



Human user testing of the Nano Membrane Toilet

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New and innovative technologies are needed to provide sanitation in urban areas in developing countries



Photo by
Chris Rose



The Reinvent the Toilet Challenge aim to develop a toilet that:

- Removes germs from human waste and recovers valuable resources such as energy, clean water, and nutrients.
- Operates “off the grid” without connections to water, sewer, or electrical lines.
- Costs less than US\$.05 cents per user per day.
- Promotes sustainable and financially profitable sanitation services and businesses that operate in poor, urban settings.
- Is a truly aspirational next-generation product that everyone will want to use—in developed as well as developing nations.

<https://www.gatesfoundation.org/What-We-Do/Global-Growth-and-Opportunity/Water-Sanitation-and-Hygiene/Reinvent-the-Toilet-Challenge>

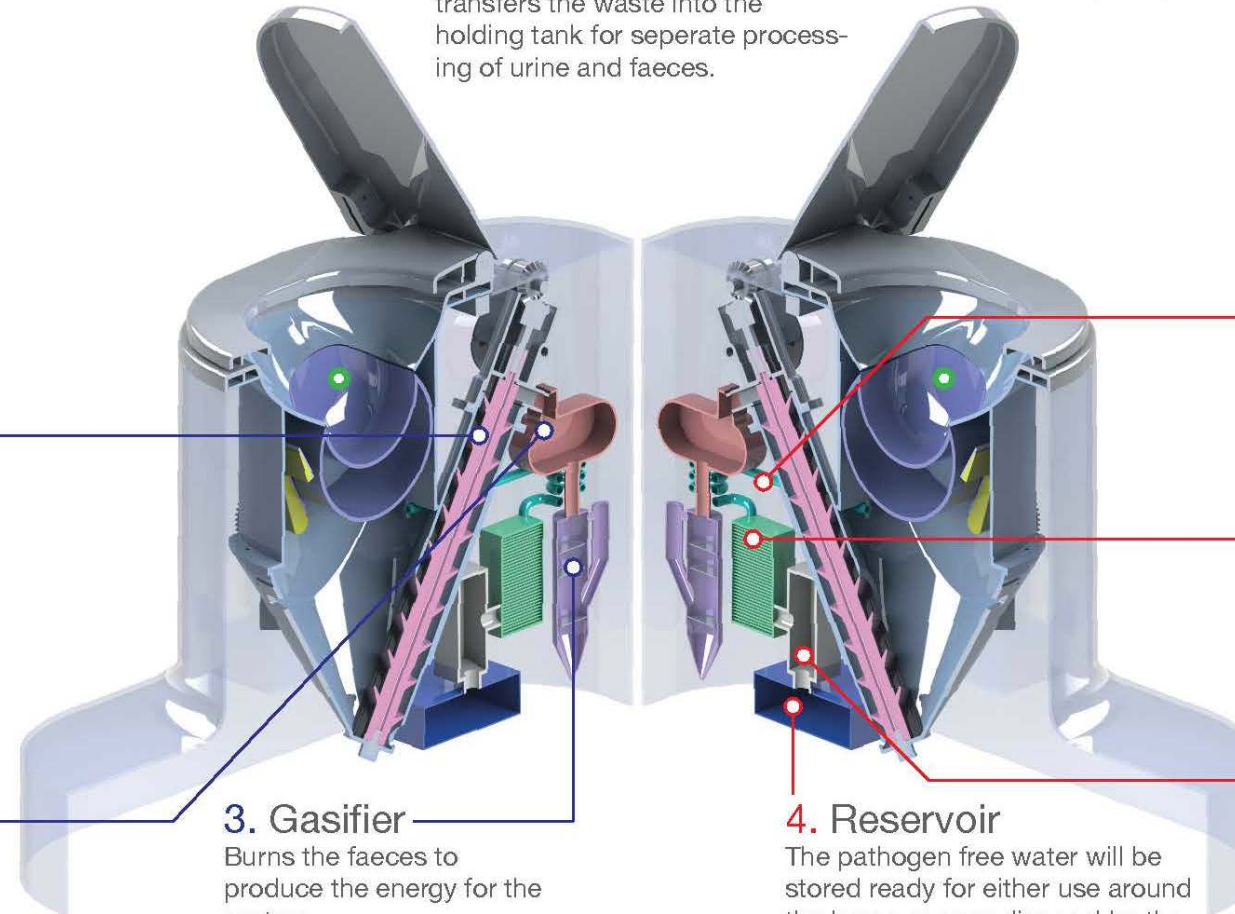


System configuration of the Nano Membrane Toilet

A waterless self-contained toilet for private household of 10 people

Rotating flush

Waste enters the toilet as normal in a mixed stream. A rotating waterless flush blocks odour and transfers the waste into the holding tank for separate processing of urine and faeces.



