								
	8 000 RPM - 20 MIN	~97	~97	~97	~97																								

<u>General information</u>	
<b>Type of data</b>	Centrifugation
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from dry ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 75%wt
<b>Total solids content</b>	~ 25%wt
<b>Volatile solids content</b>	~ 40%db
<b>Ash content</b>	~ 60%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Moisture content and water activity of the cake after centrifugation
<b>Employed methods</b>	(1) Use of moisture analyzer balance PCE-MB Series (SOP 8.7.1.5) (2) Use of water activity analyzer AquaLab Tunable Diode Laser-TDL (SOP 8.8.3.3)
<u>Publications</u>	
Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.	

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<ul style="list-style-type: none"> <li>○ Centrifugation done in a centrifuge HERMLE Z323, during 120 minutes at a rate of 5000 RPM, for 40 g of sample per centrifuge tube</li> </ul>										
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<u>Moisture content and water activity of the cake before and after centrifugation</u>  <table border="1"> <caption>Data extracted from the bar chart</caption> <thead> <tr> <th>Parameter</th> <th>Before centrifugation (%wt)</th> <th>After centrifugation (%wt)</th> </tr> </thead> <tbody> <tr> <td>Moisture content</td> <td>~72</td> <td>~58</td> </tr> <tr> <td>Water activity</td> <td>~98</td> <td>~97</td> </tr> </tbody> </table>	Parameter	Before centrifugation (%wt)	After centrifugation (%wt)	Moisture content	~72	~58	Water activity	~98	~97	<u>Observations:</u> <ul style="list-style-type: none"> <li>○ Considerable decrease of the moisture content after centrifugation</li> <li>○ Slight decrease of the water activity of the sludge after centrifugation</li> </ul>
Parameter	Before centrifugation (%wt)	After centrifugation (%wt)								
Moisture content	~72	~58								
Water activity	~98	~97								

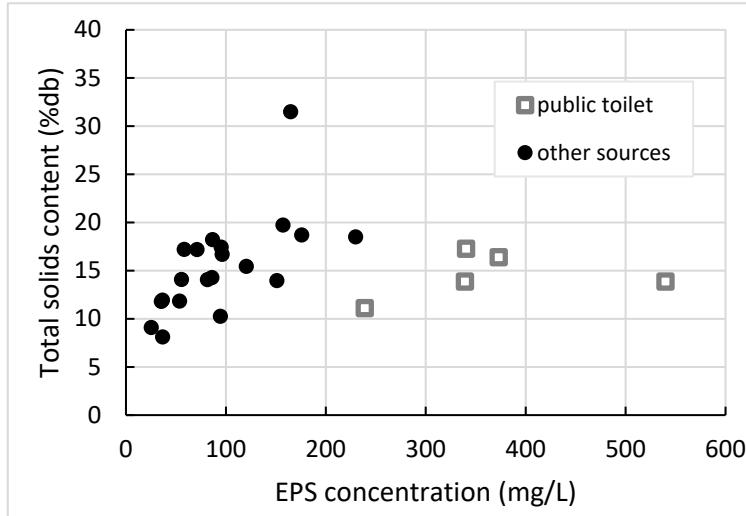
<u>General information</u>	
<b>Type of data</b>	Centrifugation
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from wet ventilated pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Moisture content (1) and water activity (2) of the cake after centrifugation
<b>Employed methods</b>	(3) Use of moisture analyzer balance <i>PCE-MB Series</i> (SOP 8.7.1.5) (4) Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.	

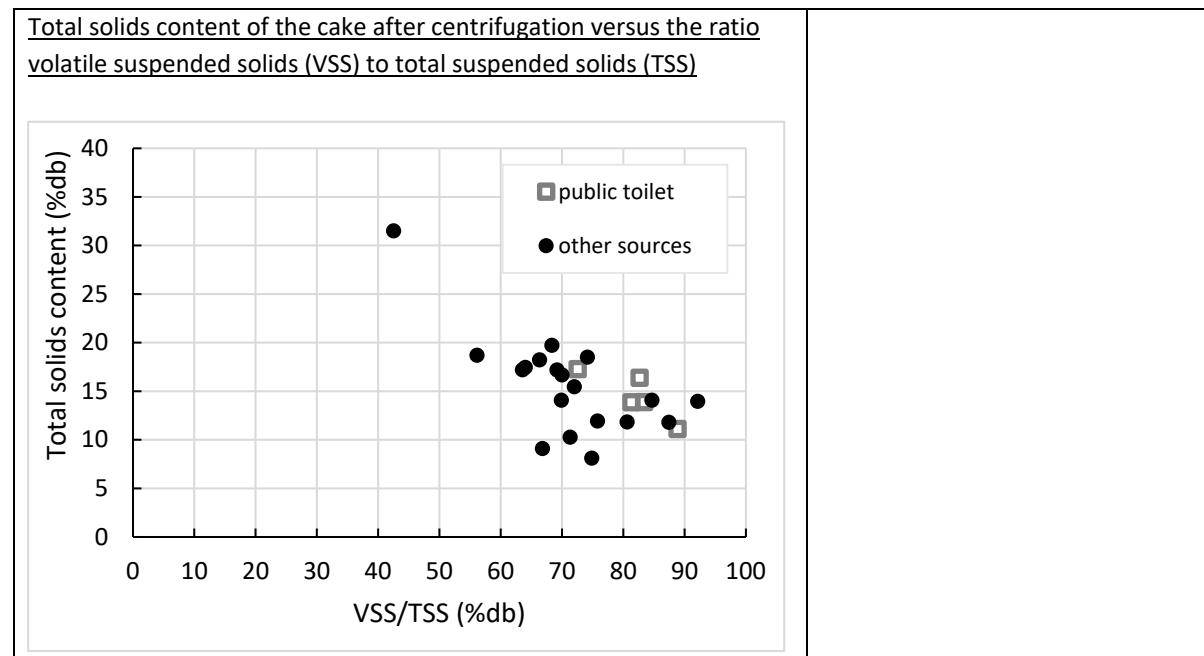
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<u>Additional Notes</u>																
<ul style="list-style-type: none"> <li>○ Centrifugation done in a centrifuge <i>HERMLE Z323</i>, during 20 minutes at a rate of 6000, 8000 and 10000 RPM, for 40 g of sample per centrifuge tube</li> </ul>																
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Parameter	Raw sludge	6 000 RPM - 20 MIN	8 000 RPM - 20 MIN	10 000 RPM - 20 MIN												
Moisture content (%wt)	~95	~85	~78	~72												
Water Activity (-)	~1.00	~1.00	~1.00	~1.00												

