Technical Description

Interfilt® Filtration System
Automatic Gravity Filter
SK Series

Filtration with the Automatic Gravity Filter (SK)

Advantages of the system

The automatic gravity filter works on the principle of differential pressure solely by the gravity of the water

– without controls –

The filter's "filtration", "backwashing" and "rinsing" functions use no moving parts. There are no valves, flow meters, controls or indicators. Backwashing is started automatically when the static pressures of the raw and the filtered water change due to the accumulation of impurities in the filter bed. The level of the water in the backwash pipe is a yardstick for the differential pressure.

– without pumps –

Backwash water is stored in a tank within the filter. There is no need for a backwash pump.
- without compressed air, pressurised water or electricity -
All processes are automatically started and camed out by the filter alone.

– without operators –

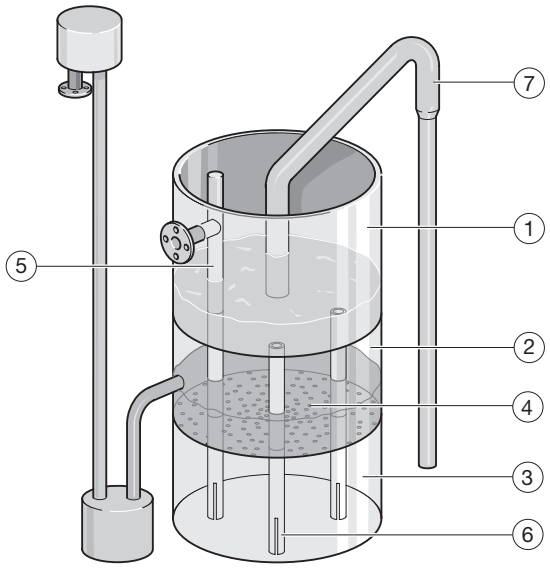
The filter works fully automatically and requires no external operators. There is nothing to be monitored, and nothing to be switched on or off. Because the filter operates entirely independently, human error is eliminated. Backwashing starts automatically when the pressure differential for the filter is reached. The backwash rate and the backwash volume are constantly maintained at the correct levels.

– without wear and tear –

Where there are no moving parts, there is no wear and tear.

Filter Design

The automatic gravity filter consists of a mild steel tank which is divided into three compartments, one on top of the other.



1. **The upper compartment** ①
   serves as a storage tank for the backwash water. When full, the contents of this compartment ① are sufficient to backwash the entire filter medium.

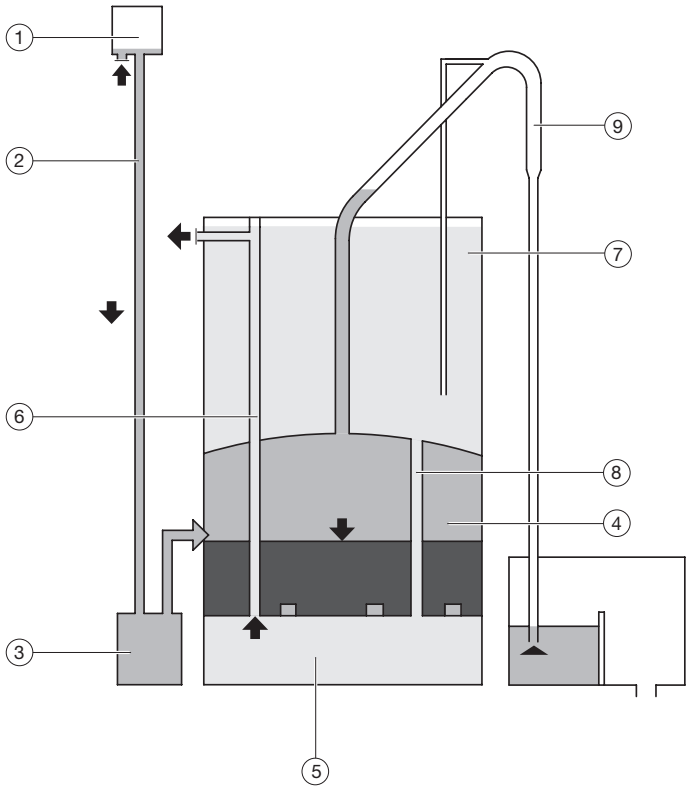
2. **The central compartment** ②
   is the actual filtration tank. The top of the compartment is the base of the backwash water storage tank. Its base is fitted with filtration nozzles ④. This compartment contains fine filter sand which retains the contaminents present in the raw water. The nozzles in the base effect a uniform discharge of the filtered water and a uniform distribution of the backwash water. The system dispenses with the usual gravel lower layer. Multi-media filtration is also possible.