Faeces processing

1. Archimedes screw

Removes solid waste from holding after settling period

2. Drier pelletizer

Reduces moisture content of the solid waste before dosing the fuel into the gasifier below

3. Gasifier

Burns the faeces to produce the energy for the system

Urine processing

1. Weir channel

Urine will pass over the weir and into the channel where it will warm up around the exhaust of the gasifier

2. Membrane bundle

The urine will pass into the membrane chamber and pure water will pass out of the hollow membrane fibres

3. Heat exchanger

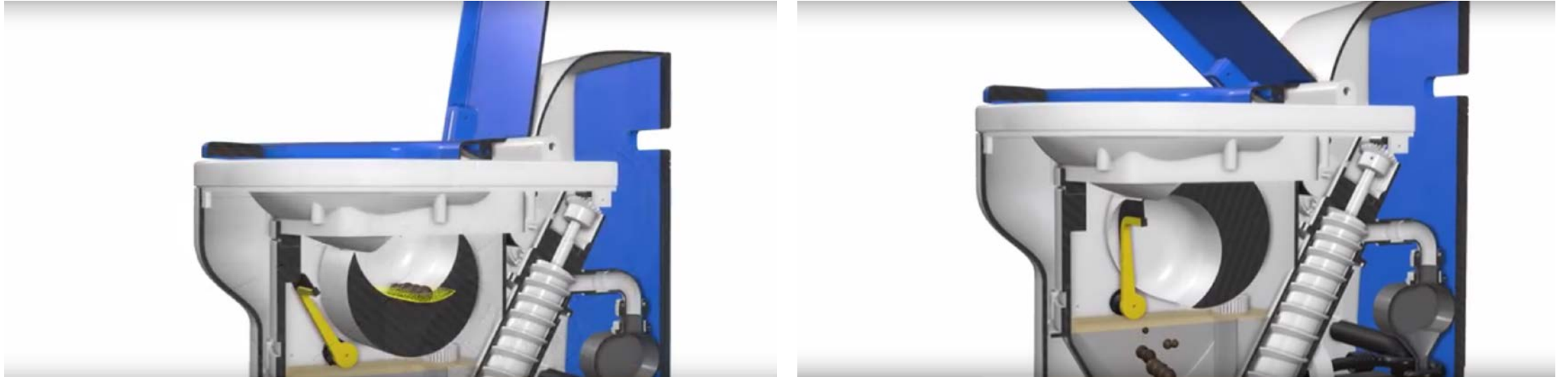
The water vapour will condense to liquid and fall to the bottom

4. Reservoir

The pathogen free water will be stored ready for either use around the home or easy disposal by the home owner