<u>General information</u>	
<b>Type of data</b>	Centrifugation
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2018 - 2019
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faeces
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	A few days
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 85%db
<b>Ash content</b>	~ 15%db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Moisture content (1) and water activity (2) of the cake after centrifugation
<b>Employed method</b>	(5) Use of moisture analyzer balance <i>PCE-MB Series</i> (SOP 8.7.1.5) (6) Use of water activity analyzer <i>AquaLab Tunable Diode Laser-TDL</i> (SOP 8.8.3.3)
<u>Publications</u>	
Septien, S., Getahun, S., Mirara, S., Makununika, B.S.N., Mugauri, T.R., Singh, A., Pocock, J., Inambao, F., Velkushanova, K., Buckley, C.A. (2019). Investigations of faecal sludge drying from on-site sanitation facilities. Proceedings of the 10th Asia Pacific Drying Conference, Vadodara, India, 14-17 December.	

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Additional Notes										
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations from healthy young adults</li> <li>○ Centrifugation done in a centrifuge <i>HERMLE Z323</i>, during 120 minutes at a rate of 5000 RPM, for 40 g of sample per centrifuge tube</li> </ul>										
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<p><u>Moisture content and water activity of the cake before and after centrifugation</u></p> <table border="1"> <thead> <tr> <th>Parameter</th> <th>Before centrifugation</th> <th>After centrifugation</th> </tr> </thead> <tbody> <tr> <td>Moisture content (%wt)</td> <td>~78%</td> <td>~76%</td> </tr> <tr> <td>Water activity (-)</td> <td>~94%</td> <td>~93%</td> </tr> </tbody> </table>	Parameter	Before centrifugation	After centrifugation	Moisture content (%wt)	~78%	~76%	Water activity (-)	~94%	~93%	<p><u>Observations:</u></p> <ul style="list-style-type: none"> <li>○ Almost no decrease of the moisture content and water activity after centrifugation</li> </ul>
Parameter	Before centrifugation	After centrifugation								
Moisture content (%wt)	~78%	~76%								
Water activity (-)	~94%	~93%								

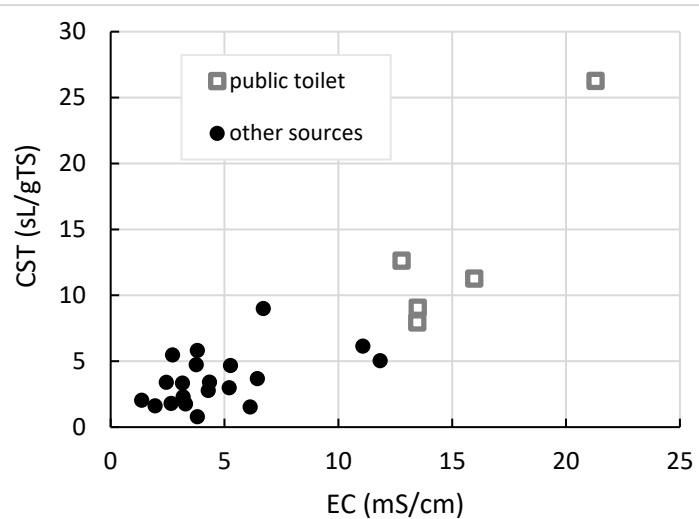
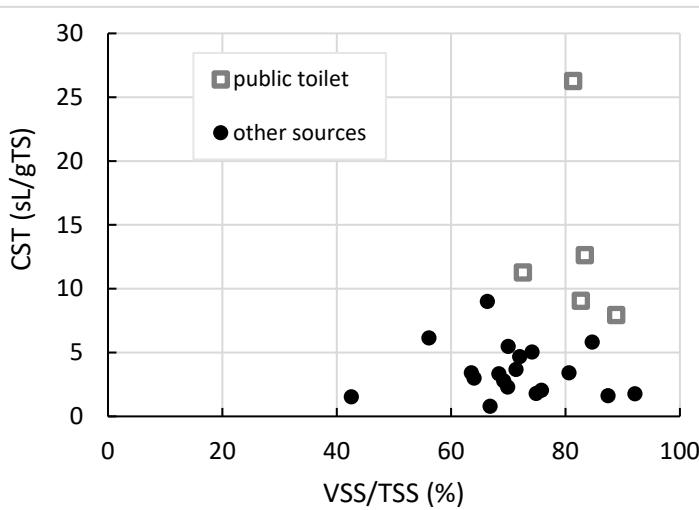
<u>General information</u>	
<b>Type of data</b>	Centrifugation
<b>Place of experimentation</b>	<ul style="list-style-type: none"> <li><input type="radio"/> Sandec: Department Sanitation, Water and Solid Waste for Development, Eawag: Federal Institute of Aquatic Science and Technology (Switzerland)</li> <li><input type="radio"/> Delvic Sanitation Initiatives, Dakar (Senegal)</li> </ul>
<b>Dates of the experiments</b>	2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from septic tanks/holding tanks and pit latrines from a variety of sources (incl. households, schools, public toilets, offices, places of worship, and restaurants)
<b>Location of collection</b>	<ul style="list-style-type: none"> <li><input type="radio"/> Dakar, Senegal</li> <li><input type="radio"/> Dar es Salaam, Tanzania</li> </ul>
<b>Age before collection</b>	Variable (from several weeks to several years)
<b>Moisture content</b>	87.0 – 99.8 %wt
<b>Total solids content</b>	0.2 – 13 %wt
<b>Volatile solids content</b>	26 – 85 %db
<b>Ash content</b>	15 – 74 %db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	None
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	<p>Total solids content, volatile solids content, total suspended solids, total volatile suspended solids, and extracellular polymer substances concentration of the bulk sludge.</p> <p>Total solids content of the cake after centrifugation.</p>
<b>Employed methods</b>	<ol style="list-style-type: none"> <li>(1) Weighing the sample before and after oven drying at 105°C for 24 h</li> <li>(2) Weighing the sample before and after ignition at 550°C</li> <li>(3) Weighing the solids after filtration of a known volume of sample followed by oven drying at 105°C</li> </ol>

