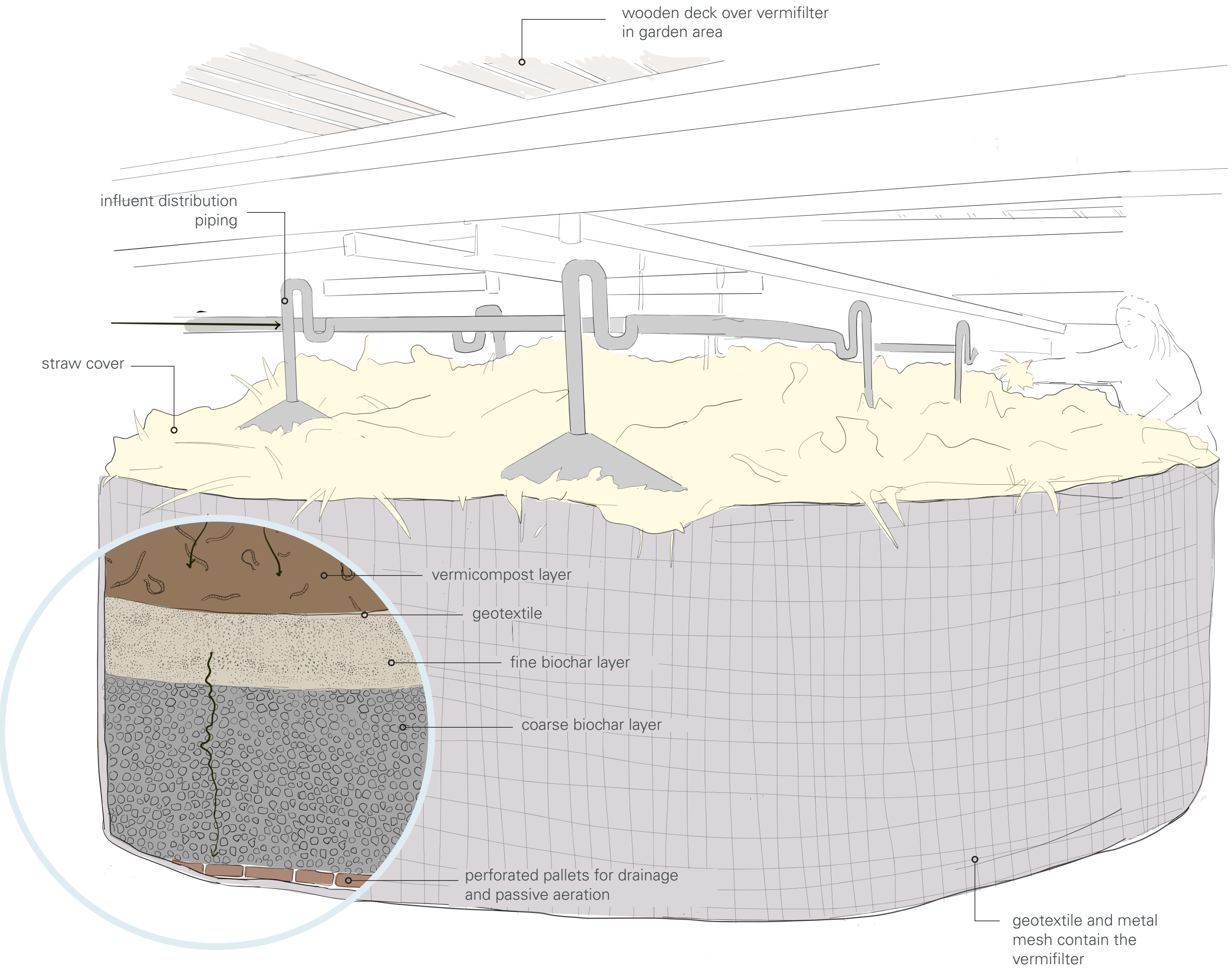
VERMIFILTERS

TECHNOLOGY

eawag aquatic research



Vermifilters treat blackwater or mixed wastewater in a multi-layered system that includes solid-liquid separation, vermicomposting of the solid fraction, and aerobic biological treatment of the liquid fraction. The wastewater is distributed on top of the vermifilter and seeps vertically down through the filter. The solids (feces and toilet paper) are retained at the top, where earthworms and microbiota degrade and process it into compost. The liquid percolates through a porous layer (of e.g., gravel, biochar, wood chips), which provides a large surface area for adsorption and further biological treatment by microorganisms growing in biofilms. While the composting layer is aerated through the borrowing activity of the worms, the drainage layer is designed to allow a passive flow of air through the filter media. Vermifilters are not an optimal technology to treat source-separated greywater, but can be fed grease and solids from a greywater grease trap.

Vermifilters are a robust, low maintenance and energy option for on-site treatment that can be maintained by the users themselves. The technology is well suited for settings without source-separation of streams, and where wastewater loads may be variable in time (e.g., alpine settings, holiday homes).

INPUT STREAMS	TARGET OUTPUT(S)
BW Blackwater	Treated Water
MW Mixed Wastewater	Soil Amendment, compost

SOUBEYRAN

Geneva, Switzerland | 2017

First example of a vermifilter in an urban setting, serving ~100 p.e.