3. **The lower compartment** ③
   The area beneath the filter compartment is used as a filtrate collecting tank. The filtrate is discharged via an outlet pipe ⑤ which exits the filter near the top. The lower compartment (filtrate collecting tank) and upper compartment (backwash water storage tank) are connected via a series of pipes ⑥. The backwash water is discharged via a separate pipe ⑦ which leads from the filter compartment to the drainage system.

Automatic Filter Cycle Filtration

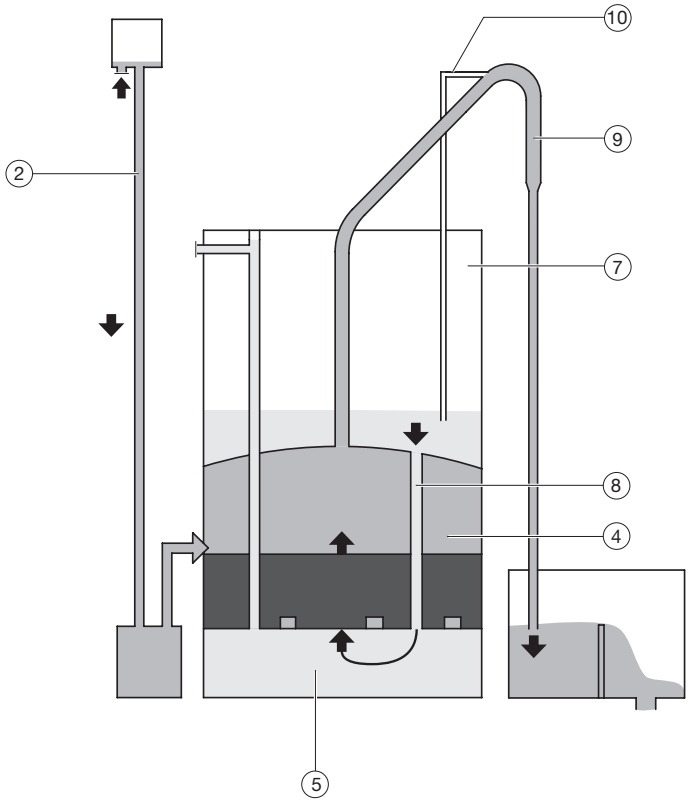
Filtration

The raw water enters the feed tank ① and descends by gravity down the feed pipe ② into a deflection and air-bleeding tank ③.The water then enters the filter compartment and flows down through the filter medium. It then drains from the filter compartment through the nozzles in the base of the filter. The filtrate then collects in the filtrate compartment. As soon as the backwash water storage tank is completely filled via the connecting pipes ⑧ the filtrate exits the filter via the outlet pipe ⑥.
The increasing accumulation of contaminants in the filter medium cause a gradual drop in the filter head. This causes the water levels to rise in the feed pipe ② and the backwash pipe ⑨. As soon is the water level in the backwash pipe ⑨ arrives at the upper bend, an automatic ejection system starts to operate, evacuating the air out of the backwash pipe. The sudden rush of water into the backwash pipe leads to a siphoning effect which starts the backwashing process.

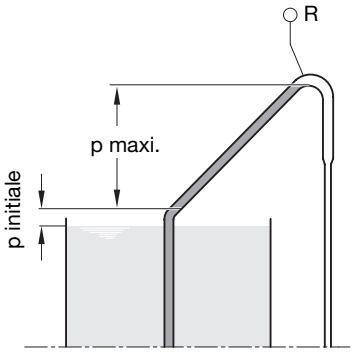


Backwashing

The backwash pipe ⑨ is of a large enough diameter to allow a flow of water several times that of the feed pipe. This results in a difference of heads between the filter compartment and the filtrate compartment and causes the water to flow upwards whilst the backwash water storage tank ⑦ is emptied. The stored water flows down the connecting pipes ⑧ into the filtrate tank ⑤, reverses and flows upwards through the filter nozzles the filter media and the filter freeboard. In the process the filter media is thoroughly loosened and cleaned. The sludge washed out of the filter medium is discharged to the drainage system via the backwash ② pipe.



