

Basic knowledge

Aerobic processes

Biological processes enable dissolved biodegradable substances (organic matter) to be removed from wastewater. The organic matter provides a nutrient for microorganisms, and is converted under aerobic conditions into biomass, carbon dioxide and water. Aerobic microorganisms need oxygen for respiration.

As well as organic matter, nitrogenous compounds such as ammonium and nitrate must usually also be removed

from wastewater. Specific microorganisms convert ammonium initially into nitrate (nitrification). Another group of micro-organisms then reduces the nitrate to nitrogen gas which escapes to the atmosphere (denitrification).

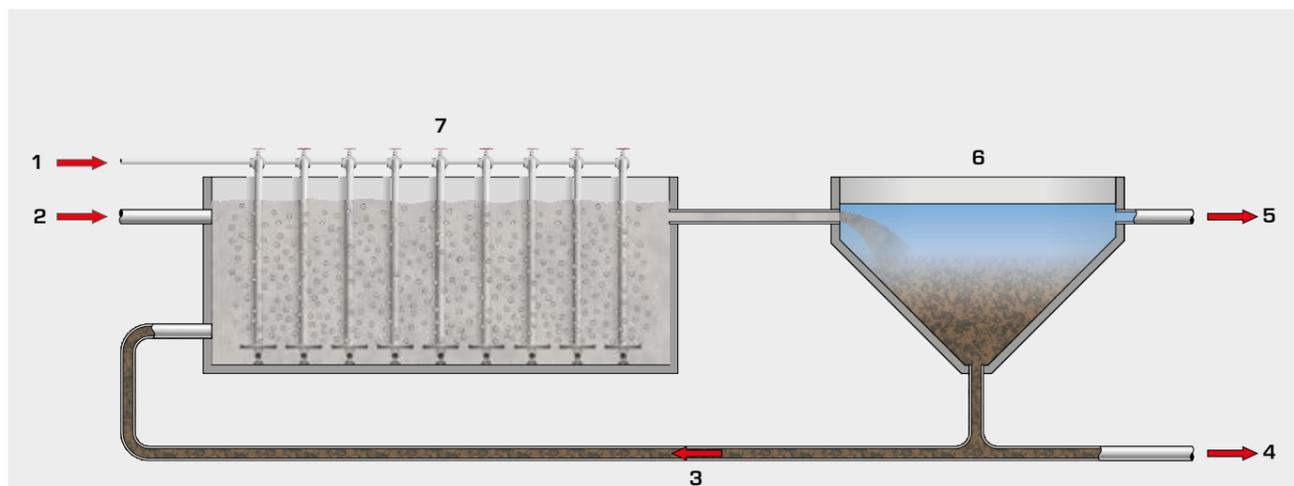
A distinction is made between biofilm and activated sludge processes.

Activated sludge process

In this process, the microorganisms are suspended in the wastewater. Aeration of the wastewater in the aeration tank provides the aerobic microorganisms with oxygen. The metabolic process causes them to form into flocs – the so called activated sludge. This is separated from the wastewater by means of sedimentation (secondary clarification). More biomass is removed from the aeration tank than is produced in the same period of time. In order to balance out this loss of biomass in the aeration tank, part of the activated sludge is returned to the aeration tank (return sludge). The portion of the activated sludge which is not returned is termed surplus sludge and is a waste product of the process.



Activated sludge



Fundamental principle of the activated sludge process:

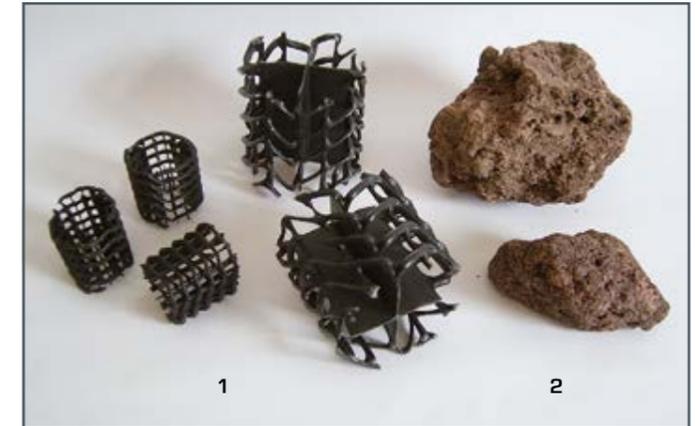
1 air, 2 wastewater, 3 return sludge, 4 surplus sludge, 5 treated water, 6 secondary clarifier (sedimentation), 7 aeration tank

Biofilm processes

Biofilm processes are based on microorganisms settling on the surfaces of solids. The resulting layer of microorganisms is called a biofilm. The solids used in this process are called carrier material. This means the wastewater must be brought into contact with the biofilm affixed to the carrier material.

