# Tove Larsen explains the toilet revolution

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**It’s no secret that urine contains valuable nutrients – or that diluting them with water which is then flushed into sewers is not the most sustainable way of managing this resource. But how can urine be kept out of wastewater? Eawag has been investigating this question for many years, and one answer is to use a urine-diverting toilet to separate it “at source”. What may sound simple turned out in practice to be a tricky task, and several generations of toilets were needed to optimise the source separation technology to the point where it can be more widely deployed.**

**Tove Larsen of Eawag’s Urban Water Management department explains how this goal was reached.**

***The latest urine-diverting toilet is being “officially” presented today at the ISH sanitation trade fair in Frankfurt. What can this model do that its predecessors couldn’t?***

The latest urine-diverting toilet, known as “save!”, is based on an innovative idea from the designer Harald Gründl of the Austrian design studio EOOS. It dispenses altogether with a valve, which had always been required to date. The toilet is designed in such a way that urine drains correctly almost automatically, by the force of gravity, while most of the flushwater “overshoots” and enters the sewer system. The innovation is the so-called urine trap, which conveys urine across the inner surface of the toilet bowl into a concealed outlet, working purely by surface tension. This phenomenon is known as the teapot effect.

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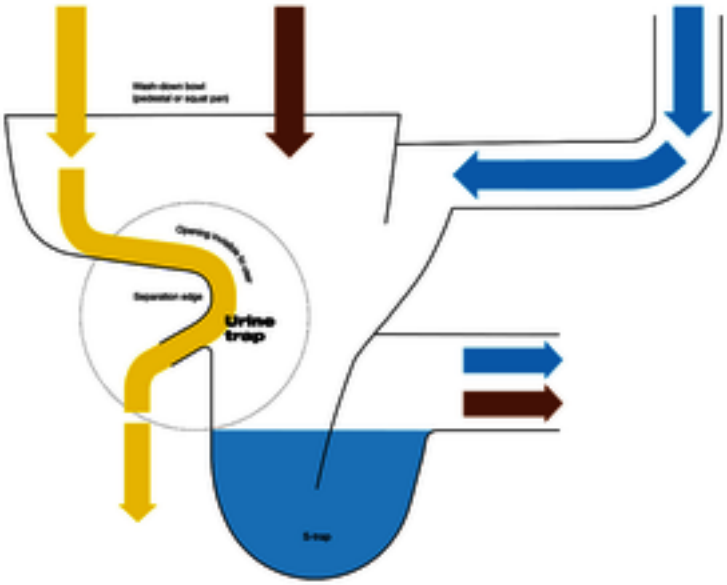


*Animated visualization of the latest NoMix toilet technology*

*http://urinetrap.com/*

Previously, urine was diverted with the aid of a valve, which was either pressure-sensitive or sensor-controlled. In practice, difficulties arose with both of these systems, as they were either not so easy to use or too costly.

*The save toilet is a collaborative effort involving various partners. What is special about this collaboration?*

It really is a very nice story: about eight years ago, Harald Gründl gave us a proposal for the design of a urine-diverting toilet. In 2011, when Eawag was invited by the Bill & Melinda Gates Foundation to compete in the Reinvent the Toilet Challenge, we were able to start work on the development of a dry urine-diverting toilet. The result of this project was the Blue Diversion toilet, which is now being further developed in various Eawag projects. I'm delighted that Harald Gründl has now managed to get the Swiss company Laufen to manufacture the new save toilet. Also involved in the development of this toilet was Professor Markus Holzner of the Institute of Environmental Engineering (IfU) at ETH Zurich. In close cooperation with EOOS and Laufen, he supported optimisation of the toilet geometry by computational fluid dynamic simulations. We've been waiting a long time for an effective urine-diverting toilet to reach the market, as that's the only way this innovation has a chance of becoming established in practice.

*What conditions have to be met and where can this system be deployed?*

The new urine-diverting toilet can, of course, only be installed where an appropriate system is in place for managing the remaining wastewater from the toilet. In other words, it's suitable above all where waterborne sewerage is available. The toilet is best installed in new construction or major renovation projects, because new pipes are needed in the building. Only when the technology is available for processing urine directly beside the toilet will it also be

possible to install a urine-diverting toilet with minimum effort when an old one needs to be replaced in existing buildings. Such systems are being developed, also at Eawag, but it's not yet clear when they will be sufficiently mature.