Due to the decreasing water level in the backwash water storage compartment ⑦, the initial backwash rate of 44 m/h eventually drops down to 30 m/h.
Backwashing is automatically discontinued when the water level in the backwash water storage tank drops below the end of the siphoning line ⑩ when air is siphoned into the backwash pipe.
The influent raw water, following the law of gravity, resumes its downward passage through the filter bed, rinsing it until the backwash water storage tank is refilled. As can be seen, the first filtrate is not discarded as usual but serves as backwash water for the next cycle.
As soon as the backwash water storage tank is refilled, the filtrate is discharged to the consumer.



Some Useful Features of the Interfilt® SK Filter

The differential head principle

The quality of raw or pre-treated water can vary from time to time. These vatiations are ignored when the filter is backwashed according to a fixed schedule. Either the filter is over-used, or water is wasted on backwashing a filter which is only partially contaminated. A true yardstick of the actual state of a filter is the head loss Δ p which increases as the filter becomes contaminated. The water level in the backwash pipe (R) is an accurate measure of the loss of head. The filter head drops to its minimum level when the water level reaches the bend of the backwash pipe. This automatically triggers backwashing. This interdependency of filter load and backwash water volume results in a thorough and economical cleaning of the filter bed.

Backwash rate

The backwashing process begins at a rate of 44 m/h. This decreases to 30 m/ in as the level in the backwash water storage compartment drops. The high initial rate serves to loosen the filter bed and creates the turbulence necessary for good cleaning whilst the transition from the higher to the lower causes the filter medium to settle in an even layer.

No funnelling or clogging

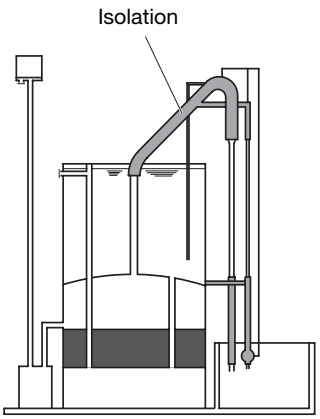
Since the filtrate is discharged from an outlet above the filter compartment, negative pressure cannot build up in the filter compartment during the filter cycle. This prevents the funnelling and clotting which can be caused when air is trapped beneath the sludge layer.

Manual control of backwashing

The gravity filter features a simple device enabling the operator to manually start a backwashing cycle at any time. The necessary water supply is provided by the filter itself. The level of contamination of the filter bed does not affect this function.
This feature is used during initial setting of the backwash rate during commissioning, or when backwashing is to be initiated for demonstration purposes.

Parallel connection of filters

When two or more filters are connected in parallel, their respective backwash systems can be connected so that only one filter at a time can go into backwashing mode. Unless the backwashing cycle of this filter is complete and filtrate is supplied again, the other filters cannot go into backwashing mode. The advantage of this system is that the drainage system requires the capacity for one filter only.



Anti-freeze protection

As a rule, the filters are installed in the open. However, in cold climates, certain parts of the pipework must be protected against freezing, for instance in narrow pipes and the main backwashing pipe in which water is standing during the filtration process.
Freezing is prevented by the use of electric strip heaters or steam jackets.

Shipping and installation

Filters up to 3.9 m diameter will be assembled completely in the factory. Site installation is simple.
Once the filter is correctly located, it is simply necessary to install the backwash pipe, fit the filtration nozzles and add the filter medium.

Filters with a diameter of more than 3.9 m will be prefabricated in the factory, delivered in parts and assembled at the site.

