**////Title: Transforming Human Waste into Sustainable Products**

**////Standfirst:**

Faecal sludge, a material derived from human waste, can be difficult to dispose of and causes significant disease and pollution worldwide. However, it also shows potential as a fuel, fertiliser and even a building material, if properly treated. Dr Santiago [san-tee-ah-go] Septien [sep-tee-uhn] Stringel and his team at the WASH R&D [wash R and D] Centre of the University of KwaZulu-Natal [kwah-zoo-loo-nay-taal], in Durban, South Africa, have been investigating the process for drying faecal sludge, towards developing new ways of transforming it into sustainable products.

**////Main text:**

Throughout history, human waste has posed considerable challenges. Because of its high pathogen content, it has been a major cause of disease worldwide, prompting significant efforts to develop methods to treat and dispose of it. With approximately 2.3 billion people still living without basic sanitation, it is more important than ever that we develop new and affordable methods for safely treating this type of waste.

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Faecal sludge, which is derived from human waste from non-sewered sanitation toilets, has several potential applications, because of its unique chemical and physical properties. Therefore, finding ways to safely treat this type of waste, while also deriving useful products from it, could help to reduce both disease and poverty in developing nations. For instance, composted human excreta has been used with great success as a natural fertiliser – providing nutrients for crops and improving soil quality.

Faecal sludge has also been considered as a renewable biofuel. Research has shown that the energy contained within this material can be as high as other common biofuel sources, such as firewood. Faecal sludge has also shown great potential as an effective building material.

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For all of these applications, faecal sludge must first be processed, which often involves drying it out. This can be easily achieved in warm climates by spreading the sludge out into beds, where it is left to dry in the heat of the sun, but this process can be quite slow. Alternatively, treatment plants can dry the sludge faster, using mechanical dehydrators and heating devices, but this process comes with additional energy costs.

The chemical and physical changes that faecal sludge undergoes during the drying process is still not very well understood. In order to make the most of this resource, we need to understand more about these changes, so that it can be used as efficiently as possible. Dr Santiago Septien Stringel and his team at the University of KwaZulu-Natal have conducted extensive research to better understanding the drying process, and how it affects the properties of this abundant waste.

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The team began by collecting samples from local latrines. They sifted through these samples to remove any unnatural materials, such as plastics and textiles, which people might dispose of in the latrines. Next, they dried the sludge using two different methods. The first method involved a special air-drying rig, which uses heated airflow to remove moisture, while the second technique employed an infrared dryer, which uses infrared light to heat the sample. Using both of these methods, the team dried the samples using various different temperatures and to different final moisture levels, in order to compare the end products.

First of all, Dr Septien Stringel and his colleagues found that the material’s elemental composition did not significantly change during the drying process, regardless of method used or the conditions under which it was dried. This was a promising finding, as it suggested that the dried sludge may still be effective as an agricultural fertiliser.

They then analysed the molecular makeup of the sludge, before and after various drying processes. The team’s results showed that concentrations of nitrogen-containing molecules, such as ammonium, nitrites and nitrates, decreased considerably during the drying process. As the elemental nitrogen concentration remained relatively consistent, this decrease indicates that the ammonium, nitrates and nitrites transform into other chemical forms that are bound to the molecular skeleton of the faecal sludge during drying. Dr Septien Stringel explains that this is not a drawback, as it may mean that dried sludge will release nutrients more slowly. In this case, it could provide a consistent release of nutrients to promote stronger crop growth.

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The team also wanted to understand the effect of drying on the energy content of the faecal sludge, to assess its suitability as a fuel. From their experiments, they found that drying did not significantly affect the energy content of the sludge, giving it a value very similar to that of firewood. As such, the team’s results show that dried faecal sludge could be used as a sustainable biofuel.

Furthermore, the heat capacity, which represents how much energy is required to heat a material, was much lower once the moisture had been removed. This is also a positive result, as it means it can be burned with a lower energy input, theoretically making it a more efficient source of fuel.

Finally, Dr Septien Stringel and his colleagues also found that the dried sludge has a significantly lower heat conductivity than the raw material, meaning that it acts as a good insulator. Its insulating properties could make dried faecal sludge a very promising building material.

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Dr Septien Stringel and his team have gained invaluable insights into the effects of the drying process on faecal sludge. By investigating the chemical and physical changes that take place during the drying process, the researchers have demonstrated the potential of faecal sludge as a fertiliser, biofuel and building material.

The team’s work highlights how to effectively treat human waste, so that it can be transformed into safe products, which can be used for many important applications. If implemented on a large scale, these methods could help to reduce excreta-related disease, mitigate poverty and improve crop yields, while also reducing our reliance on Earth’s dwindling natural resources.

This SciPod is a summary of the paper ‘Effect of drying on the physical and chemical properties of faecal sludge for its reuse’ from the *Journal of Environmental Chemical Engineering*.

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