	(4) Weighing the solids after filtration of a known volume of sample followed by ignition at 550°C (5) Extraction by sonication and then analysis using size exclusion chromatography <i>LC-OCD-OND</i> for organic carbon detection-organic nitrogen detection																																							
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<u>General information</u>	
<b>Type of data</b>	Capillary suction time
<b>Place of experimentation</b>	<ul style="list-style-type: none"> <li><input type="radio"/> Sandec: Department Sanitation, Water and Solid Waste for Development, Eawag: Swiss Federal Institute of Aquatic Science and Technology (Switzerland)</li> <li><input type="radio"/> Delvic Sanitation Initiatives, Dakar (Senegal)</li> </ul>
<b>Dates of the experiments</b>	2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from septic tanks/holding tanks and pit latrines from a variety of sources (incl. households, schools, public toilets, offices, places of worship, and restaurants)
<b>Location of collection</b>	<ul style="list-style-type: none"> <li><input type="radio"/> Dakar, Senegal</li> <li><input type="radio"/> Dar es Salaam, Tanzania</li> </ul>
<b>Age before collection</b>	Variable (from several weeks to several years)
<b>Moisture content</b>	87.0 – 99.8 %wt
<b>Total solids content</b>	0.2 – 13 %wt
<b>Volatile solids content</b>	26 – 85 %db
<b>Ash content</b>	15 – 74 %db
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	None
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Capillary suction time, volatile solids content, total suspended solids, total volatile suspended solids, electrical conductivity, and extracellular polymer substance concentration of the bulk sludge.
<b>Employed methods</b>	<ol style="list-style-type: none"> <li>(1) Use of the capillary suction time analyser <i>Triton 319 Multi-CST</i></li> <li>(2) Weighing the sample before and after ignition at 550°C</li> <li>(3) Weighing the solids after filtration of a known volume of sample followed by oven drying at 105°C</li> <li>(4) Weighing the solids after filtration of a known volume of sample followed by ignition at 550°C</li> </ol>

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Capillary suction time (CST) versus electrical conductivity (EC)Capillary suction time (CST) versus the ratio of volatile suspended solids (VSS) to total suspended solids (TSS)

# DISINFECTION

<u>General information</u>	
<b>Type of data</b>	Ascaris eggs viability during infrared drying
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2014 - 2015
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrine (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 70%db
<b>Ash content</b>	~ 30%db
<b>Presence of trash?</b>	Yes
<b>Pre-treatment</b>	<ul style="list-style-type: none"> <li>○ Screening to remove the large pieces of trash</li> <li>○ Addition of 3%wt of sawdust for pellets formation</li> </ul>
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Laboratory-scale medium infrared (MIR) dryer ('LaDePa')
<b>Drying time</b>	4, 8, 17, 25 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ MIR emitters power: 3, 5 and 6.5 kW</li> <li>○ Distance between the emitters and the sample: 115 mm</li> <li>○ Air stream flowrate: 10.4 m<sup>3</sup>/min</li> <li>○ Air humidity: ambient (70-80%)</li> </ul>
<b>Sample form in the dryer</b>	Pellets of 8 and 14 mm diameter
<b>Analysed parameters</b>	Viability of Ascaris eggs development
<b>Employed method</b>	Extraction of Ascaris eggs from the sludge and count of viable eggs in the microscope (SOP 8.9.3.1)
<u>Publications</u>	
Septien, S., Singh, A., Mirara, S. W., Teba, L., Velkushanova, K., & Buckley, C. A. (2018). "LaDePa' process for the drying and pasteurization of faecal sludge from VIP latrines using infrared radiation'. <i>South African journal of chemical engineering</i> , 25, 147-158.	

Mirara, S.W. (2017). *Drying and pasteurization of VIP latrine faecal sludge using a bench-scale medium infrared machine*. Msc thesis, University of KwaZulu-Natal, South Africa.

Mirara, S.W., Singh, A., Septien, S., Velkushanova, K., Buckley. C.A (2015). *Characterisation of On-site Sanitation Material and Products: VIP latrines and pour-flush toilets. Volume 2: LaDePa* (final report K5/2137). Water Research Commission, South Africa.

### Data source files

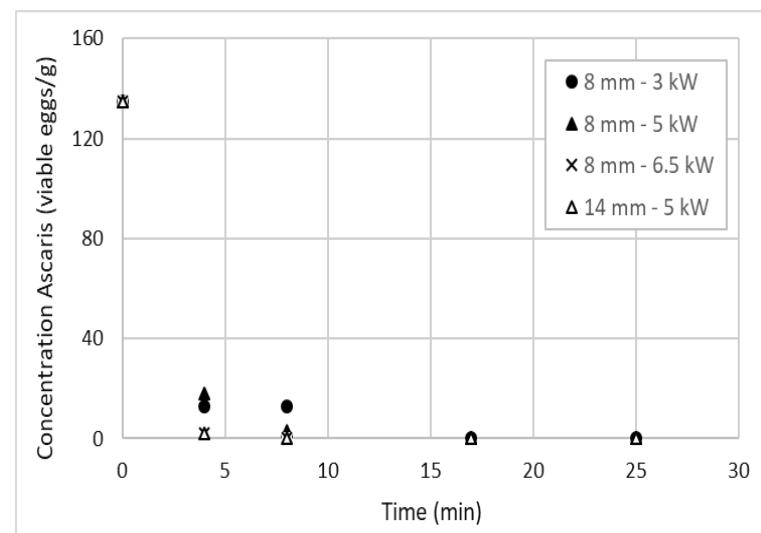
<https://www.dropbox.com/s/x8dytnm2jkwibot/2014-2015%20Deactivation%20of%20VIP%20sludge%28Ascaris%20eggs%20viability%29.xlsx?dl=0>

### Additional Notes

- Temperature measured in the drying zone: ~ 90, 140 and 220°C at 3, 5 and 6.5 kW respectively

### Description of Data

#### Ascaris egg viability versus drying time as a function of the MIR emitter power and pellet diameter



#### Observations

- Decrease of the viability as a function of the drying time
- Full deactivation above 17 min for all conditions
- Note: high damage observed for the viable Ascaris after processing (so, uncertain if possible development)

<u>General information</u>	
<b>Type of data</b>	Ascaris eggs viability with sludge dryness
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 60%db
<b>Ash content</b>	~ 40%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic, and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form in the dryer</b>	Sludge trays
<b>Analysed parameters</b>	Viability of Ascaris eggs development
<b>Employed methods</b>	Extraction of Ascaris eggs from the sludge and count of viable eggs in the microscope (SOP 8.9.3.1)
<u>Publications</u>	
Naidoo, D., Archer, C. E., Septien, S., Appleton, C. C., & Buckley, C. A. (2020). Inactivation of Ascaris for thermal treatment and drying applications in faecal sludge. <i>Journal of Water, Sanitation and Hygiene for Development</i> , 10(2), 209-218.	

