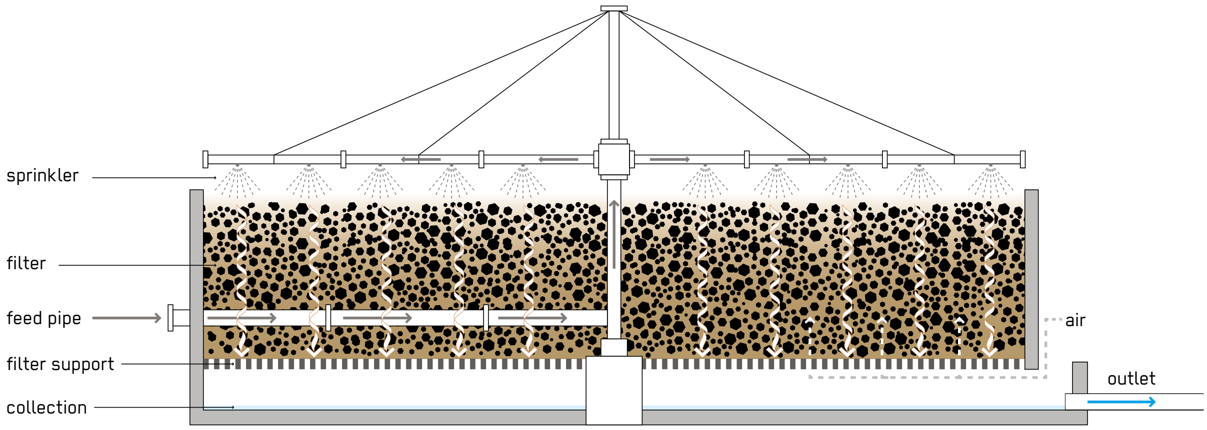
Trickling Filter

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	Household * Neighbourhood ** City	Household Shared ** Public	TSS and TDS reduction, Nitrification
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
** Medium	*** High	Effluent, Blackwater, Greywater	Effluent, Sludge



A Trickling Filter is a fixed-bed, biological reactor that operates under (mostly) aerobic conditions. Pre-settled wastewater is continuously 'trickled' or sprayed over the filter. As the water percolates through the pores of the filter, organics are degraded by the biofilm covering the filter material.

The Trickling Filter is filled with a high specific surface area material, such as rocks, gravel, shredded PVC bottles, or special pre-formed plastic filter media. The high specific surface provides a large area for biofilm formation. Organisms that grow in the thin biofilm over the surface of the media oxidise the organic load in the wastewater into carbon dioxide and water, while generating new biomass. The incoming pre-treated wastewater is trickled over the filter, e.g. with the use of a rotating sprinkler. In this way, the filter media goes through cycles of being dosed and exposed to air. However, oxygen is depleted within the biomass and the inner layers may be anoxic or anaerobic.

Design Considerations: The filter is usually 1 to 2.5 m deep, but filters packed with lighter plastic filling can be up to 12 m deep. Primary treatment is essential to prevent clogging and to ensure efficient treatment. Adequate air flow is important to ensure sufficient treatment performance and prevent odours. The underdrains should provide a passageway for air at the maximum filling rate. A perforated slab supports the bottom of the filter, allowing the effluent and excess sludge to be collected. With time, the biomass will grow thick and the attached layer will be deprived of oxygen; it will enter an endogenous state, will lose its ability to stay attached and will slough off. High-rate loading conditions will also cause sloughing. The collected effluent should be clarified in a settling tank to remove any biomass that may have dislodged from the filter. The hydraulic and nutrient loading rate (i.e. how much wastewater can be applied to the filter) is determined based on wastewater characteristics, type of filter media, ambient temperature, and discharge requirements.

Materials: Not all parts and materials may be locally available. The ideal filter material is low-cost and durable, has a high surface to volume ratio, is light, and allows air to circulate. If available, crushed rock or gravel is usually the cheapest option. The particles should be uniform and 95 % of them should have a diameter between 7 and 10 cm. A material with a specific surface area between 45 and 60 m^2/m^3 for rocks and 90 to 150 m^2/m^3 for plastic packing is normally used. Larger pores (as in recycled plastic packing) are less prone to clogging and provide for good air circulation.

Applicability: A Trickling Filter is usually part of a wastewater treatment plant as a secondary or tertiary treatment step and is applicable only in water-borne systems. It is a viable solution during the stabilisation and recovery phase of an emergency when a longer-term solution is required. This technology can only be used following primary clarification since high solids loading will cause the filter to clog. A low-energy (working with gravity) trickling system can be designed, but in general, a continuous supply of power and wastewater is required. Trickling Filters are compact, they are best suited for peri-urban or large, rural settlements. Trickling Filters can be built in almost all environments, but special adaptations for cold climates are required.

Operation and Maintenance: A skilled operator is required full-time to monitor the filter and repair the pump in case of problems. Sludge that accumulates on the filter must be periodically washed away to prevent clogging and keep the biofilm thin and aerobic. High hydraulic loading rates (flushing doses) can be used to flush the filter. Optimum dosing rates and flushing frequency should be determined from the field operation. The packing must be kept moist. This may be problematic at night when water flow is reduced or when there are power failures. Snails grazing on the biofilm and filter flies are well known problems associated with Trickling Filters and must be handled by backwashing and periodic flooding.

Costs: Capital costs are moderate to high depending on the filter material and feeder pumps used. Costs for energy have to be considered. Energy is required to operate the pumps feeding the Trickling Filter.

Social Considerations: Odour and fly problems require that the filter be built away from homes and businesses. Appropriate measures must be taken for pre- and primary treatment, effluent discharge and solids treatment, all of which can still pose health risks.

Strengths and Weaknesses:

- (+) Can be operated at a range of organic and hydraulic loading rates
- (+) Efficient nitrification (ammonium oxidation)
- (+) High treatment efficiency with lower land area requirements compared to wetlands

- (−) High capital costs
- (−) Requires expert design and construction, particularly the dosing system
- (−) Requires operation and maintenance by skilled personnel
- (−) Requires a constant source of electricity and constant wastewater flow

→ **References and further reading material for this technology can be found on page 194**