General information about filtration

Filtration is the most important process stage in the field of water treatment. Many different filter materials are used for this. The choice of the most optimum filter materials in each case depends on the raw problem, the selected treatment process and the filter speed v_f.

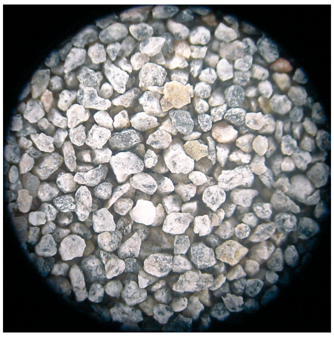
The following tasks can be roughly defined:

- Removal of undissolved water constituents and particles from the water (multi-stage filter system, flocculation filtration)
- Neutralisation by chemical reaction of free carbon dioxide with the filter material (deacidification)
- Removal of chemical water constituents on activated carbon (adsorption)
- Reduction of organic materials through biological degradation processes (fixed-bed reactor, bio-filtration)
- Reduction of disinfectants (dechlorination, ozone removal)

As with natural filtration with leaching, in many cases various materials are used in a filter stage in various layers.

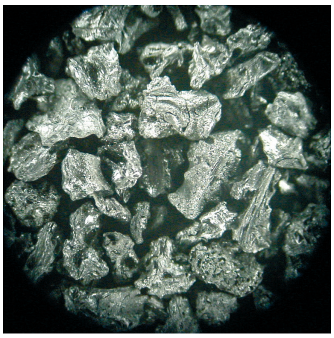
Filter materials comparison


Quartz sand grain size 1


Hydro-phonolite grain size 1


Hydro-carbonate


Filter carbon "Hydro-Anthrasit H"


Filter carbon "Hydro-Anthrasit P"


Activated carbon CC 8x30

Multi-stage filter

Filters with various materials in separate layers are referred to as multi-stage filters. In a multi-stage filter, the materials are combined so that the greatest possible depth effect is achieved for the filtration effect - combined with a simultaneously optimised hydraulic performance.

Rapid filtration

Rapid filtration has become established in water treatment. This can be realised as either a closed or open filter stage. The filter speed v_f varies here within the range of 5 to 15 m/h, or in special cases up to 30 m/h.

The following filter speeds can be estimated for reliably working filters (guideline values):

- Bio-filtration 5 – 7 (max. 9) m/h
- Deferrisation 8 – 11 m/h
- Demanganisation 10 – 12 m/h
- Flocculation filtration 12 – 15 m/h
- Activated charcoal filtration 5 - 20 (max. 25) m/h
- Bath water filtration 30 - 45 m/h (higher temperatures, lower viscosity)

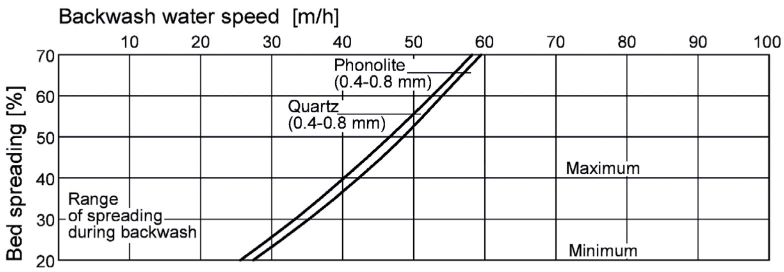
Rapid filter system for deferrisation and demanganisation

In filtration, it is important that the total filter surface is used evenly. To guarantee this, as a rough rule the total height of the filtering layers must at least correspond to the diameter of the filter.

Larger particles and flakes are held back due to the blocking effect between the individual grains. The actual particle separation occurs inside the filter filling between the pores. As a result of the more powerful deflection of the water flowing through, particles are deposited here on the surface of the filter material, onto which the particles bond and remain largely stable until cleaning with the backflushing process. The surface structure of the filter grain is therefore crucial to the effectiveness of the filtration.