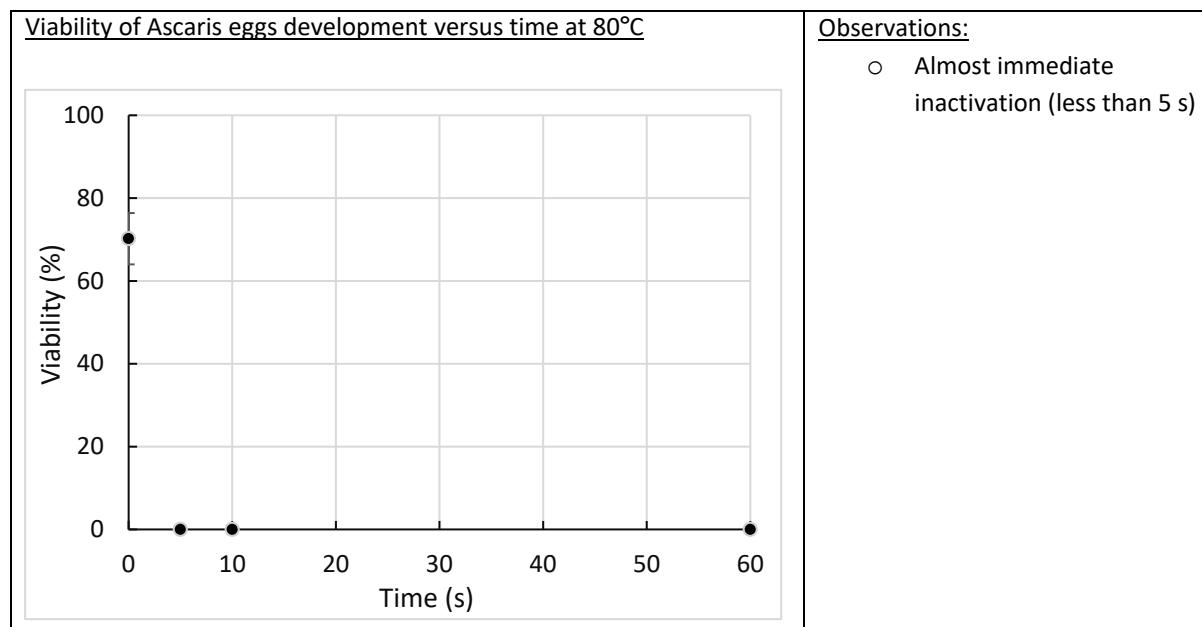
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<u>General information</u>	
<b>Type of data</b>	Ascaris eggs viability with sludge dryness
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017-2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 90%wt
<b>Total solids content</b>	~ 10%wt
<b>Volatile solids content</b>	~ 65%db
<b>Ash content</b>	~ 35%db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Oven
<b>Drying time</b>	Until achieving 20, 30, 40, 50 and 60%wt moisture content
<b>Operating conditions</b>	105°C
<b>Sample form in the dryer</b>	Sludge trays
<b>Analysed parameters</b>	Viability of Ascaris eggs development
<b>Employed methods</b>	Extraction of Ascaris eggs from the sludge and count of viable eggs in the microscope (SOP 8.9.3.1)
<u>Publications</u>	
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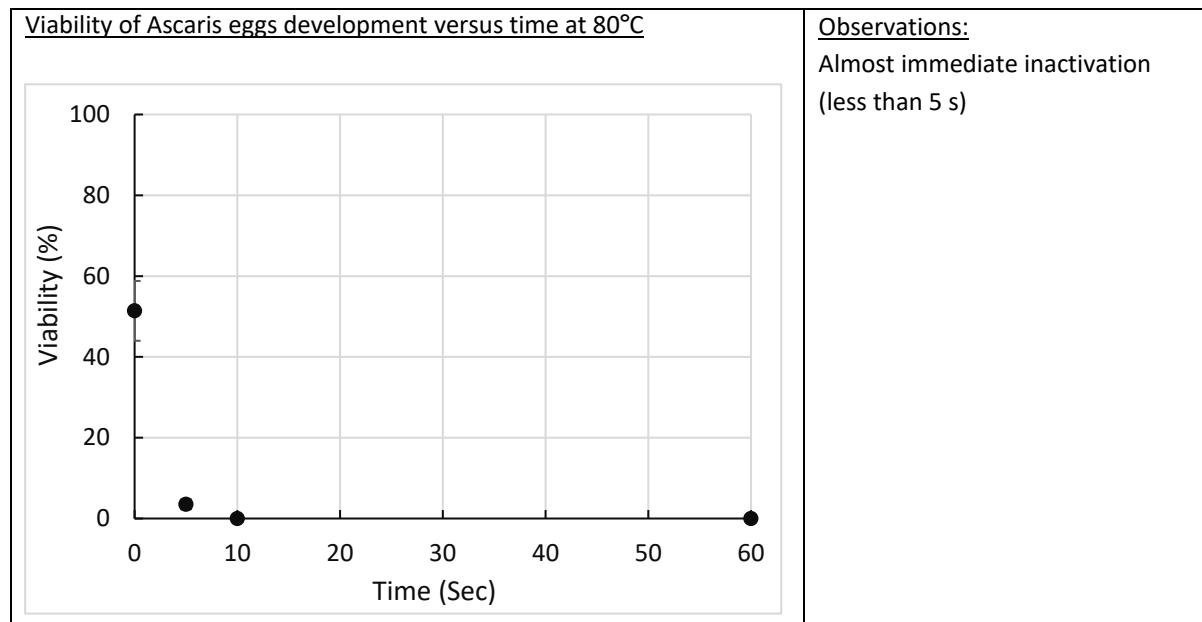
<u>General information</u>	
<b>Type of data</b>	Ascaris eggs deactivation with temperature
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets (UDDT)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 3 years
<b>Moisture content</b>	~ 80%wt
<b>Total solids content</b>	~ 20%wt
<b>Volatile solids content</b>	~ 60%db
<b>Ash content</b>	~ 40%db
<b>Presence of trash?</b>	Yes (mainly hair extensions, plastic, and rocks)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Viability of Ascaris eggs development
<b>Employed methods</b>	Extraction of Ascaris eggs from the sludge and count of viable eggs in the microscope (SOP 8.9.3.1)
<u>Publications</u>	
Naidoo, D., Archer, C. E., Septien, S., Appleton, C. C., & Buckley, C. A. (2020). Inactivation of Ascaris for thermal treatment and drying applications in faecal sludge. <i>Journal of Water, Sanitation and Hygiene for Development</i> , 10(2), 209-218.	

