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FILTRATION — GE 4

Filtration is a procedure whereby a liquid containing solid particles is passed through a porous medium (filter) which traps the solids while letting the liquid filter through (filtrate).

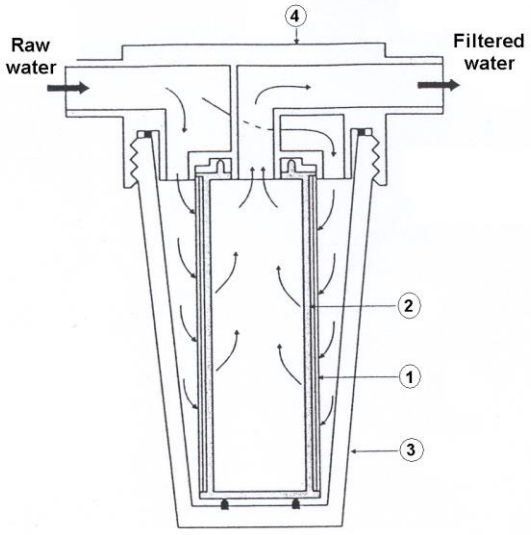
If the suspended particles are larger than the pores, they are caught at the filter surface; this is the case with cartridge filtration. In the case of deep or filter-bed filtration , the particles are trapped inside the porous mass.

In either case, the phenomena related to the trickling of water through a porous medium are governed by Darcy's law, which states that the pressure loss P is proportionate to the filtration rate R (instantaneous flow-rate Q / surface unit ratio).

The filtration stage is essential for performing the following treatment operations.

Cartridge filtration : (fig. 1 below)

Generally comprises a plastic or stainless steel pan containing one or more filter cartridges of appropriate size and porosity for the intended treatment.



Cartridge filter (principle)

Two main groups can be distinguished :

Nominal or relative filters (variable pore size)

capable of trapping 90 % of those particles whose size exceeds the indicated filtration threshold.

Absolute filters (uniform pore size)

capable of trapping 99.99 % of those particles whose size exceeds the indicated filtration threshold.

The fouling of these cartridges is controlled by the pressure loss (difference in pressure between the ingoing and outgoing manometers). These filtering elements must be replaced :

- systematically after a certain operating period ranging between 2 and 6 months, depending on the intended use of the water,
- as soon as the maximum pressure loss is reached, generally between 0.2 and 0.5 bar.

Filter-bed filtration : (fig. 2 in page 2)

Deep filtration of particles which are smaller than the gaps in the filter bed generally takes place under the following conditions :

Filters are usually of the closed, pressurised type.

The ***filter mass*** inside the filter frame consists of one or more superimposed layers of calibrated granules :

- of crystal (cartridge filtration)
- of anthracite (deep filtration)
- sometimes superimposed layers of sand and anthracite
- active charcoal when intending to separate organic particles or chlorine.

The most common ***granule sizes*** range from 0.5 to 1.35 mm ; the largest granules are often used as a foundation layer.

The ***height*** of each layer generally ranges from 0.6 to 1 m.

The ***filtration rate*** varies according to the applications, between 10 and 30 m/h.

Washing the filter mass :

The filter mass must be washed as soon as the charge loss reaches 0.4 to 0.5 bar.

Reverse-flow washing in an upstream direction expands the filter mass and dislodges impurities which are then drained away.

The filter mass is washed :

- either by simply reversing the flow of water,
- or by backflow and low pressure air injection (0.2 to 0.3 bar)

Washing with water only :

15 to 75 m/h according to granule size for 5 to 10 minutes

Air and water wash :

air flow : 50 $Nm^3/h/m^2$

water flow : 13 to 15 $m^3/h/m^2$

Holding capacity

Filters equipped with a bed of grainy material have a holding capacity of 1 to 5 kg of solid matter per m².

Raw water can be filtered either directly or by adding a coagulant prior to filtering. Filtration is designated by its "rate" which is indicated in cubic meters filtered per square meter of filtering surface per hour (m/h).

Pressurised filters consist of a metal cylinder or cylindrical winding called the « filter frame » which houses water distribution and recovery devices in its upper and lower sections, and is fitted with manual or automatic pipes and valves on the outside for filtration, washing and rinsing if necessary.

The filter mass housed within the filter frame consists of one or more superimposed layers of calibrated granules :

- of crystal, ranging from 0.3 to 2.5 mm in size, depending on the purpose,
- or anthracite,
- sometimes superimposed layers of both for certain types of treatment
- or active charcoal for trapping dissolved organic substances or eliminating any chlorine present in the water, in addition to purification.

The filter mass must be washed regularly in order to clear it totally of trapped impurities.

The frequency of these washes is generally determined by measuring the pressure loss on the filter with a maximum of 0.4 to 0.5 bar.

- Pressurised filter -