Waterless flush



International human user testing of the toilet frontend



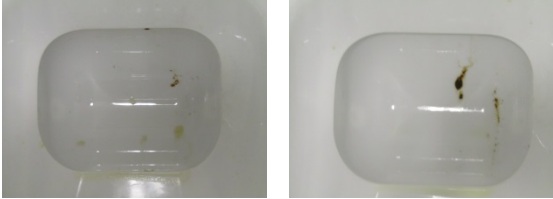



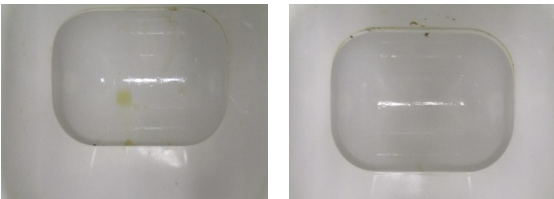







University



Household in a peri-urban area



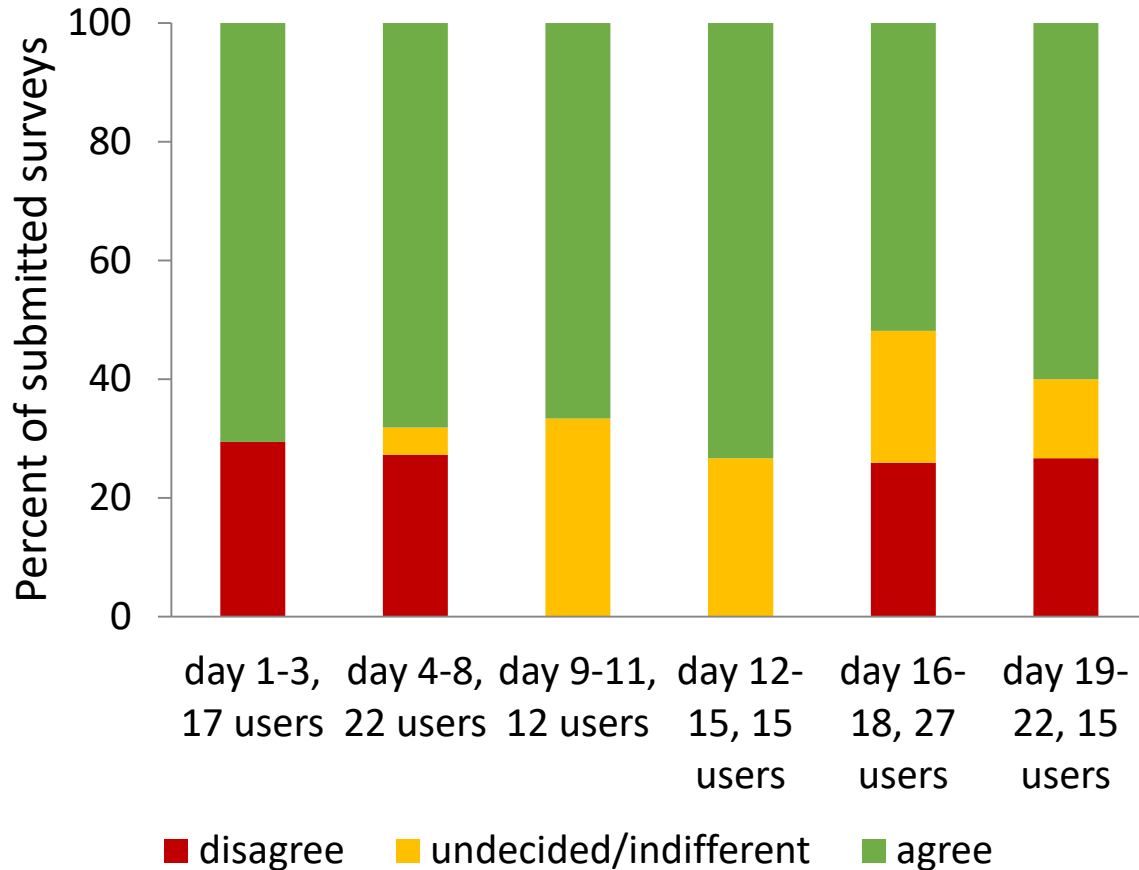
Testing of different swipe materials

| | Silicone oil bleed | Silicone | Polyurethane |
|------------|---|---|---|
| No spray |   |   |   |
| With spray |   |   |   |

