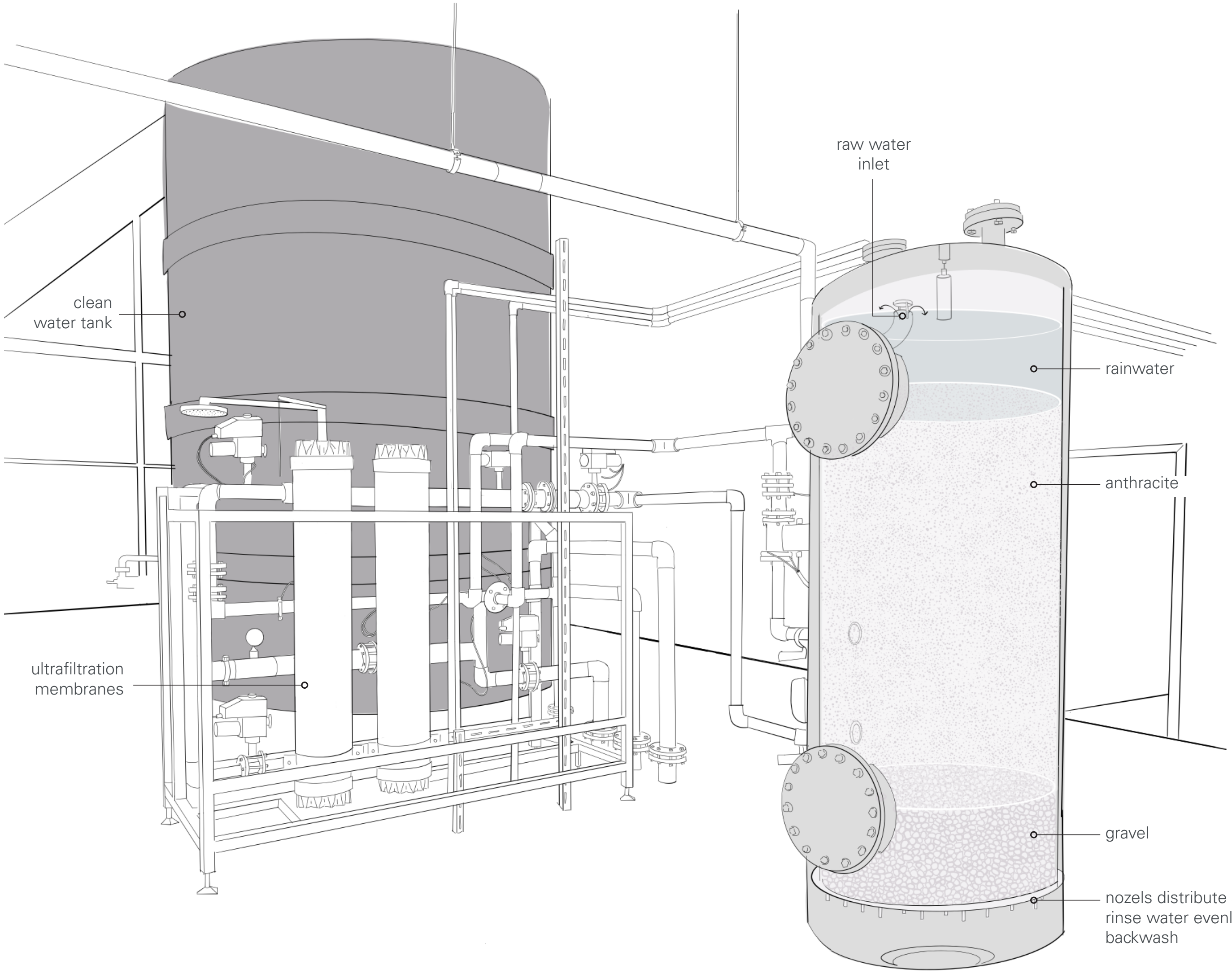
T.49 GRANULAR MEDIA FILTERS

eawag aquatic research

TECHNOLOGY



Granular media filtration removes suspended and colloidal particles by passing (treated) water downward through one or several layers of granular filter material (e.g., sand, anthracite, activated carbon, zeolite, gravel, etc.). These porous filters are based on three main types of retention mechanisms: straining at the surface, attachment of particles to the media (adsorption, ion exchange) or settling. Pressure filters are water-tight, closed systems in which the water flows through the media under pressure. In open sand filters water flows though the media by gravity. During (prolonged) operation, suspended solids will clog the media pores, increasing hydraulic resistance in the filter. To restore filter capacity, the filter either needs to be cleaned (by backwashing) or discarded (typically cartridge filters). For relatively clean water streams, granular media filtration can be implemented directly. If the water contains high solids concentrations, pretreatment is recommended.

Granular media filters are effective in removing suspended solids. Some filters are effective for the removal of pathogens, organics and inorganics, and for odor, color and taste correction.

INPUT STREAMS

- GW Pre-treated Greywater
- MW Pre-treated Mixed Wastewater
- RW Rainwater

TARGET OUTPUT(S)

- Treated Water

NYE SUBURB

Aarhus, Denmark | 2018

Multimedia filter for rainwater treatment for non-potable use

This Aarhus suburb (~13,500 inhabitants) is a modular housing project, with a rainwater treatment and reuse system operated by the local utility. Rainwater, collected in outdoor lakes, is first treated with a multimedia pressure filter, followed by ultrafiltration and storage in a clean water tank (55 m^3). Before distribution, the water undergoes UV disinfection, and is used for toilet flushing and laundry, providing 40% of the water demand in Nye.

RW — T.41 CISTERN — T.49 MULTIMEDIA FILTER — T.48 ULTRAFILTRATION — T.41 STORAGE TANK — T.50 UV DISINFECTION

