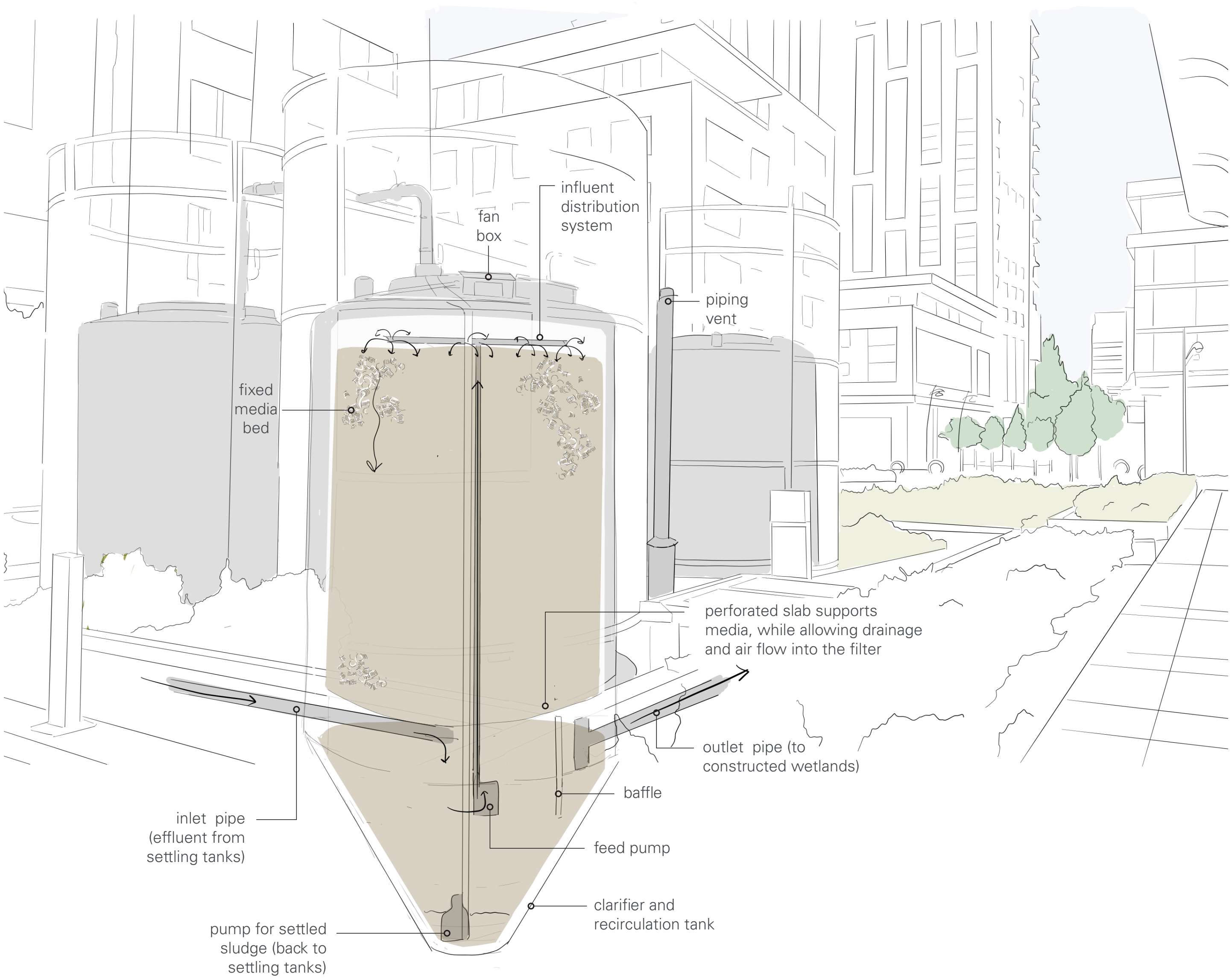
TRICKLING FILTERS

TECHNOLOGY



Trickling filters (sometimes also referred to as packed bed filters, biological filters or recirculating media filters) are aerobic biological reactors that degrade organics. The wastewater trickles over a fixed bed of media with a high specific surface area (engineered textiles, wood chips, biochar, lava rock, prefabricated plastic media, coarse sand, gravel, peat moss). Microorganisms growing as a biofilm on the media surface degrade organic pollutants as the water trickles past. Trickling filters can be fed by gravity, requiring no energy input, or can be more sophisticated, requiring energy to recirculate the wastewater over the bed. To ensure efficient treatment, adequate air flow is important. Design must ensure adequate drainage to achieve unsaturated, aerobic conditions either via passive ventilation systems or intermittent feeding. The hydraulic loading rate depends on the wastewater characteristics, the type of filter media, and the ambient temperature. Rotating biological contactors (RBC) are similar to trickling filters; both are passive aeration fixed film processes. In RBCs, a biofilm growing on discs is rotated through the wastewater, intermittently exposed to air.

INPUT STREAMS

- GW Pre-treated Greywater
- BW Pre-treated Blackwater
- MW Pre-treated Mixed Wastewater

TARGET OUTPUT(S)

- Treated Water

HASSALO ON 8th
Portland, OR, USA | 2018

Four trickling filters integrated into the urban landscape

The wastewater treatment system of this LEED Platinum neighbourhood treats an estimated 230 m³ of wastewater per day from three large residential buildings. A series of trickling filters and constructed wetlands are integrated into the urban landscape. After UV disinfection, the treated water is reused for toilet flushing, cooling systems, and landscape irrigation. Excess treated water is injected into dry wells for groundwater recharge.