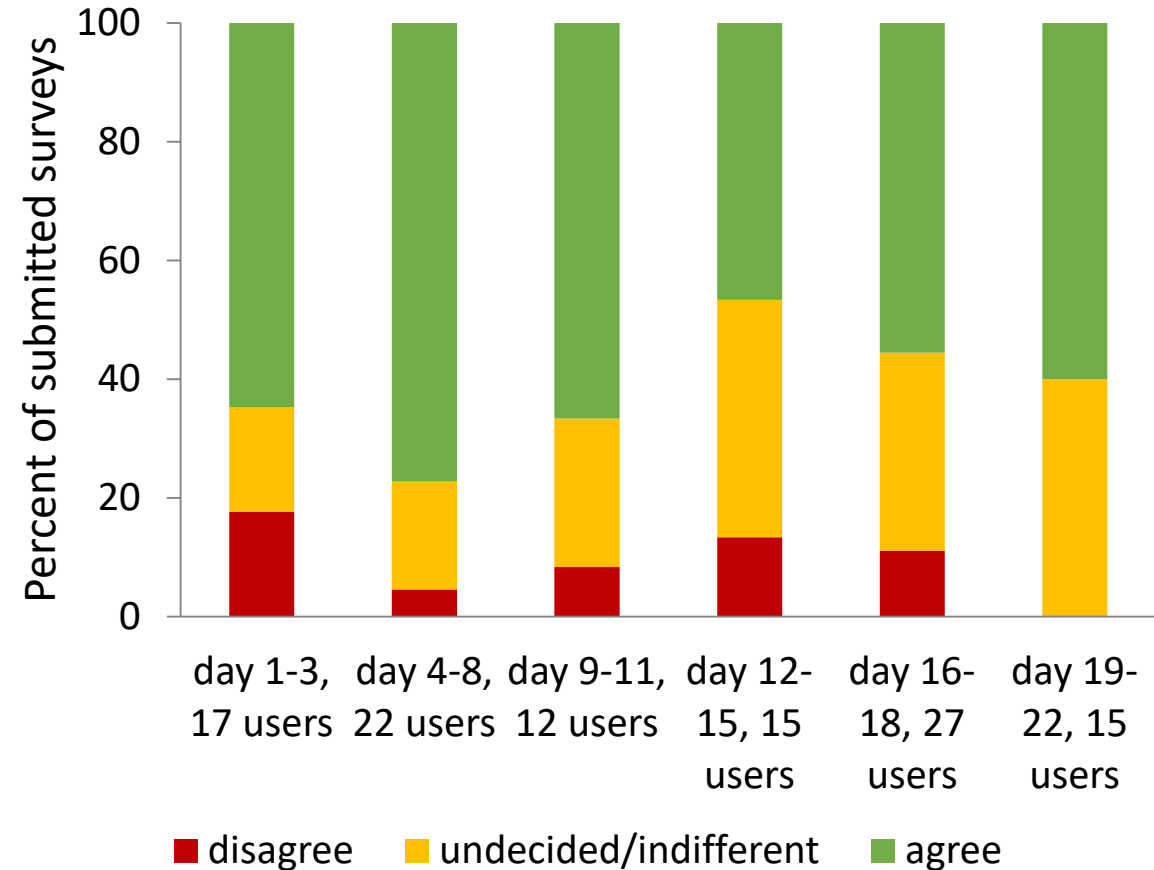


User survey data from a university setting

How much do you agree with the statement
“The toilet was clean”?

