

## **Empowered Septic Tanks – Vertical flow constructed wetlands combined with electrochemical disinfection to treat septic tank effluent and provide safe water for reuse**

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India faces a significant water quality challenge as 80% of its wastewater is being discharged into receiving water bodies without prior treatment. This is not only detrimental to the environment, but also leads to major health concerns related to water-borne diseases and associated deaths. Sadly, young children and poor households bear the maximum brunt of inadequate sanitation. India is only one of many developing countries facing these problems as 2.4 billion people worldwide lack access to basic sanitation services. With global populations projected to reach 9.8 billion by 2050, and natural disasters such as droughts or floods expected to increase due to climate change, water scarcity is inevitable. There is an increasing need for wastewater treatment technologies that address the problem at the source and integrate resource recovery and reuse, in order to achieve the sustainable development goals on water.

Here, we present a decentralized wastewater treatment technology that combines high-rate vertical constructed wetlands for solids removal with electrochemical disinfection of the solid free water. This technology has been designated Empowered Septic Tanks and was developed as part of The Gates Foundation 'Reinvent the toilet' challenge. This zero-chemical-input technology can be directly integrated with the toilet and septic tank, requires only electricity and can be operated with low technical expertise. Lab-scale experiments and field trials in India have shown promising results with respect to COD/N/P removal (30-90%), pathogen removal (5-log unit reduction) and inactivation of Helminth eggs (morphological changes). Further lab-scale testing using sand filtration and electrochemical disinfection at Ghent University has allowed us to select optimal configuration, liquid flow path and electrode materials for maximal chlorine production. A robust second generation system is currently being developed to alleviate issues related to solids accumulation and membrane degeneration, and to minimize power input while still achieving sufficient disinfection. This system will be deployed in the field under different settings, i.e. at a community toilet, railway station, apartment building and school (100 people equivalent), in order to determine its long-term stability. The objective is to obtain treated wastewater at low cost that can be safely discharged or ideally reused for household (toilet flushing) or agricultural (irrigation) purposes. Decentralized wastewater treatment systems such as Empowered Septic Tanks have the power to increase clean water supply while simultaneously decreasing freshwater demand, hereby contributing to a sustainable water economy in developing countries.

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