Selection Chart

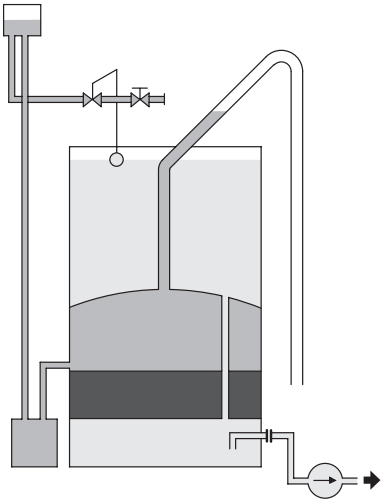
Interfilt® SK Filter

Type of Filter	Filter Diameter (mm)	Flow Rate (m^3/h)	Backwash Water Consumption (≈m^3)	Empty Weight (≈t)	Operating weight (≈t)
SK- 9	900	6.5	1.4	1.2	4.5
SK-12	1200	11.5	2.5	1.5	7.1
SK-15	1500	18	4	2	12.1
SK-18	1800	26	5.6	2.5	15
SK-21	2100	35	8	3	21
SK-24	2400	46	10	3.5	26
SK-27	2700	57	12.6	4	32
SK-30	3000	71	15.6	4.5	40
SK-33	3300	85	19	6	48
SK-36	3600	105	22.6	6.5	56.5
SK-39	3900	121	26.5	7	65.5
SK-42	4200	141	31	8	77
SK-46	4600	166	37	9	92
SK-48	4800	182	40	10	100
SK-54	5400	232	50.6	11.5	124
SK-60	6000	286	62.5	13	153
SK-68	6800	365	80	16	196
SK-75	7500	446	97.5	18.5	239
SK-82	8200	532	116.5	22	286
SK-90	9000	642	140	25	340

Technical Data

Flow Rate:	3...10 m/h
Backwash cycle: (depending on type and proportion of contaminants)	approx. 8...36 h
Head Loss:	120...150 mbar
Suspended solids content of the filtrate: (depending on the raw water quality and the filter media)	0...3 mg/l
Backwash rate:	
initial	44 m/h
mid-cycle	37 m/h
end of cycle	30 m/h
Cylinder height: (similar for all types)	4500 mm
Overall height: (depending on filter diameter)	6500-6900 mm
Backwashing and Refilling Time:	13...15 min
Filter Sand according to DIN 4924:	
- Depth of Layer	600 mm
- Grain Size	0.7-1.2 mm
Filter Nozzles:	
- Type	Lamellar Type
- Material	PPN
- Slit Width	0,2 mm

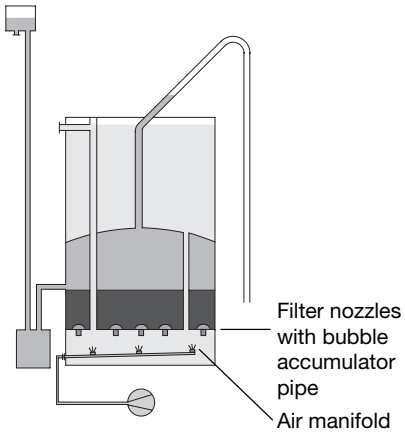
Modifications of the Standard Design



a) For continuous operation

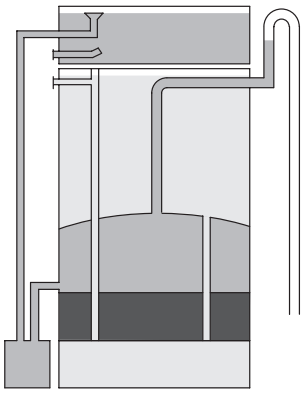
When there is only one filter, there is no filtered water available for about 15 minutes while the filter is backwashed and refilled. This may be acceptable in most cases. However, if a continuous supply of filtered water is to be maintained, one of the following measures may be taken:

- Parallel operation of several filters
- Provision of a storage tank if only one filter is available
- Adoption of the **SK-K** version
  In this version, the filtered water does not leave the filter at the top but it is pumped continuously out of the filtrate compartment. The filtrate required during the backwash cycle is stored in the backwash water storage tank in addition to the normal backwash water volume, the additional volume being gained by an increase of the height of the cylinder.



b) Type SK-L for combined water and air scavenging

In some rare cases when it is difficult to remove the retained pollutants in the usual way, air scavenging may be employed to assist backwashing.
In this case, the nozzle floor is equipped with air-cushion nozzles and an air manifold will be installed.
The necessary compressed air may be supplied by the works mains or by a separate blower.



