

A Better Toilet for a Cleaner World



RTI International is developing a toilet that converts human waste into burnable fuel, stored energy, and disinfected, non-potable water. The system is designed as a closed loop, applying technology that treats and reuses the liquids and generates power for the system through the combustion process. This novel waste treatment system could help improve public health, the environment, and quality of life among people in developing nations. The system will not require piped-in water, a sewer connection, or outside electricity. RTI demonstrated its first prototype at the *Reinvent the Toilet Fair India* in New Delhi in March 2014. In May 2014, RTI began field activities in India to gather user insights on the prototype's technology and interface, along with feedback on the approach to on-site waste treatment.

Toilet Technology

RTI's design will accomplish three primary functions: disinfect liquid waste, dry and burn solid waste, and convert the resulting combustion energy into stored electricity.

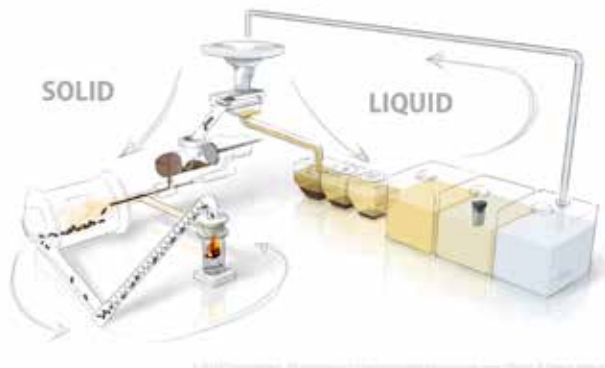
The solid waste drying process will use a combination of mechanical, solar, and thermal energy. A mechanical screw-like device will separate out liquids and begin the process of converting solid waste into combustion fuel. Solar energy, natural drafts, and heat from burning waste will further aid the drying process. As it dries, the waste will be broken down into uniform-sized pellets, which will be burned using a novel combustion unit designed by Colorado State University. This self-powered unit also captures a portion of the heat produced and converts it into electricity using thermoelectric devices. The electricity is stored in a battery and will be used to power the liquid disinfection.

Liquid waste—including urine and liquid that are removed from the solid waste—will be disinfected through electrochemical processes using an electrochemical cell. The liquid waste processing module converts the natural salts found in urine into oxidants such as chlorine. The electrochemically generated oxidants disinfect the liquid by destroying the pathogens that come from mixing with the solid waste.

The liquid treatment system uses a three-tank system consisting of a baffled buffer tank, a central processing tank, and a holding tank. The baffled collection tanks allow solids to settle and dissolve prior to entering the process module, eliminating the need to pre-filter the liquid before entering the electrochemical cell.

The central processing tank batch-processes liquid through the electrochemical cell via a circulating pump. Once disinfection is complete, the process tank contents are transferred to a holding tank. System automation is implemented by a microcontroller, and diagnostic information can be obtained through a USB port.

A Better Toilet for a Cleaner World



Why We Care

Much of the world's population is in dire need of improved sanitation, but it remains a neglected priority. Currently, 2.5 billion people do not have access to improved sanitation, and nearly 1.1 billion resort to open defecation. Open defecation poses significant health and environmental risks. Even in urban areas, more than 2 billion people in the developing world lack access to services and infrastructure for the safe disposal of human waste. Each year, 1.5 million children die from diarrheal disease. Improper waste management can seriously contaminate important sources of drinking water.

India Prototype Test and Evaluation

RTI is focusing its work in 2014–2015 in urban India. Ahmedabad is the chosen hub, and additional work will be undertaken in Vadodara (Baroda). These locations provide strong collaborations with local government, leading universities, and nongovernment organization partners working on meeting the challenge of improved urban sanitation.

RTI is working with several partners in India to execute this work. Self Employed Women's Association (SEWA), the women's union with national reach in-country, is supporting user studies through the mobilization of communities to provide input and feedback on our system design and

approach. NEERMAN, a Mumbai-based research and consulting organization, is supporting qualitative and quantitative data work. These non-profit partners are instrumental in contributing to a range of social, economic, and cultural perspectives from a diverse set of communities in Gujarat and are supporting our engagement and conversations about the technology and approach in Hindi and Gujarati. L&T Engineering, from its Vadodara office, is conducting a value engineering task on our prototype and is hosting our work with SEWA and NEERMAN for user studies in Vadodara communities.

Who We Are

RTI International has been awarded a grant from the Bill & Melinda Gates Foundation to develop an affordable toilet and waste treatment system that treats all pathogens on site. The RTI technology converts human waste into burnable fuel, stored energy, and disinfected, non-potable water.

RTI is partnered with Duke University, Colorado State University, NASA's Ames Research Center, and the U.S. Naval Research Laboratory to develop a prototype of this safe, sanitary, and affordable waste treatment system. Our team includes experts in engineering, water and sanitation, energy, and economics.

More Information

Brian Stoner, PhD
Senior RTI Fellow, Project Lead
919.248.1119
stoner@rti.org

Myles Elledge
Senior Director, Project Lead (India)
919.541.8739
melledge@rti.org

RTI International
3040 E. Cornwallis Road, PO Box 12194
Research Triangle Park, NC 27709-2194 USA

www.rti.org
www.abettertoilet.org

RTI 8633 R2 0615



RTI International is one of the world's leading research institutes, dedicated to improving the human condition by turning knowledge into practice. Our staff of more than 3,700 provides research and technical services to governments and businesses in more than 75 countries in the areas of health and pharmaceuticals, education and training, surveys and statistics, advanced technology, international development, economic and social policy, energy and the environment, and laboratory testing and chemical analysis. For more information, visit www.rti.org.

RTI International is a registered trademark and a trade name of Research Triangle Institute