<u>Data source files</u>											
<a href="https://www.dropbox.com/s/78ftqql40pwfb2/2017%20-2018%20UDDT%20Thermal%20Disinfection%20%28Ascaris%20eggs%20viability%29.xlsx?dl=0">https://www.dropbox.com/s/78ftqql40pwfb2/2017%20-2018%20UDDT%20Thermal%20Disinfection%20%28Ascaris%20eggs%20viability%29.xlsx?dl=0</a>											
<u>Additional Notes</u>											
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<u>Description of Data</u>											
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Time (Min)	Viability (%)										
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Time (min)	Viability (%)										
0	~70										
0.5	~12										
2	~2										



<u>General information</u>	
<b>Type of data</b>	Ascaris eggs deactivation with temperature
<b>Place of experimentation</b>	Pollution Research Group, University of KwaZulu-Natal (South Africa)
<b>Dates of the experiments</b>	2017 - 2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from ventilated improved pit latrines (VIP)
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Up to 5 years
<b>Moisture content</b>	~ 90% wt
<b>Total solids content</b>	~ 10% wt
<b>Volatile solids content</b>	~ 65% db
<b>Ash content</b>	~ 35% db
<b>Presence of trash?</b>	No (sludge pre-screened during pit emptying)
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	N.A.
<b>Drying time</b>	N.A.
<b>Operating conditions</b>	N.A.
<b>Sample form in the dryer</b>	N.A.
<b>Analysed parameters</b>	Viability of Ascaris eggs development
<b>Employed methods</b>	Extraction of Ascaris eggs from the sludge and count of viable eggs in the microscope (SOP 8.9.3.1)
<u>Publications</u>	
Naidoo, D., Archer, C. E., Septien, S., Appleton, C. C., & Buckley, C. A. (2020). Inactivation of Ascaris for thermal treatment and drying applications in faecal sludge. <i>Journal of Water, Sanitation and Hygiene for Development</i> , 10(2), 209-218.	

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Time (Mins)	Viability (%)												
0	50												
0.5	5												
1	2												
2	1												
5	0												



# GAS ANALYSIS

<u>General information</u>	
<b>Type of data</b>	Emissions testing
<b>Place of experimentation</b>	Delhi (India)
<b>Dates of the experiments</b>	2018
<u>Feedstock</u>	
<b>Type of faecal material</b>	Fresh faecal waste
<b>Location of collection</b>	Coimbatore, India
<b>Age before collection</b>	1-3 days
<b>Moisture content</b>	N/A
<b>Total solids content</b>	N/A
<b>Volatile solids content</b>	N/A
<b>Ash content</b>	N/A
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	N/A
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	A custom-designed dryer connected to an exhaust system
<b>Holding or residence time</b>	8 hours
<b>Operating conditions</b>	80°C
<b>Sample form in the dryer</b>	Sample produced by a jerky gun
<b>Analysed parameters</b>	ISO 30500 air stack parameters
<b>Employed method</b>	<p>Gas analysis through the ISO 30500 sampling trains</p> <p>Sampling from exhaust pipe and work zone: a nozzle, followed by a thimble filter, sampling probe, sampling kit containing gas specific absorbing solutions for SO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, VOC, PAH, and gas meter measuring CO, CO<sub>2</sub>, NOx, and O<sub>2</sub>, exit via vacuum pump.</p> <p>PM<sub>2.5</sub>: cyclonic setup containing a nozzle at one end, connected to a probe at the other end; a 40 mm glass fibre</p>

	filter to collect particles smaller than 2.5 micron in diameter, then weighed to determine PM2.5 particles in the exhaust air															
<u>Publications</u>																
-																
<u>Data source files</u>																
<a href="https://www.dropbox.com/s/xq4lwro9hciv40v/Gas%20emissions%20testing_TUV%20Noida_India%20%282018%29.xlsx?dl=0">https://www.dropbox.com/s/xq4lwro9hciv40v/Gas%20emissions%20testing_TUV%20Noida_India%20%282018%29.xlsx?dl=0</a>																
<u>Additional Notes</u>																
<ul style="list-style-type: none"> <li>○ Tests performed to validate testing methods of the ISO 30500 standard</li> <li>○ During first 4 days of drying, gas emissions measured from a sampling port in the exhaust pipeline (photo A).</li> <li>○ During 5<sup>th</sup> day of operation, gas emissions measured near the exhaust hood of the dryer (photo B).</li> <li>○ 2 drying processes per day.</li> </ul>																
A																
B																
<u>Description of Data</u>																
<u>Gas emissions from sampling in the exhaust pipeline (n=8)</u>																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; padding: 5px;">Parameter</th> <th style="text-align: center; padding: 5px;">CO</th> <th style="text-align: center; padding: 5px;">NO<sub>x</sub>: NO+NO<sub>2</sub></th> <th style="text-align: center; padding: 5px;">H<sub>2</sub>S</th> <th style="text-align: center; padding: 5px;">VOC (benzene)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 5px;">Stack Results (mg/Nm<sup>3</sup>)</td><td style="text-align: center; padding: 5px;">BDL (DL:1.0)</td><td style="text-align: center; padding: 5px;">BDL (DL:1.0)</td><td style="text-align: center; padding: 5px;">BDL (DL:0.1)</td><td style="text-align: center; padding: 5px;">BDL (DL:0.5)</td></tr> <tr> <td style="text-align: center; padding: 5px;">Standard Deviation (mg/Nm<sup>3</sup>)</td><td style="text-align: center; padding: 5px;">BDL (DL:1.0)</td><td style="text-align: center; padding: 5px;">BDL (DL:1.0)</td><td style="text-align: center; padding: 5px;">BDL (DL:0.1)</td><td style="text-align: center; padding: 5px;">BDL (DL:0.5)</td></tr> </tbody> </table>		Parameter	CO	NO <sub>x</sub> : NO+NO <sub>2</sub>	H <sub>2</sub> S	VOC (benzene)	Stack Results (mg/Nm <sup>3</sup> )	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:0.1)	BDL (DL:0.5)	Standard Deviation (mg/Nm <sup>3</sup> )	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:0.1)	BDL (DL:0.5)
Parameter	CO	NO <sub>x</sub> : NO+NO <sub>2</sub>	H <sub>2</sub> S	VOC (benzene)												
Stack Results (mg/Nm <sup>3</sup> )	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:0.1)	BDL (DL:0.5)												
Standard Deviation (mg/Nm <sup>3</sup> )	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:0.1)	BDL (DL:0.5)												
<u>Observations</u> <ul style="list-style-type: none"> <li>○ Lower concentration of the compounds measured from the pipe line (probable because dilution with air)</li> <li>○ Compounds detected during drying: CO, NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub>, particles PM<sub>2.5</sub></li> </ul>																

