



How local materials and climate shape optimal vermifilter design

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Topics: Drinking Water | Wastewater | Ecosystems | Water & Development | Society | Climate Change & Energy

The sanitation objective of Sustainable Development Goal 6, sanitation for all, is off-track and far from being completed by 2030. Vermifiltration could help address this gap: The nature-based sanitation management system shows increasing promise globally because of its low cost. Researchers at Eawag’s Sandec department visited vermifilter installations in India and Switzerland to examine how local differences influence their optimal design.

Vermifiltration is a non-sewered sanitation technology that uses a symbiotic relationship between earthworms, often *Eisenia fetida*, and microorganisms, to treat wastewater. The earthworms not only break down organic matter, which is then more easily available to the microorganisms, but they also aerate the vermifilter via their burrowing activity and this stimulates bacterial productivity. This technology has various advantages: it is low-cost and robust, requires minimal to no energy use and can be built with local, easily available materials (compost, biochar, gravels, sand, etc.). Additionally, treated wastewater can be used to close water and resource loops.

Comparison of vermifilters in India and Switzerland

“To understand how local context influences vermifilter design and to compare findings with those observed in Switzerland, I visited vermifilter facilities in India”, says Kayla Coppens, PhD student at Eawag’s department of Sanitation, Water and Solid Waste for Development (Sandec) and the University of Geneva.

Because vermifiltration systems use locally available materials, different filter media are used at the facilities in Geneva, Switzerland, and in Jaipur and Pune, India. The Geneva and Jaipur systems use vermicompost as the bedding material, while in Pune, the bedding layer utilises coconut chips. In Jaipur, tests combining coconut biochar and vermicompost as the filter media have also been implemented.

The three vermifilters also differed in pre-treatment approaches. In Geneva, the vermifilter was installed without additional pre-treatment, while the one in Jaipur uses settling tanks to decrease solid loads, and the vermifilter in Pune uses grit chambers for this. Solid load variations influenced dispersion system choices. In Jaipur and Pune, low solid loading allowed for sprinkler systems, whereas in Geneva, higher solid loads required a shredding pump and 10 mm plumbing tubes.

The differences in filter materials, climate conditions, and pre-treatment approaches required adjustments to operational parameters. For example, the significantly higher temperatures in Jaipur and Pune compared to Geneva influenced how much wastewater could be applied to the filters. Despite these variations, all three systems achieved comparable treatment performance, demonstrating that vermifiltration can be successfully adapted to different local contexts.

No “one size fits all” vermifilter design

“My key takeaway is that using local resources and expertise is crucial to the development of vermifilters, and that there is no single optimal vermifilter configuration”, explains Coppens. Climate, for example, heavily influences the vermifilter design. The facilities in India have to take the high temperatures and humidity of the local climate into consideration, while in Switzerland the challenge is keeping the cold out. Future research should identify effective design and operational configurations for specific contexts.



Vermifilter system in Jaipur, India (Photo: Kayla Coppens, Eawag).



Vermifilter installation in Pune, India (Photo: Kayla Coppens, Eawag).

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Cover picture: Vermifilter in Geneva, Switzerland (photo: Kayla Coppens, Eawag)

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