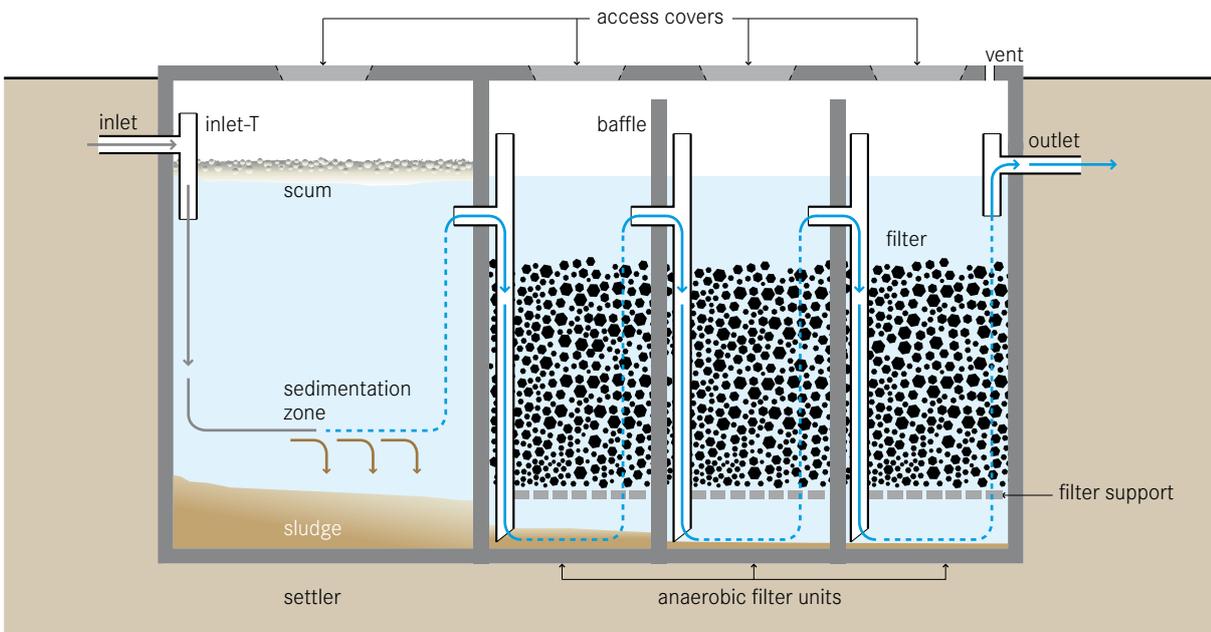# Anaerobic Filter

Application Level:

☐★ Household
★★ Neighbourhood
☐ City

Management Level:

☐★ Household
★★ Shared
★★ Public

Inputs: ☐ Blackwater ☐ Brownwater
☐ Greywater

Outputs: ☐ Effluent ☐ Sludge

An anaerobic filter is a fixed-bed biological reactor with one or more filtration chambers in series. As wastewater flows through the filter, particles are trapped and organic matter is degraded by the active biomass that is attached to the surface of the filter material.

With this technology, suspended solids and BOD removal can be as high as 90%, but is typically between 50% and 80%. Nitrogen removal is limited and normally does not exceed 15% in terms of total nitrogen (TN).

Design Considerations Pre- and primary treatment is essential to remove solids and garbage that may clog the filter. The majority of settleable solids are removed in a sedimentation chamber in front of the anaerobic filter. Small-scale, stand-alone units typically have an integrated settling compartment, but primary sedimentation can also take place in a separate Settler (T.1) or another preceding technology (e.g., existing Septic Tanks). Designs without a settling compartment (as shown in T.4) are of particular interest for (Semi-) Centralized Treatment plants that combine the anaerobic filter with other technologies, such as the Anaerobic Baffled Reactor (ABR, T.3).

Anaerobic filters are usually operated in upflow mode because there is less risk that the fixed biomass will be washed out. The water level should cover the filter media by at least 0.3 m to guarantee an even flow regime. The hydraulic retention time (HRT) is the most important design parameter influencing filter performance. An HRT of 12 to 36 hours is recommended.

The ideal filter should have a large surface area for bacteria to grow, with pores large enough to prevent clogging. The surface area ensures increased contact between the organic matter and the attached biomass that effectively degrades it. Ideally, the material should provide between 90 to 300 m^2 of surface area per m^3 of occupied reactor volume. Typical filter material sizes range from 12 to 55 mm in diameter. Materials commonly used include gravel, crushed rocks or bricks, cinder, pumice, or specially formed plastic pieces, depending on local availability. The connection between the chambers can be designed either with vertical pipes or baffles. Accessibility to all chambers (through access ports) is necessary for maintenance. The tank should be vented to allow for controlled release of odorous and potentially harmful gases.

Appropriateness This technology is easily adaptable and can be applied at the household level, in small neighbourhoods or even in bigger catchment areas. It is most appropriate where a relatively constant amount of blackwater and greywater is generated. The anaerobic filter can be used for secondary treatment, to reduce the organic loading rate for a subsequent aerobic treatment step, or for polishing.

This technology is suitable for areas where land may be limited since the tank is most commonly installed underground and requires a small area. Accessibility by vacuum truck is important for desludging.

Anaerobic filters can be installed in every type of climate, although the efficiency is lower in colder climates. They are not efficient at removing nutrients and pathogens. Depending on the filter material, however, complete removal of worm eggs may be achieved. The effluent usually requires further treatment.

Health Aspects/Acceptance Under normal operating conditions, users do not come in contact with the influent or effluent. Effluent, scum and sludge must be handled with care as they contain high levels of pathogenic organisms. The effluent contains odorous compounds that may have to be removed in a further polishing step. Care should be taken to design and locate the facility such that odours do not bother community members.

Operation & Maintenance An anaerobic filter requires a start-up period of 6 to 9 months to reach full treatment capacity since the slow growing anaerobic biomass first needs to be established on the filter media. To reduce start-up time, the filter can be inoculated with anaerobic bacteria, e.g., by spraying Septic Tank sludge onto the filter material. The flow should be gradually increased over time. Because of the delicate ecology, care should be taken not to discharge harsh chemicals into the anaerobic filter.

Scum and sludge levels need to be monitored to ensure that the tank is functioning well. Over time, solids will clog the pores of the filter. As well, the growing bacterial mass will become too thick, break off and eventually clog pores. When the efficiency decreases, the filter

must be cleaned. This is done by running the system in reverse mode (backwashing) or by removing and cleaning the filter material.

Anaerobic filter tanks should be checked from time to time to ensure that they are watertight.

Pros & Cons

+ No electrical energy is required
+ Low operating costs
+ Long service life
+ High reduction of BOD and solids
+ Low sludge production; the sludge is stabilized
+ Moderate area requirement (can be built underground)
- Requires expert design and construction
- Low reduction of pathogens and nutrients
- Effluent and sludge require further treatment and/or appropriate discharge
- Risk of clogging, depending on pre- and primary treatment
- Removing and cleaning the clogged filter media is cumbersome

References & Further Reading

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