SPECIFICATIONS

INFRASTRUCTURE

In urban contexts, compact media filters are often placed in a (basement) technical room together with pre- and post- treatment steps. These systems are often pressure filters (that require backwashing) or cartridge filters (that are periodically replaced).

Open sand filters are placed outdoors and have larger footprints than encased granular media filters. However, open sand filters can be integrated into courtyard and garden landscapes for aesthetic appeal.

OPERATION & MAINTENANCE

Operation and maintenace of media filters includes the pumping of water into the system and the cleaning of the filters, either by backwashing or replacement.

Backwash-based: To clean the filter, the direction of the water flow through the filter is reversed to release captured solids and restore filtration efficiency. This needs to be performed in regular intervals (e.g., either manually, or automatically). During a short period, high energy consumption takes place to pump the water and air through the system.

Cartridge: Once cartridge filters have reached loading capacity, the cartridges are discarded and replaced periodically. Their replacement is done manually. Costs for material and personel are low, though recurring.

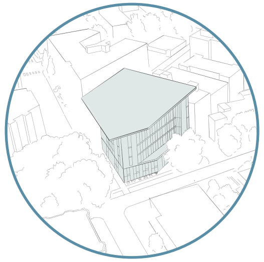
Backwash water is a byproduct stream of granular media filtration that requires additional treatment. Typically, this stream is sent to sewer, meaning the technology lends itself best to contexts where a connection to sewer is possible.

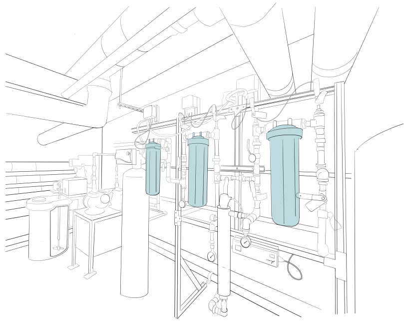
TARGET OUTPUTS

Granular media filtration renders a treated water stream. Removal of suspended particles and organic matter is the primary treatment objective of the technology. Pathogens are also partially removed. The treated water is often treated further (e.g., membrane filtration and/or disinfection) to achieve higher water quality. Suitability of the treated water for reuse depends on the type of water treated, intended use, local regulations, and public health requirements.