c) Type SK-R with reaction tank

If eg. dissolved iron or manganese is to be removed from the water, this is done by oxidizing these substances by means of oxygen taken from the air. This process requires a certain reaction time.
To this end, the feed tank volume is increased in order to obtain the required retention volume.
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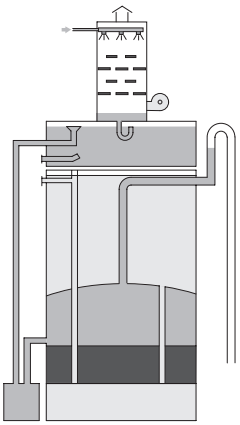


d) Type SK-RI with additional degassing tower

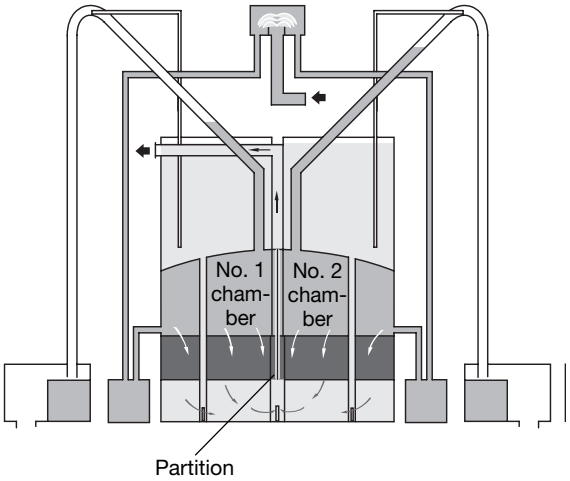
If, besides iron and/or manganese, carbon dioxide (CO_2) is to be removed, the filter will be equipped with a degassing tower on top of the reaction tank. The water is sprayed into the degassing tower where it is finely distributed (packed column or baffle type) into the reaction tank. A counter-current air stream is blown out of an integrated blower. This scours the carbon dioxide and oxidises the water.

e) Type SK-V2 with two vertically partitioned filter compartments
Type SK-V3 with three vertically partitioned filter compartments

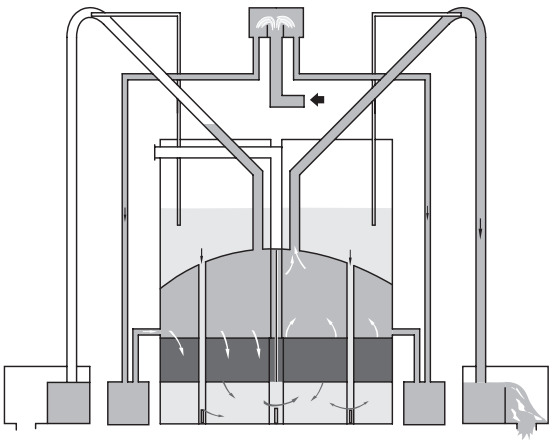
The partioned types are used where the capacity of the sewage system is limited.

The fiiter principle is the same as with the standard type SK. However, the filter compartment is divided by partitions into two or three chambers. Each chamber has its own independently operating backwashing system. Thus, the backwash water volume is only one half or one third of the usual volume. Since the backwashing water storage tank is shared by all three chambers, the volume of water to be stored is correspondingly lower. This results in a decrease of the height of the filter to 3.6 and 3.4 m resp. as compared with 4.5 m of the SK type.

