

Separating urine for 'greener' wastewater treatment

"We should see urine as a resource rather than a waste," says Dr Jac Wilsenach, a senior researcher at CSIR Natural Resources and the Environment. "In a water-scarce country like South Africa, it seems inconceivable that we use drinking-quality water to flush our toilets. However, seeing as this water is never consumed, but only used and re-used, we should pay this price for the benefit of urban hygiene."



Dr Jac Wilsenach, who did his PhD on urine separation technology while working at Delft University in the Netherlands

Most of the wastewater treatment plants in South Africa are stretched to capacity, and meeting the Department of Water Affairs and Forestry's (DWAF) effluent standards remains a challenge. The first priority is to protect human health, so while faecal bacteria and other pathogens may be effectively dealt with, the discharged effluent generally contains high concentrations of nutrients, contributing to the eutrophication (nutrient enrichment) of our rivers. The abundant supply of nitrogen, phosphorus and potassium has a fertilizer effect, leading to excessive growth of riverine reeds, water weeds and algae, with a range of knock-on impacts for freshwater ecosystems.

"Nutrient removal is the most difficult aspect of wastewater treatment," says Wilsenach. "It requires special activated sludge processes, with skilled operators and high-level maintenance. But if urine was collected at source and treated separately, effluent quality could be drastically improved in simpler processes." This is because urine contributes most of the nutrients in domestic wastewater, accounting for about 80% of the nitrogen, 50% of the phosphate and 70% of the potassium. These nutrients could potentially also be recovered from urine and converted into commercial fertilizers if they were not diluted into the sewer system.

"Separated urine collection and treatment has been advocated in Sweden since the 1990s, but in the past few years it has received much attention throughout Europe, and pilot projects have started in a number of countries," he says. Wilsenach became interested in urine separation technology while working at Delft University in the Netherlands for five years, eventually writing up his research for a PhD.

"The concept is not to have a urine separation toilet in every home - that would be impractical - but to install them in office blocks, schools, airports and shopping malls, where each toilet is used daily by scores of people. It is important to realise that a partial collection of urine at source can already have an impact. We don't have to aim at 100% separation."

Urine diversion toilets - often called NoMix toilets after the leading brand in Europe - have a partition in the toilet bowl for a urine drain at the front, and a bowl for faeces at the back. Best results are achieved if men sit down to urinate, which means that resistance to the toilets can be expected in some cultures. Fortunately, new kinds of waterless urinals are also being marketed abroad. Urinals should be the first target.

Reducing urine input to wastewater treatment works would also allow the treatment process to be conducted in a more energy-efficient way. In fact, Wilsenach says, treatment works could become net generators of energy, as the organic material used for nutrient removal in conventional systems could instead be used for the production of biogas.

Yet another potential benefit of urine separation technology is the removal of pharmaceutical residuals that are excreted in urine. Media reports of high levels of Prozac in London's recycled drinking water, as well as in fish collected from American river systems, focused attention on this issue recently. Furthermore, regular discoveries of aquatic animals exhibiting both male and female characteristics have raised alarm about the gender-bending effects of hormones excreted by women on contraceptive pills or hormone replacement therapy. Pesticides and herbicides from agricultural runoff, as well as many other chemicals that find their way into river systems, are also endocrine disrupters that affect the development of sex organs.

"With separate urine collection and treatment there might be processes that could remove pharmaceutical chemicals," says Wilsenach, "but their end-of-pipe concentrations are too low to deal with efficiently. This is important in wastewater recycling to drinking water. Another issue is salinity, which is the ultimate concern in water recycling. Dealing with the salts in urine separately can make a valuable contribution in this regard too."

So what are the chances of urine separation being implemented in South Africa in the near future?

"The technology has great potential, but it is logistically challenging," Wilsenach admits. "We really need to demonstrate it to get people in South Africa to sit up and take notice. We've been discussing the possibility of a demonstration project with municipalities.

"At this stage we are still in the technology development phase, and have been focusing on modelling studies and working on a reactor design. To move forward we would need an industrial partner to take the final steps with us in scaling up to a full-scale reactor."

Hopefully, once the technology has been tried and tested on a larger scale in Europe, its benefits will be too obvious for South Africans to ignore. It may be only a matter of time, then, before urine separation toilets are routinely installed in large developments.

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