Parameter	SO <sub>2</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	PAH
Stack Results (mg/Nm <sup>3</sup> )	10	BDL (DL:1.0)	BDL (DL:0.1)	BDL (DL:0.0001)
Standard Deviation (mg/Nm <sup>3</sup> )	5.9	BDL (DL:1.0)	BDL (DL:0.1)	BDL (DL:0.0001)

\*BDL: below detectable limit

#### Gas emissions from sampling near the exhaust hood (n=2)

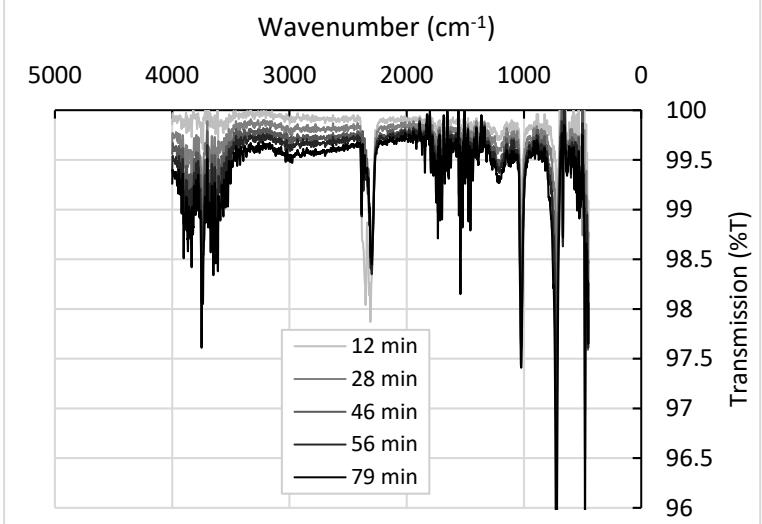
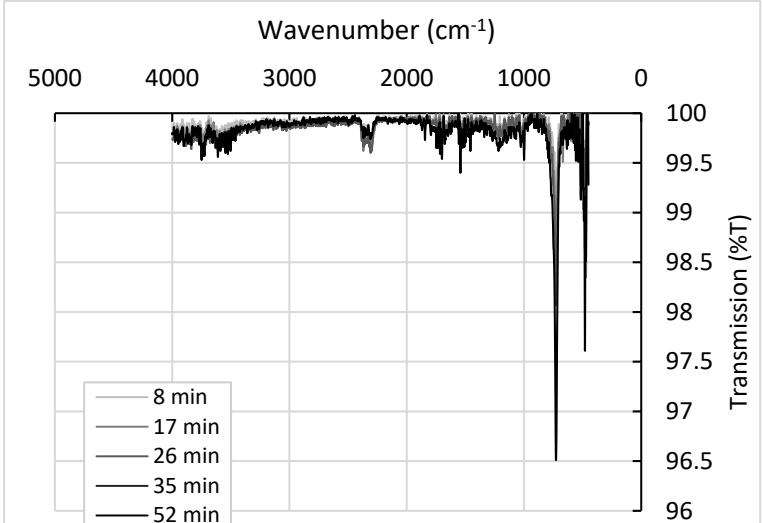
Parameter	CO	NO <sub>x</sub> (NO+NO <sub>2</sub> )	H <sub>2</sub> S	VOC
Average (mg/m <sup>3</sup> )	1.145	14.1	BDL (DL:0.1)	BDL (DL:0.5)
S.D. (mg/m <sup>3</sup> )	0.810	3.960	BDL (DL:0.1)	BDL (DL:0.5)
Range (LL – HL) mg/m <sup>3</sup>	0.335 – 0.955	10.14 – 18.06	BDL (DL:0.1)	BDL (DL:0.5)

Parameter	SO <sub>2</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	PAH
Average (mg/m <sup>3</sup> )	2.85	16.5	0.0031	BDL(DL:0.0001)
S.D. (mg/m <sup>3</sup> )	0.354	2.121	0.001	BDL(DL:0.0001)
Range (LL – HL) mg/m <sup>3</sup>	2.49 – 3.2	14.37 – 18.62	0.003 – 0.004	BDL(DL:0.0001)