*Why is the separation of urine and faeces sensible and sustainable?*

Eawag has been interested in urine separation for a long time because most of the nutrients are contained in urine. For decades, nutrients in natural waters have been a problem, which is being exacerbated worldwide by population growth, urbanisation and climate warming. By building sewers and treatment plants, you can remove a large proportion of nutrients from wastewater. But globally speaking, only a fraction of the nutrients are removed from wastewater in this way, particularly because large-scale centralised infrastructure is expensive and requires a well-organised public sector. Urine separation can be introduced at the local level and is effective immediately, whereas a sewer system initially accelerates the transport of nutrients to natural waters, and it normally takes decades for effective treatment plants with nutrient elimination to be built – if they are ever built. Although the protection of water resources is a priority for Eawag, nutrient recycling has always been another driver of technology development. Urine can be used to produce an excellent agricultural fertiliser, thus promoting the closing of nutrient cycles.

*Tove Larsen in conversation.*
*(Photo: Peter Penicka, Eawag)*

*What happens to the faeces and urine after flushing?*

Faeces, toilet paper and flushwater are transported via the sewers to the treatment plant along with the other wastewater. The urine, in most cases, ends up in agriculture, where the nutrients are used as a fertiliser, although more or less complex treatment is required for this purpose. At Eawag, a technology was developed which is to be commercialised by the spin-off Vuna. With this system, urine is stabilised by nitrification, a biological process which converts ammonium to nitrate while also lowering the pH. This is necessary to prevent the release of ammonia during subsequent treatment. Organic micropollutants are then removed by activated carbon, and finally the liquid is evaporated to produce a 20-fold concentrated

nutrient solution. The end product, called Aurin, has been approved by the Federal Office for Agriculture for use – without any restrictions – as a liquid fertiliser.

*Isn't a connection to the sewer network compulsory in Switzerland?*

Yes, that's true, although in our experience at Eawag, there's no problem getting permission for urine-diverting toilets in Switzerland. But if they are to widely installed, they would have to be accepted as standard by the authorities and specified as a requirement, for example, for new housing developments. Before that can happen, there will need to be pilot projects – which are now possible with the save toilet. Housing associations, especially, are interested in pilot projects of this kind, and with appropriate preparations I wouldn't expect there to be any problems gaining permission.

*What about the question of financing?*

Initially, new green technologies are always expensive – they gradually become cheaper. We can see that happening in the renewable energy sector, and it won't be any different for urine-diverting toilet installations. Sewers and treatment plants were also subsidised at first. In France, from 2019, subsidies will cover 80 per cent of the additional investment costs for all installations of urine-diverting toilets in new public buildings and apartment blocks in the Seine-Normandie agglomeration – from the toilet to fertiliser production. There, the source separation technology is expected to offer a cheaper alternative to the expansion of wastewater treatment plants in Paris – which will soon be necessary as a result of increased nitrogen loads from the growing city. We also expect that, at some point, mature source separation technology will provide an economic alternative to nutrient elimination at treatment plants. But at the moment we're still in a pilot phase where installations are not yet financially attractive.

*What are the next steps?*

The new urine-diverting toilet will probably come onto the market at the beginning of 2020. At Eawag, they'll be installed in the new FLUX building, and we're expecting a series of pilot projects in this country and abroad. This toilet is designed for Europe, and we've received enquiries mainly from Switzerland but also from Germany, Sweden and France. Colleagues in Australia, Canada and the US would also like to carry out pilot projects – for example, on their own campus. These we will also support, as far as possible. At Eawag, research and development in the field of urine treatment will continue, not only for the Vuna technology but also for other systems such as Blue Diversion Autarky. In addition, within the Water Hub research platform, various source separation projects are being integrated – for instance, greywater treatment or recovery of energy resources from wastewater.

Design Award for the Toilet Revolution

The new save toilet was developed by the Austrian design studio EOOS and the Swiss bathroom ceramics manufacturer LAUFEN. It builds on the concept developed by Eawag and EOOS for the Blue Diversion toilet, which was funded by the Bill & Melinda Gates Foundation.

At the design fair in Milan, the Triennale, "save" has just won the Silver Black Bee Award as Austria's contribution under the title "Circular Flows - The Toilet Revolution". Gold went to Australia for a contribution to the Great Barrier Reef, bronze to Russia, which has studied the state of the rivers in Moscow: press release of the Triennale [pdf]. Information from the MAK (Austrian Museum of Applied Arts, Vienna).

## Related Links

Further information on source separation and wastewater treatment technologies

https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/tove-larsen-explains-the-toilet-revolution

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