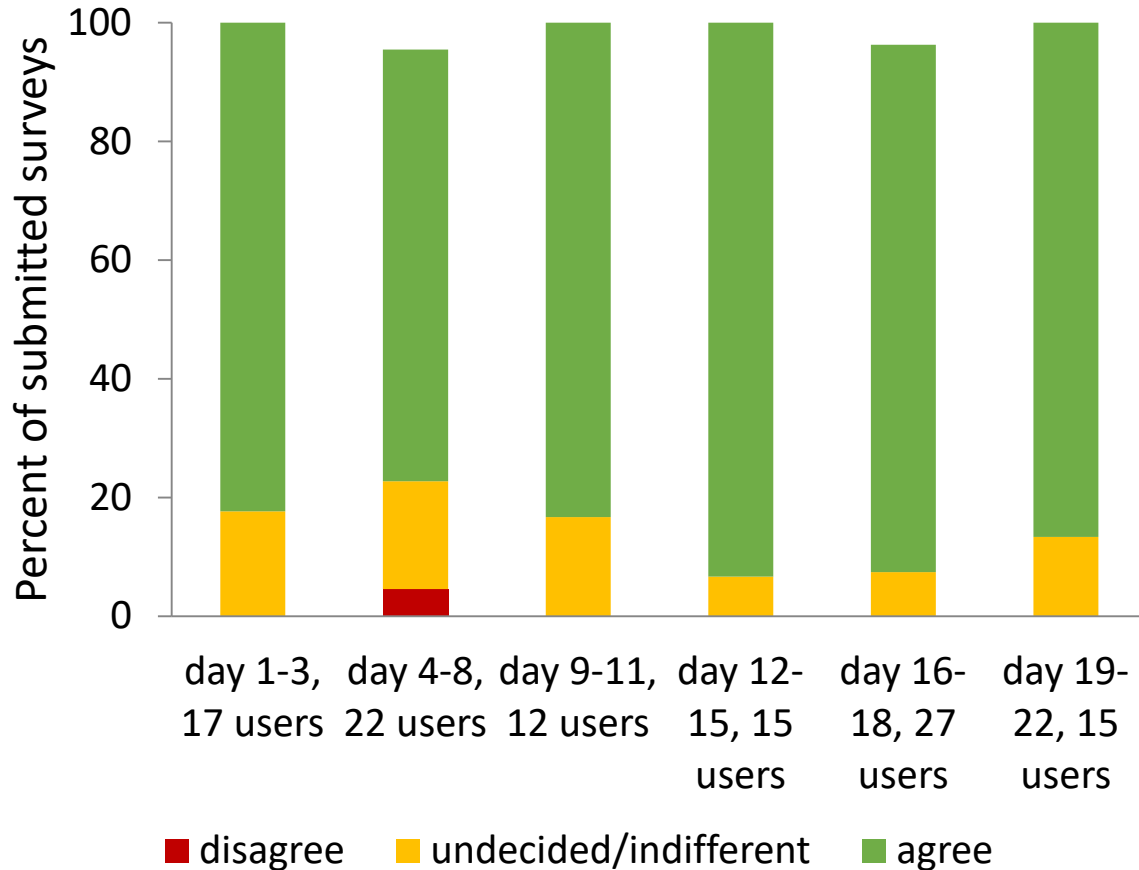


How much do you agree with the statement
“the toilet didn't smell bad”?

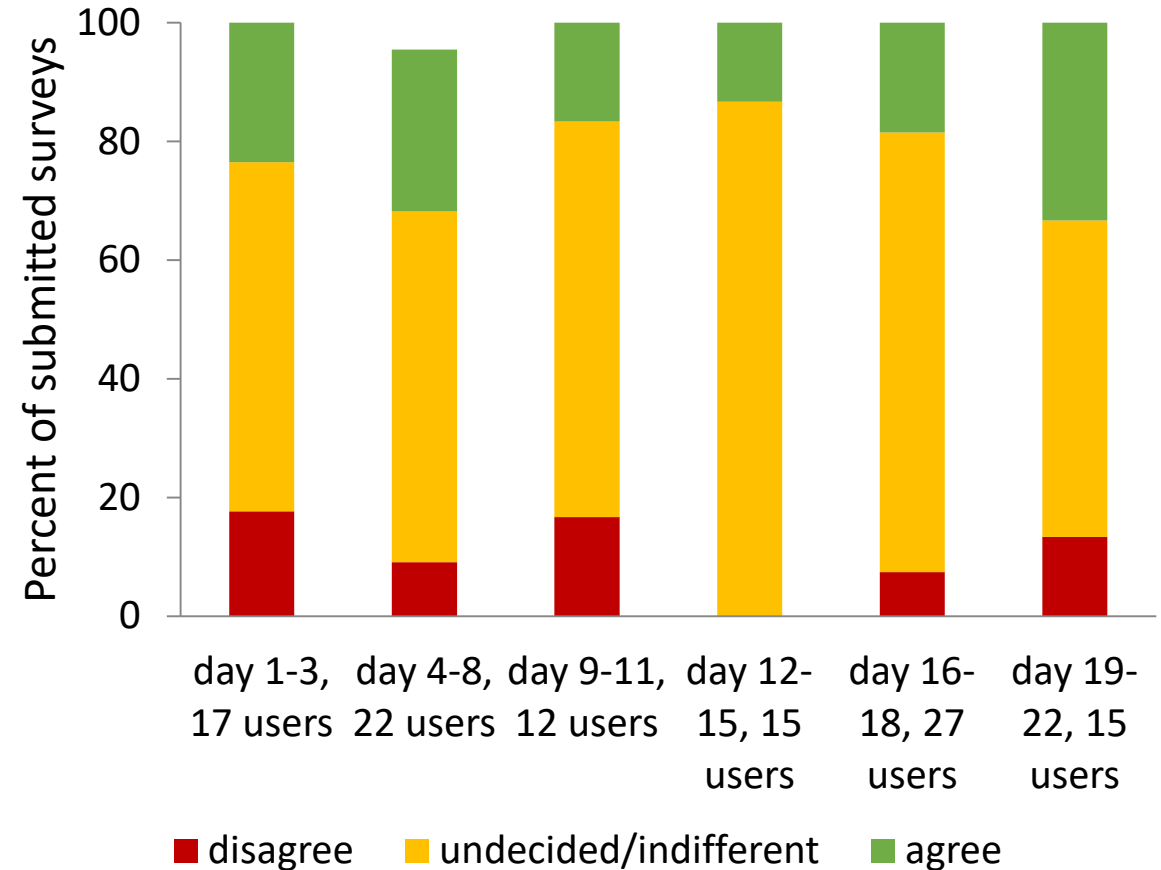


User survey data from a university setting

How much do you agree with the statement
“Using the toilet was easy”?