Filtering



Backwashing chamber no. 2

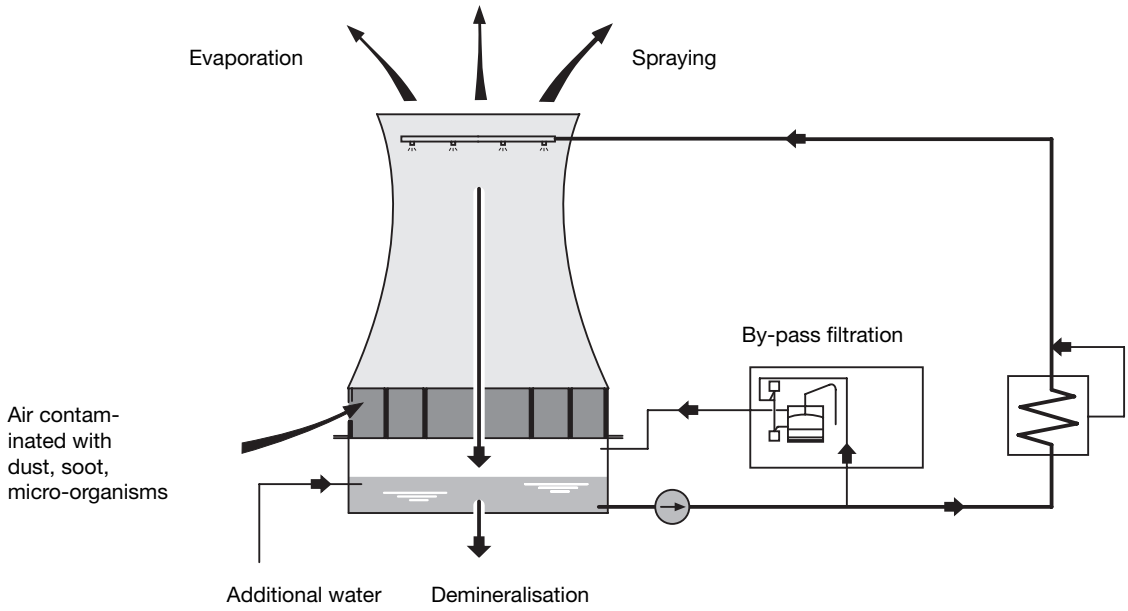


Typical Applications of SK Interfilt® Gravity Filter

The SK Interfilt® Gravity Filter is suitable for practically all filtration applications e.g.:
Chemical industry, oil refining, pulp and paper industry, metal industry, food processing and beverage industry, municipal water supply and waste water treatment, plastic and electrical industry, glass industry, etc., power stations and power supply companies.

Some examples:

By-pass Filtration



Re-circulating cooling water in open water cooling systems is subject to a steady increase in the suspended solids content, particularly from air pollution, bird fouling and corrosive products.

However, an optimal function of the cooling water system cannot be expect-ed unless cooling water, heat exchangers and piping system are clean and remain so.

Besides the chemical treatment of the cooling water, mechanical treatment eg. by slipstream filtration is indispensible.

The reasons are obvious: Suspended matter in the cooling water is prone to settle down and choke up heat exchanger;, p~pes and other system equ pment

This will result in increased costs since choked-up heat exchangers reduce heat transfer, increase head-loss, foster corrosion and require additional cleaning and servicing.

The solution:

By-pass filtration via the **SK Interfilt Gravity Filter from ProMinent,** simple, efficient and economical.

Filtration of just a small proportion (1 - 5%) of the circulating water will reduce contamination levels in the circulating system, thus ensuring the smooth operation of the heat exchanger and other parts, with the resultant cost savings.

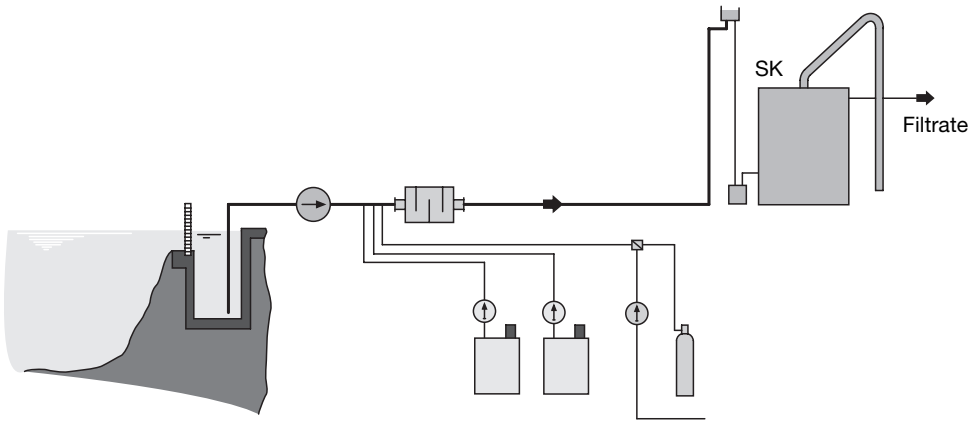
The SK Interfilt Gravity Filter is installed next to the cooling tower. It is very easy to integrate into an existing system. A by-pass is fed off from the discharge side of the circulation pump, passed through the filter and returned to the cooling tower reservoir.