SPECIFICATIONS

INFRASTRUCTURE

Trickling filters can be placed in a technical room within the building, but are more often placed (partly) underground and outdoors. Different prefabricated configurations are commercially available, while custom-made solutions in concrete or with liners are also possible. To prevent the filter from clogging, a preceding degreaser, screen, and/or solids removal step (usually a settling tank) is needed. A clarifying step after the filter collects the sludge, or "sloughed biomass", that has shed from the media bed. A clarifier often also serves as a recirculation tank. The sludge from the clarifier can be sent to a preceding settling tank, or to sewer, if available. Alternatively, it needs to be dewatered and properly disposed of.

OPERATION & MAINTENANCE

Trickling filters are low tech systems. Simple configurations have few to no moving parts (i.e., rely on gravity) and therefore require very little maintenance. More complex designs require control systems, a continuous power supply for pumping (i.e., recirculating the effluent over the filter) and regular maintenance. However, both energy and maintenance needs are relatively small compared to actively aerated bioreactors T.47 . Operation and maintenance is performed by a skilled operator, and includes monitoring of effluent quality, inspection of clogging or blockages, media cleaning if necessary, and sludge management. Trickling filter media may need periodic washing, to remove excess biofilm and optimize air flow through the media. Sometimes the media may need replacement.

> Recirculation improves organic removal and nitrification due to longer contact times with the biofilm. Diluting the influent, lowers organic concentrations and increases the hydraulic loading rate. Recirculation also maintains moisture in the media, particularly useful when handling variable flows.

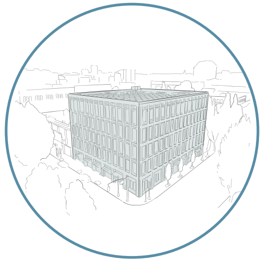
TARGET OUTPUTS

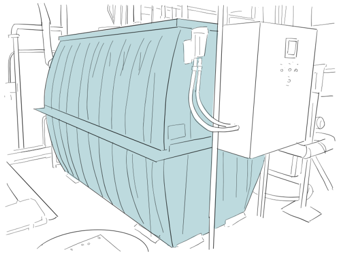
Trickling filters are used for removal of organic matter (measured in BOD_5 and COD removal) and for nitrification of ammonium to nitrate. Nutrient removal is usually not significant. As with other biological treatment steps, removal of pathogens and micropollutants is limited, therefore the effluent should be treated with additional treatment steps (e.g., filtration disinfection steps to achieve the water quality necessary for the desired water reuse application and to comply with local regulations, and public health requirements.

SELECTED CASE STUDIES

PAE BUILDING

Portland, OR, USA | 2021





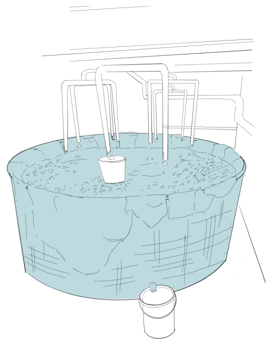
Recirculating textile filter treating office building greywater

Greywater from the PAE office building (from sinks, showers and dishwashers) is treated in the mechanical room on the first floor in a compact prefabricated unit (overdimensioned to handle unexpected peak flows) containing a lightweight, engineered textile to support biofilm growth. The wastewater is recirculated from the bottom of the tank and sprayed over the suspended textile via a pump and pressurized distribution system. The effluent flows through 30-micron bag filters and UV disinfection before non-potable reuse for flushing of the vacuum toilets, urinals and for onsite irrigation. The building is Living Building certified.

GW — T.42 SETTLING TANK — T.45 RECIRCULATING TEXTILE FILTER — BAG FILTERS — T.50 UV DISINFECTION — T.41 PRESSURIZED STORAGE TANK

SOUBEYRAN

Geneva, Switzerland | 2017



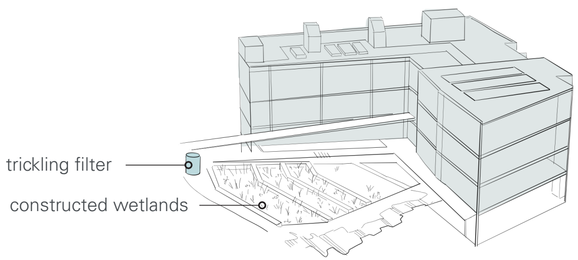
Biochar filter to treat greywater from a residential building

Soubeyran in a 6-story building comprised of 38 homes (~100 p.e.). After a degreaser, the greywater (~5.2 m^3/d) trickles down through a biochar filter placed below a wooden deck in the shared garden (adjacent to the vermifilter for blackwater treatment). Effluent from the biochar filter is treated further in a sand filter (50 m^3, vertical flow, located below) and a gravel filter (55m^3, horizontal flow, located adjacent under the grass), together with rainwater and the effluent from the vermifilter. The treated water is stored in a 26m^3 tank, and reused for toilet flushing and irrigation.

GW — DEGREASER — T.45 BIOCHAR FILTER — (RW) (BW) — T.49 SAND & GRAVEL FILTERS — T.41 STORAGE TANK

SIDWELL FRIENDS MIDDLE SCHOOL

Washinaton DC. USA | 2007



Landscape-integrated trickling filter and constructed wetlands

This LEED Platinum-certified school treats mixed wastewater from toilets and sinks through a series of physical and biological technologies. Mixed wastewater travels through the entire treatment train for 3-5 days before reuse for toilet flushing and irrigation on the campus. The constructed wetland and trickling filter are integrated in the landscape, adjacent to the rain garden and biology pond. The side of the trickling filter is used for educational signage and includes a diagram of the on-site wastewater and stormwater management. The school has reduced their water consumption by 90%.

MW — T.42 SETTLING TANK — T.44 CONSTRUCTED WETLAND — T.45 TRICKLING FILTER — T.49 SAND FILTER — T.50 UV DISINFECTION