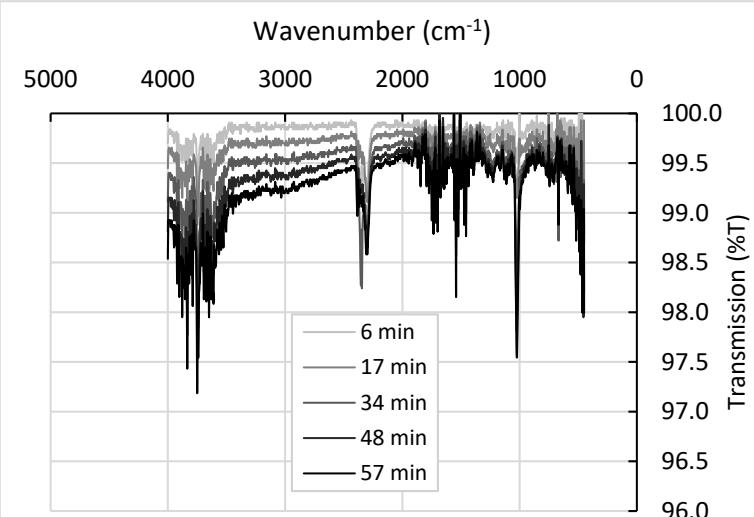
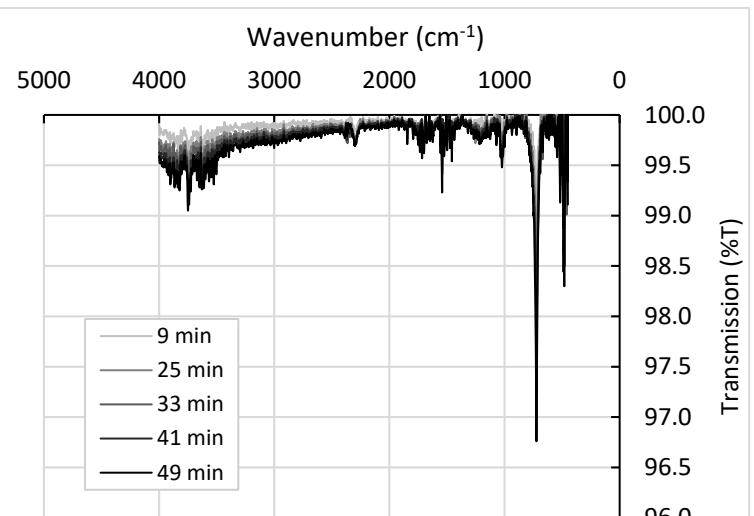
<u>General information</u>	
<b>Type of data</b>	Gas analysis
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from anaerobic baffled reaction from a decentralised wastewater treatment system
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	Unknown
<b>Moisture content</b>	~ 85%wt
<b>Total solids content</b>	~ 15%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly small pieces of paper after pre-screening during pit emptying)
<b>Pre-treatment</b>	Screening to remove trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Holding or residence time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55 and 155°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Identification of chemical compounds in the gas stream
<b>Employed method</b>	Use of the Fourier transform infrared (FTIR) spectroscopy analyser <i>Perkin Elmer Spectrum 100</i>
<u>Publications</u>	
-	

<u>Data source files</u>	
-	
<u>Additional Notes</u>	
<ul style="list-style-type: none"> <li>○ Samples couriered from South Africa</li> <li>○ FTIR analyser hyphenated to the STA</li> <li>○ No quantification of the concentration of the identified compounds</li> <li>○ Considerable drying of the sample before reaching the set temperature at 155°C</li> </ul>	
<u>Description of Data</u>	
<p><u>FTIR spectrum during drying up to 55°C at different times of analysis</u></p> <p>Wavenumber (<math>\text{cm}^{-1}</math>)</p> <p>Transmission (%T)</p> <p>13 min 23 min 42 min 54 min 79 min</p>	<p><u>Observations</u></p> <ul style="list-style-type: none"> <li>○ Main regions identified:  <math>4000 - 3400 \text{ cm}^{-1} \rightarrow \text{H}_2\text{O}</math>          (O-H stretch)  <math>2400 - 2250 \text{ cm}^{-1} \rightarrow \text{CO}_2</math>  <math>1800 - 650 \text{ cm}^{-1} \rightarrow</math>          possible organic          compounds (ether, ester,          alcohol, aromatic, amine,          alkene) and <math>\text{H}_2\text{O}</math> scissoring       </li> <li>○ Gas from drying composed          by water (as expected),          carbon dioxide and          organic compounds</li> </ul>
<p><u>FTIR spectrum during drying up to 155°C at different times of analysis</u></p> <p>Wavenumber (<math>\text{cm}^{-1}</math>)</p> <p>Transmission (%T)</p> <p>10 min 19 min 28 min 39 min 49 min</p>	

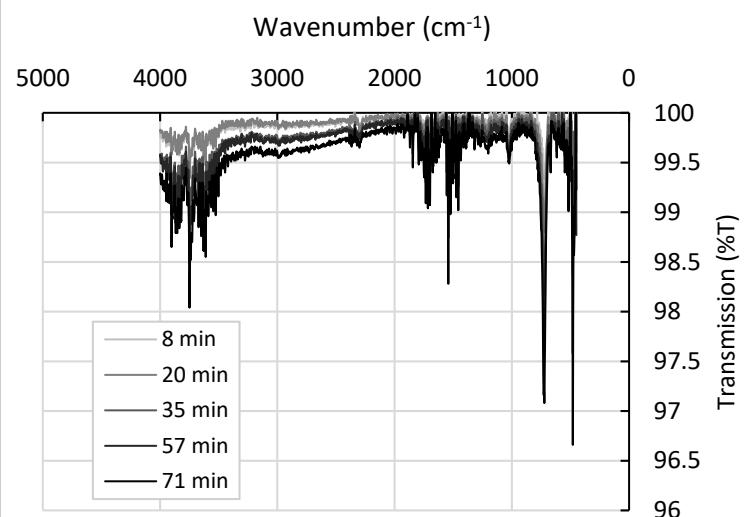
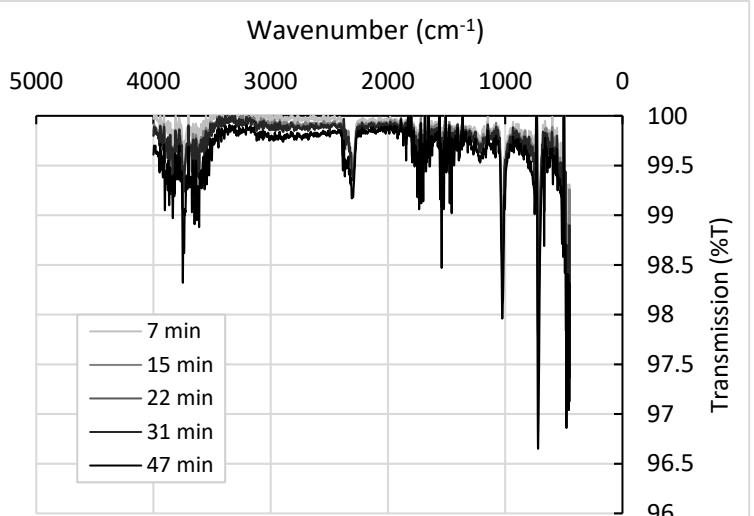
<u>General information</u>	
<b>Type of data</b>	Gas analysis
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	1 – 3 years
<b>Moisture content</b>	~ 70%wt
<b>Total solids content</b>	~ 30%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Holding or residence time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55 and 155°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Identification of chemical compounds in the gas stream
<b>Employed method</b>	Use of the Fourier transform infrared (FTIR) spectroscopy analyser <i>Perkin Elmer Spectrum 100</i>
<u>Publications</u>	
-	

