

## Cranfield University Research and Development The Nano Membrane Toilet

### Section 1 About the project

#### Summary

In response to the Bill and Melinda Gates Foundation's 'Reinvent the Toilet Challenge' the Nano Membrane Toilet is being developed to provide a sanitation solution for the 2 billion people who currently do not have a toilet. It converts waste into useful products without external water, energy or a sewer connection.

#### Project partners

University of Kwa Zulu Natal, Clean Team, Three Bird Swan, RTI International

### Section 2 The results

#### The problem

A staggering 2.5 billion people on this planet still lack access to improved sanitation – they have nowhere safe to go to the toilet. They might have to defecate outside which is hardly safe for lone women. They might have to defecate in a plastic bag which they throw with their other rubbish which itself may not be collected regularly. They might have to share a toilet with hundreds of others who together leave it in an unhygienic condition.

In rural areas people can build simple pit latrines and install a hygienic slab on top which keep it safe. When the pit fills up they just cover it up and dig a new one elsewhere. But in urban areas where people live crowded together, this is not an option. In many unplanned settlements and even in some planned ones there are no sewer pipes to take the waste away. There may not even be piped water or electricity either. In these situations sanitation is really challenging.

#### The approach

Cranfield University is developing the Nano Membrane Toilet which will be able to treat human waste on-site without external energy or water. The toilet is designed for single-household use (equivalent to 10 people) and will accept urine and faeces as a mixture. The toilet is still under development; this is the vision of how it will work: The toilet flush uses a unique rotating mechanism to transport the mixture into the toilet without demanding water whilst simultaneously blocking odour and the user's view of the waste.

Solids separation (faeces) is principally accomplished through sedimentation. Loosely bound water (mostly from urine) is separated using low glass transition temperature hollow-fibre membranes. The unique nanostructured membrane wall facilitates water transport in the vapour state rather than as a liquid state which yields high rejection of pathogens and some odorous volatile compounds. A novel nano-coated bead enables

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#### Profile

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# Finalist's case study

water vapour recovery through encouraging the formation of water droplets at the nanobead surface. Once the droplets form a critical size, the water drains into a collection vessel for reuse at the household level in washing or irrigation applications.

Following release of unbound water, the residual solids (around 20-25% solids) are transported by mechanical screw into a gasifier which will convert them into ash and energy. The energy will power the membrane processes, and there may be extra energy for charging mobile phones or other low voltage items. The toilet will be rented by the households and maintenance will be undertaken with a trained operative responsible for the franchised area.

## Our goals

To develop an aspirational, affordable off-grid toilet that works without connection to water, sewerage or electricity.

## Obstacles and solutions

An energy source for the toilet	Partnership with RTI International who have developed a gasifier
Removal of the dewatered solids from the holding chamber	Partnership with UKZN to develop the screw

## Performance and results

Proof of concept has been made. A prototype is being developed for field testing in 2016.

## Section 3 The future

### Lessons learned

Academics from different disciplines in the same institution can work together effectively with a good communication plan. External academics and companies can help overcome obstacles.

### Sharing our project

The project has a website ([www.nanomembranetoilet.org](http://www.nanomembranetoilet.org)), blog and animated video on youtube. This has resulted in significant media attention including articles in E&T (engineering sector magazine) Hindustan Times (Indian national daily) and Guardian. It has also been exhibited at the Reinvent the Toilet Fair in India and the Natural History Museum in London. These activities result in numerous enquiries from people wanting to install the toilet or use some of our ideas. We are happy to share details of the technology as widely as possible and actually this is a requirement of our funders, the Bill and Melinda Gates Foundation. We are increasingly engaging new partners in the project, who bring different technical expertise and different experience of sanitation projects across the world.

### What has it meant to your institution to be a Green Gown Award finalist?

It is fantastic that our high impact research has been recognized, in particular this project which is addressing one of the most pressing global problems: sanitation.

### Further information

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