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Nutrient recovery from urine: Operation and optimization of reactors in eThekwini

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75,000 urine-diverting dry toilets (UDDTs) have been installed in the rural and peri-urban areas of eThekwini to address the sanitation "backlog". UDDTs allow the separation of urine from the faeces stream by a divider inside the pedestal. The source-separated urine is a source for fertilizer production, as it contains the majority of nutrients found in wastewater streams. Since October 2010, the Swiss Federal Institute of Aquatic Science and Technology (Eawag), eThekwini Water and Sanitation (EWS), the University of KwaZulu-Natal and the Swiss Federal Institute of Technology Zurich (ETHZ) have worked together in the VUNA (Valorisation of Urine Nutrients in Africa) project to develop a sustainable urine collection system and adequate urine treatment processes (www.vuna.ch).

In a first step, a precipitation reactor was built to recover phosphorus from urine. By adding soluble magnesium to stored urine (e.g. $MgCl_2$), struvite (magnesium ammonium phosphate hexahydrate; $MgNH_4PO_4 \cdot 6H_2O$) precipitates, and can be recovered as a powder, ready to use as fertilizer after drying. With the first reactor set-up, a recovery of more than 91% of total phosphorus was achieved. The reactor operation will be automated and a test plant installed in the field at the Agricultural Hub in Newlands-Mashu, Durban, to run further tests and develop a user-friendly and robust process.

In a next step, another reactor setup will be used to recover all nutrients found in urine (e.g. nitrogen, phosphorus, and potassium). The process consists of an aerated nitrification reactor containing biofilm carriers to stabilize the urine biologically, followed by an evaporation reactor, which removes water and produces a concentrated nutrient solution or even a solid. The final product contains high amounts of ammonium nitrate (up to 24% nitrogen in the solid product) and promises to be an effective nitrogen fertiliser.

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