<u>Data source files</u>	
-	
<u>Additional Notes</u>	
<ul style="list-style-type: none"> <li>○ Samples couriered from South Africa</li> <li>○ FTIR analyser hyphenated to the STA</li> <li>○ No quantification of the concentration of the identified compounds</li> <li>○ Considerable drying of the sample before reaching the set temperature at 155°C</li> </ul>	
<u>Description of Data</u>	
<u>FTIR spectrum during drying up to 55°C at different times of analysis</u>  <p>Wavenumber (<math>\text{cm}^{-1}</math>)</p> <p>Transmission (%T)</p> <p>12 min 28 min 46 min 56 min 79 min</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Main regions identified:  <math>4000 - 3400 \text{ cm}^{-1} \rightarrow \text{H}_2\text{O}</math> (O-H stretch)  <math>2400 - 2250 \text{ cm}^{-1} \rightarrow \text{CO}_2</math>  <math>1800 - 650 \text{ cm}^{-1} \rightarrow</math> possible organic compounds (ether, ester, alcohol, aromatic, amine, alkene) and <math>\text{H}_2\text{O}</math> scissoring         </li> <li>○ Gas from drying composed by water (as expected), carbon dioxide and organic compounds</li> </ul>
<u>FTIR spectrum during drying up to 155°C at different times of analysis</u>  <p>Wavenumber (<math>\text{cm}^{-1}</math>)</p> <p>Transmission (%T)</p> <p>8 min 17 min 26 min 35 min 52 min</p>	

<u>General information</u>	
<b>Type of data</b>	Gas analysis
<b>Place of experimentation</b>	Materials Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Faecal sludge from urine diversion dry toilets
<b>Location of collection</b>	Durban, South Africa
<b>Age before collection</b>	1 – 3 years
<b>Moisture content</b>	~ 95%wt
<b>Total solids content</b>	~ 5%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	Yes (mainly stones, hair and plastics)
<b>Pre-treatment</b>	Screening to remove the trash
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Holding or residence time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55 and 155°C (during 80 and 40 minutes respectively)</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Identification of chemical compounds in the gas stream
<b>Employed method</b>	Use of the Fourier transform infrared (FTIR) spectroscopy analyser <i>Perkin Elmer Spectrum 100</i>
<u>Publications</u>	
-	

Data source files	
-	
Additional Notes	
<ul style="list-style-type: none"> <li>○ Samples couriered from South Africa</li> <li>○ FTIR analyser hyphenated to the STA</li> <li>○ No quantification of the concentration of the identified compounds</li> <li>○ Considerable drying of the sample before reaching the set temperature at 155°C</li> </ul>	
Description of Data	
<u>FTIR spectrum during drying up to 55°C at different times of analysis</u> 	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Main regions identified:  <math>4000 - 3400 \text{ cm}^{-1} \rightarrow \text{H}_2\text{O}</math>  (O-H stretch)  <math>2400 - 2250 \text{ cm}^{-1} \rightarrow \text{CO}_2</math>  <math>1800 - 650 \text{ cm}^{-1} \rightarrow</math> possible organic compounds (ether, ester, alcohol, aromatic, amine, alkene) and H<sub>2</sub>O scissoring </li> <li>○ Gas from drying composed by water (as expected), carbon dioxide and organic compounds</li> </ul>
<u>FTIR spectrum during drying up to 155°C at different times of analysis</u> 	

<u>General information</u>	
<b>Type of data</b>	Gas analysis
<b>Place of experimentation</b>	Material Engineering Department (SPECIFIC), Swansea University Prifysgol Abertawe
<b>Dates of the experiments</b>	2018 - 2020
<u>Feedstock</u>	
<b>Type of faecal material</b>	Human faeces
<b>Location of collection</b>	Cranfield, UK
<b>Age before collection</b>	Fresh
<b>Moisture content</b>	~ 60%wt
<b>Total solids content</b>	~ 40%wt
<b>Volatile solids content</b>	Not measured
<b>Ash content</b>	Not measured
<b>Presence of trash?</b>	No
<b>Pre-treatment</b>	Mixing
<u>Experimental Procedure</u>	
<b>Drying experimental setup</b>	Thermogravimetric analyser - simultaneous thermal analysis <i>Perkin Elmer STA 6000</i>
<b>Holding or residence time</b>	~ 40 - 80 min
<b>Operating conditions</b>	<ul style="list-style-type: none"> <li>○ Set temperature: 55 and 155°C</li> <li>○ Heating rate: 10°C/min</li> <li>○ Carrier gas: nitrogen</li> <li>○ Flow rate: 30 mL/min</li> </ul>
<b>Sample form in the dryer</b>	~ 40 mg in a crucible
<b>Analysed parameters</b>	Identification of chemical compounds in the gas stream
<b>Employed method</b>	Use of the Fourier transform infrared (FTIR) spectroscopy analyser <i>Perkin Elmer Spectrum 100</i>
<u>Publications</u>	
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<u>Data source files</u>	
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<u>Additional Notes</u>	
<ul style="list-style-type: none"> <li>○ Fresh faeces collected from voluntary and anonymous donations</li> <li>○ FTIR analyzer hyphenated to the STA</li> <li>○ No quantification of the concentration of the identified compounds</li> <li>○ Considerable drying of the sample before reaching the set temperature at 155°C</li> </ul>	
<u>Description of Data</u>	
<u>FTIR spectrum during drying up to 55°C at different times of analysis</u>  <p>Wavenumber (<math>\text{cm}^{-1}</math>)</p> <p>Transmission (%T)</p> <p>8 min 20 min 35 min 57 min 71 min</p>	<u>Observations</u> <ul style="list-style-type: none"> <li>○ Main regions identified:  <math>4000 - 3400 \text{ cm}^{-1} \rightarrow \text{H}_2\text{O}</math>          (O-H stretch)  <math>2400 - 2250 \text{ cm}^{-1} \rightarrow \text{CO}_2</math>  <math>1800 - 650 \text{ cm}^{-1} \rightarrow</math>          possible organic          compounds (ether, ester,          alcohol, aromatic, amine,          alkene) and <math>\text{H}_2\text{O}</math>          scissoring       </li> <li>○ Gas from drying          composed by water (as          expected), carbon dioxide          and organic compounds</li> </ul>
<u>FTIR spectrum during drying up to 155°C at different times of analysis</u>  <p>Wavenumber (<math>\text{cm}^{-1}</math>)</p> <p>Transmission (%T)</p> <p>7 min 15 min 22 min 31 min 47 min</p>	