SELECTED CASE STUDIES

BULLITT CENTER
Seattle, WA, USA | 2015



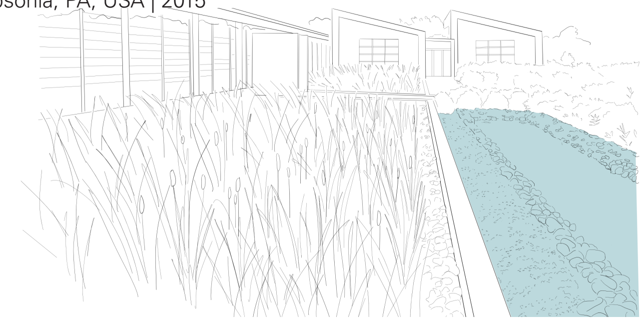


Cartridge filters for rainwater treatment in office building

The Bullitt Center is a six-story office building (175 occupants) with a rain-to-tap treatment system. From the rooftop catchment area to a 800 m³ cistern in the basement, the rainwater is treated by a 5 micron activated carbon cartridge filter, a first 0.5 micron cartridge filter, UV disinfection, a second 0.5 micron cartridge filter, remineralization, and chlorination. Treated water is stored in two 2 m³ tanks before reuse as tap water; vacuum toilets are flushed with separately-treated greywater. The building uses 94% less water than an average building in the city and is Living Building Challenge (LBC) certified.

RW — T.41 CISTERN — T.49 CARBON FILTERS — T.50 UV DISINFECTION — T.49 CARBON FILTER — CALCITE FILTER — T.50 CHLORINE DISINFECTION — T.41 STORAGE TANK

EDEN HALL CAMPUS
Gibsonia, PA, USA | 2015

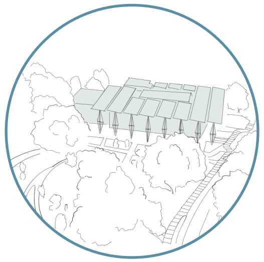


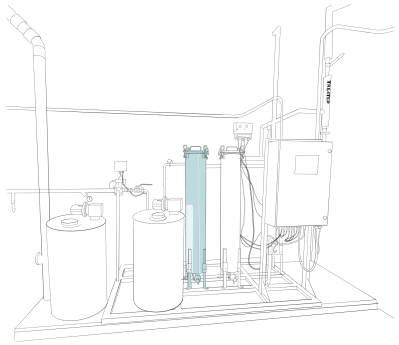
Open sand filter treats university greywater and wastewater

The wastewater system collects greywater and blackwater for treatment using a low-energy plant-based system with a design flow of 23 m³ per day. The sand filter is an encased, rectangular bed of sand and gravel with subsurface horizontal flow through the filter. The treated water accounts for 16% of the onsite water consumption and covers 100% of the toilet flushing demand. Excess water is used for subsurface irrigation. Their water reuse strategy helps them meet building accreditation goals including LEED platinum and Living Building Challenge (LBC).

GW (BW) — T.42 SETTLING TANK — T.45 TRICKLING FILTER — T.44 CONSTUCTED WETLAND — T.49 SAND FILTER — EFFLUENT TANK — T.50 UV DISINFECTION

KENDEDA BUILDING
Atlanta, GA, USA | 2017





Media filtration for rainwater to tap in university building

Rainwater is harvested from the green roof and PV paneled-roof deck of the classroom building at Georgia Tech University. After collection and coarse filtration, it is stored in a cistern (190 m³) in the basement. Treatment includes media filtration (turbidity reduction filter), ultrafiltration, UV and chlorine disinfection, and point-of-use dechlorination. While 41% of the rainwater is treated and used to supply all potable water demands for the building, 59% is directly directed to onsite stormwater systems. The building is certified under the Living Building Challenge (LBC).

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