The advantages of the system can be summarised as follows:

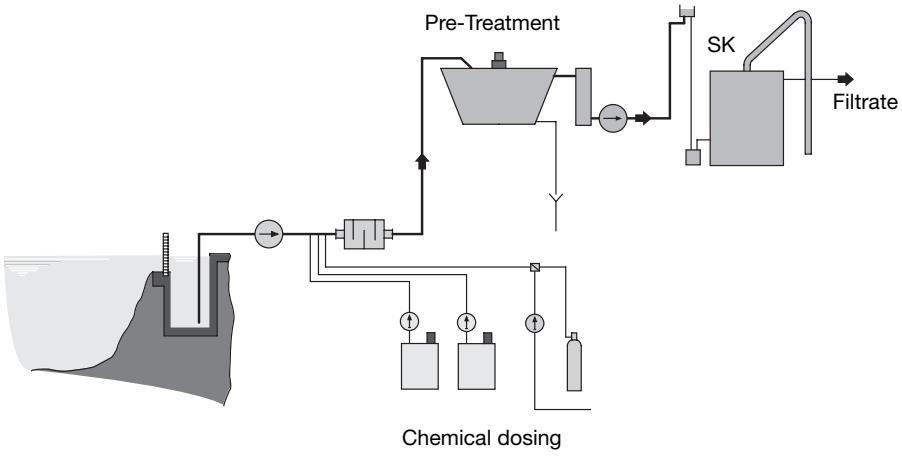
1. Reduces suspended solids content in the entire cooling water system to a minimum level
2. Counteracts contamination of heat exchangers, pipework and other system parts
3. Maintains heat transfer, efficiency and initial head
4. Substantially reduces danger of corrosion
5. Considerably reduces costs of cleaning and maintaining heat exchangers, pipework and other system parts
6. Reduction of bleed volume.

Water Treatment Systems and Processes

a) Direct filtration of eg. river water

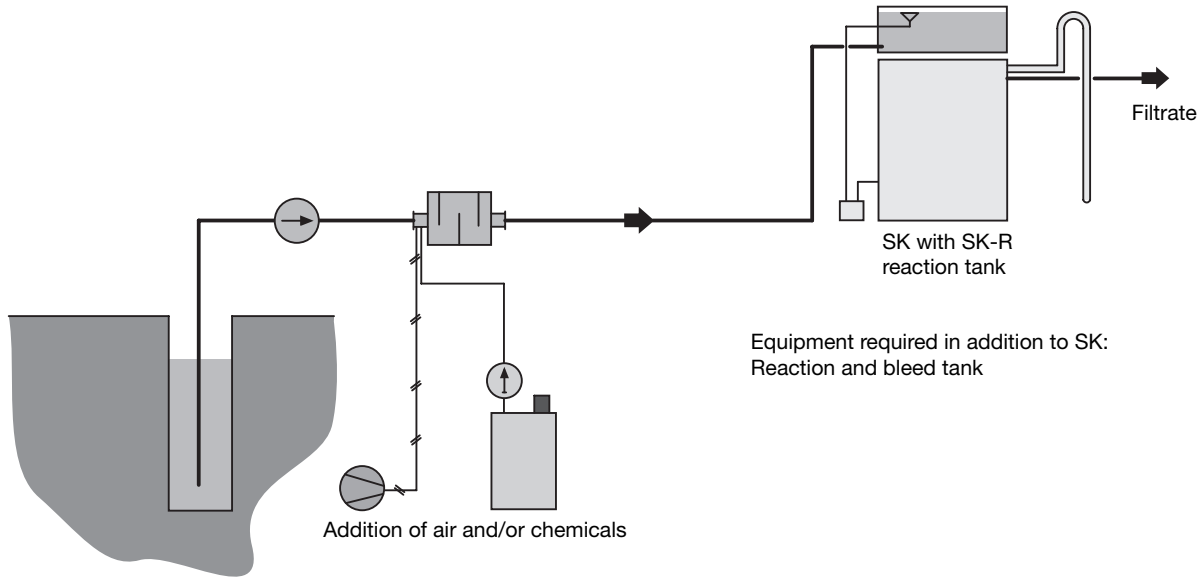


b) Filtration after pre-treatment of eg. river water



Treatment of Deep Well and Spring Water

a) Iron removal



b) Removal of iron, manganese and carbon dioxide