A filter is generally loaded in the direction of flow. With an optimum loading progression, the concentration in the upper layers increases more markedly than in the lower layers. In this context, we also refer to the depth effect of a filter. The filter resistance also increases with the loading. The filter resistance can thereby be used to start filter flushing. If backflushing is not done in time, a filter can break through or can be blocked as a consequence of overloading.

Filter rinsing



The filter rinsing must be done so that the filter material is in a state of suspension. Only in this way can the held-back substances also be reliably removed from the filter material again. The bed spreading for a good washing process should be at least 30%.
The filter flushing detaches the particles stuck to the grain surfaces and transports them out of the filter with the water flow. The duration of the backflushing depends on the level of filter contamination. The water consumption for a backflushing operation is approx. 5 – 6 m^3 per m^2 of filter surface. Following the filter flushing, the first filtrate (min. 1 x filter volume) should be separated off and discarded.

Air flushing

Besides pure water flushing, air can also be used in the form of pure air flushing or in a combination of air/water flushing. Air flushing used to be installed as standard - particularly in single-stage filters. Multi-stage filters with an optimised stage structure can be superbly cleaned with pure water flushing. If multi-stage filters are flushed with air, the entire filter bed is mixed. Following air flushing, the filter bed of a multi-stage filter must therefore be re-graded by adequate water flushing.

Today, the possibility of air flushing is mainly provided in deacidification filters. Here there is a latent risk of the deacidification material caking together. This can be prevented by regular air flushing.
For air flushing to function, it is important that the filter has air cushion nozzles and that the water level in the filter is lowered to just above the surface of the filter material before flushing commences. Furthermore, air flushing must not be done for too long.
A maximum of 2 minutes applies as a guideline value.

Physical properties of filter materials

Physical difference

Grainy filter materials for the separation of solids are normally produced by breaking and by sieving/grading. The physical properties of the source material influence the shape of the grains here. This is how spherical grains are obtained from broken quartz and phonolite. Quartz and phonolite display similar backflushing behaviour, which is why quartz can be readily replaced by phonolite.

Grain surface

The grain surface is decisive for the hydraulic properties and the particle deposition. Ouartz has a glassy, smooth surface, and phonolite has a rough surface. Liquid can also flow through between the contact surfaces due to this rough surface. This results in a slower flow speed between the grains, a pressure loss of up to 25 % lower, a thereby much lower real filter speed and thus much improved particle retention.

Filtration checklist

Project name: ____________________

Customer:
(if required)

Name ____________________

Street ____________________ Post code, city ____________________

Telephone ____________________ Fax ____________________

E-mail ____________________ Internet ____________________

Project management:
(if required)

Name ____________________

Street ____________________ Post code, city ____________________

Telephone ____________________ Fax ____________________

E-mail ____________________ Internet ____________________

Water analysis:

chemical/physical analysis available: ❑ yes, see Appendix biological analysis: ❑ yes, see Appendix

Raw water description:

Pre-treatment available: ❑ no
❑ yes, which ____________________

Design data:

Intended use of raw water	____________________	
Required filter capacity	________ m³/h	Operating pressure ________ bar
operating time / day	________ h	Temperature ________ °C
Required purity	❑ Drinking water pursuant to Drinking Water Standards	
	❑ Process water in accordance with following specification	
	Max. particle size: ____________________	
Pure water	❑ in intermediate storage	❑ in system with mains pressure
Operation of the system	❑ fully-automatic	❑ manual
backflushing of the system	❑ with raw water	❑ from intermediate storage
Installation space available	❑ no	❑ yes, dimensions (LxWxH) ____________________

Remarks: ____________________

HydroGroup®/Hydro-Elektrik GmbH • Angelestraße 48/50 • 88214 Ravensburg, Germany • Tel.: +49 751 60 09 0
www.hydrogroup.biz