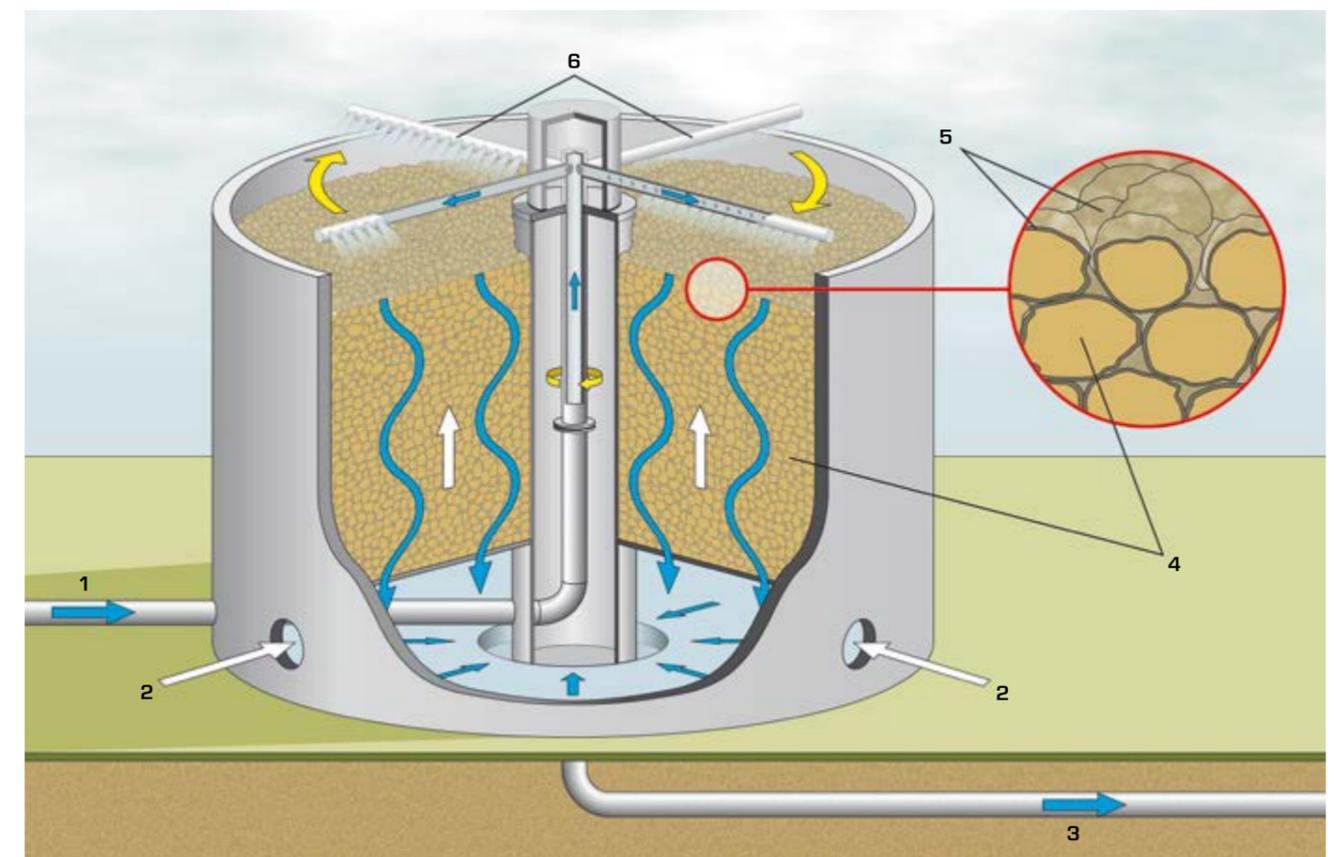
The most important version are **trickling filters**. Here the wastewater is trickled over a layer of carrier material (fixed bed) using a rotating distributor. Whilst the wastewater passes through the carrier material it is biologically cleaned by the microorganisms. Aeration of the trickling filter is normally via natural convection. This is based on the temperature difference between the outside air and the inside of the trickling filter.

Carrier materials have high specific surface areas (approx. $200 \text{ m}^2/\text{m}^3$). Carrier materials can be of natural origin (e.g. extrusive rocks) or be artificially produced.



Carrier materials for biofilms:

1 artificial carrier material (plastic),
2 natural carrier material (e.g. extrusive rocks)



How a trickling filter works:

1 wastewater, 2 aeration by natural convection, 3 treated water, 4 carrier material, 5 biofilm, 6 distributor