A large vermifilter (8 m in diameter) is located below ground, under a wooden deck in the garden area (total area: 80 m2, depth: 3 m). Blackwater from toilets is alternately distributed over half of the vermifilter. The liquid effluent is treated further and reused onsite together with treated greywater and rainwater for toilet flushing and irrigation. Excess treated water is piped to the local storm drain. Vermicompost (~1m3/year) is used in the garden after maturation.

SPECIFICATIONS

INFRASTRUCTURE

Vermifilters perform more efficiently when treating blackwater, but can also treat mixed wastewater. It can therefore be retrofitted without modifying the plumbing system as an “end-of-pipe” solution. Vermifilters are best placed in a basement or underground for several reasons:

1) Temperatures are relatively constant, and freezing is avoided.
2) Filters are directly fed by gravity, without the need for a buffer tank. When gravity feeding is not an option, macerating pumps in a small collection tank are possible.
3) Space requirements may be less of a constraint since vermifilters require up to 0.5 m² per p.e.. In either configuration, it is important to leave enough head and elbow space to be able to reach the entirety of the filter surface for maintenance.

OPERATION & MAINTENANCE

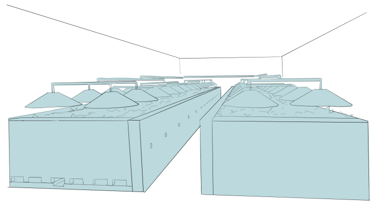
Very little to no energy consumption is necessary for vermifilter operation. Energy is only required for the feed pumps, if necessary. No control system is required and the system has few to no moving parts. Therefore, vermifilters require little regular maintenance: only the addition of straw, cardboard or dry plant matter to decrease humidity and increase the carbon to nitrogen (C:N) ratio for optimal composting. Grease and solids from a greywater grease trap can also be manually fed to a blackwater vermifilter. Once or twice a year, compost can be manually taken out of the filter for further maturation before use.

TARGET OUTPUTS

Vermifilters are robust and efficient for the removal of organic matter from blackwater or mixed wastewater but have variable performance for nitrogen removal and limited removal of pathogens and micropollutants. Therefore, the liquid effluent from the vermifilter should be treated with additional biological treatment, filtration, and/or disinfection steps to achieve the water quality necessary for the desired water reuse application. Because worms efficiently reduce the volume of the solids by 60 to 90%, relatively small volumes of vermicompost are produced. Once removed from the vermifilter, the compost will require maturation (e.g., storage during 6-12 months) before safe application as a soil amendment.

SELECTED CASE STUDIES

LA BISTOQUETTE
Geneva, Switzerland | 2025

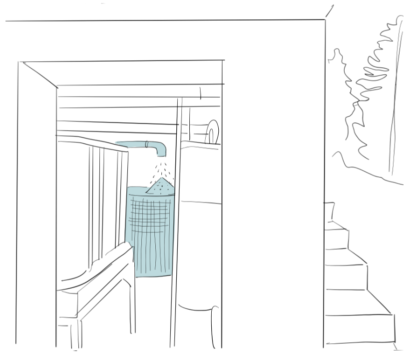


Vermifilter in the basement of an urban building complex

Three apartment buildings (330 p.e.) belonging to La Bistoquette cooperative include source separation of greywater, urine and blackwater from urine-diverting flush toilets. The blackwater will be treated in a large vermifilter in the basement of one of the buildings. The effluent from the vermifilter will be pumped onto 20 small biochar trickling filters for post treatment. The treated water will be stored in a tank together with treated greywater and collected rainwater and used for toilet flushing and irrigation of the terraces, balconies and ground floor.

BW — T.43 VERMIFILTER (→ vermicompost) — T.45 TRICKLING FILTERS — T.41 STORAGE TANK

BLONAY
Vaud, Switzerland | 2024

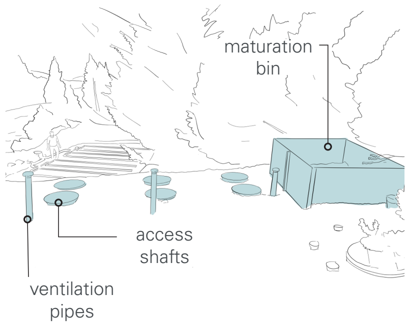


Small vermifilter in rural family home

A small vermifilter treats the mixed wastewater (excluding urine) from a family home (5 p.e.). Both the vermifilter and the dedicated urine treatment are housed in a concrete basement structure below the house. The liquid effluent from the vermifilter is infiltrated onsite.

MW — DEGREASER — T.43 VERMIFILTER (→ vermicompost) — INFILTRATION

CHAMANNA CLUOZZA
Zernez, Switzerland | 2022



Underground vermifilters in an alpine setting

Located at 1882 m in the heart of the Swiss National Park, Chamanna Cluozza offers accommodation to (~30) hikers and staff. The mixed wastewater stream from the alpine hut is treated in three alternately-fed, underground vermifilters using woodchips as a filter media. The filters occupy an area of roughly 12 m² some distance away from the hut and feed into a 40 m² constructed wetland. The effluent is infiltrated. The vermicompost is periodically shoveled into a maturation bin, for further treatment, before use.

MW — T.43 VERMIFILTER (→ vermicompost) — T.44 CONSTRUCTED WETLAND — INFILTRATION