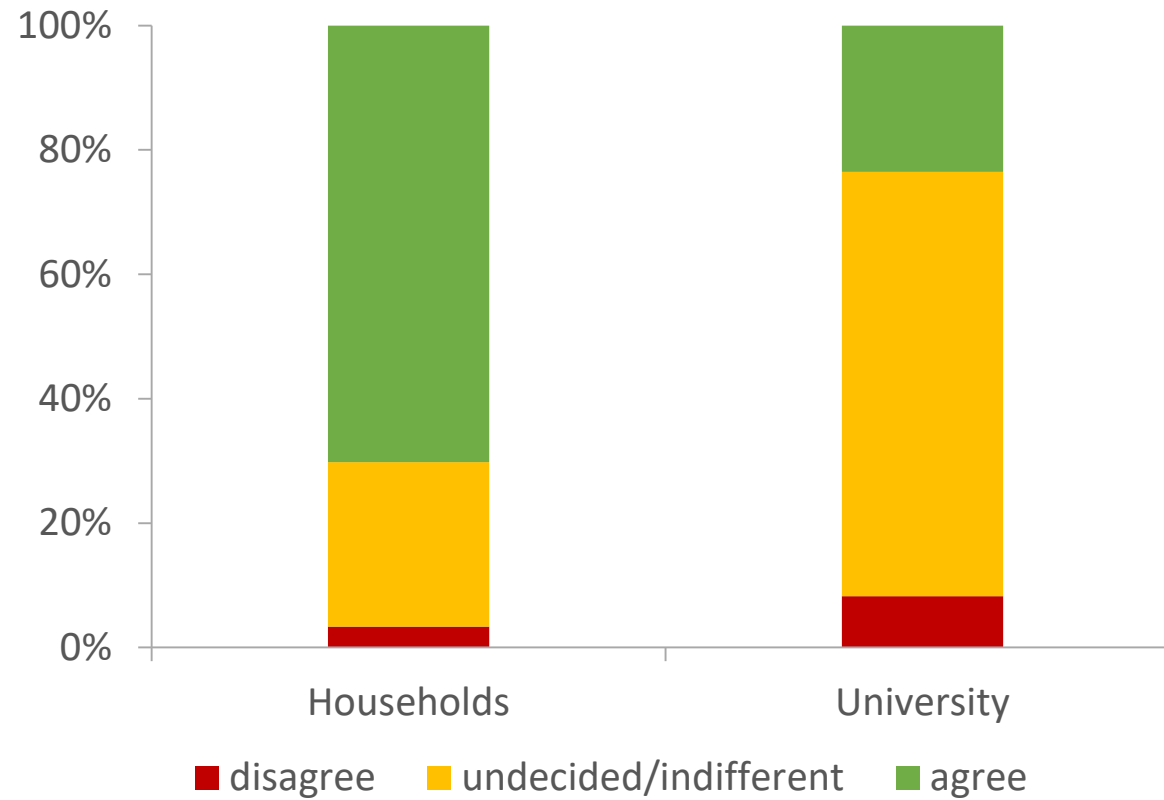


How much do you agree with the statement “I prefer this toilet to my usual one”?



Preference of the toilet by users in different settings

How much do you agree with the statement "I prefer this toilet to my usual one"?



User guidance needed

- When the toilet is installed a short instruction is given on how to use the toilet
 - Pull the toilet seat all the way up before sitting down
 - After use, close the lid to flush the toilet
 - A swipe will clean the toilet when the lid is closed
- Most users find the instructions easy to understand
- Users are able to teach new users how to use the toilet frontend



Conclusions

- International human user testing of the frontend prototype gives valuable information on swipe and bowl performance for a future redesign of the toilet
- A mechanical flush has the potential to keep the toilet clean without the use of flush water
- Most users find the toilet frontend easy to use and only a short explanation is needed to introduce new users
- Household users who normally use a UDDT toilet have a higher preference of the Nano Membrane Toilet over their normal toilet than University users who normally uses a flush toilet.



Acknowledgments



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Thank you for your attention. Any questions?

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www.nanomembranetoilet.org

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