



Water management for the Power Generation Industry

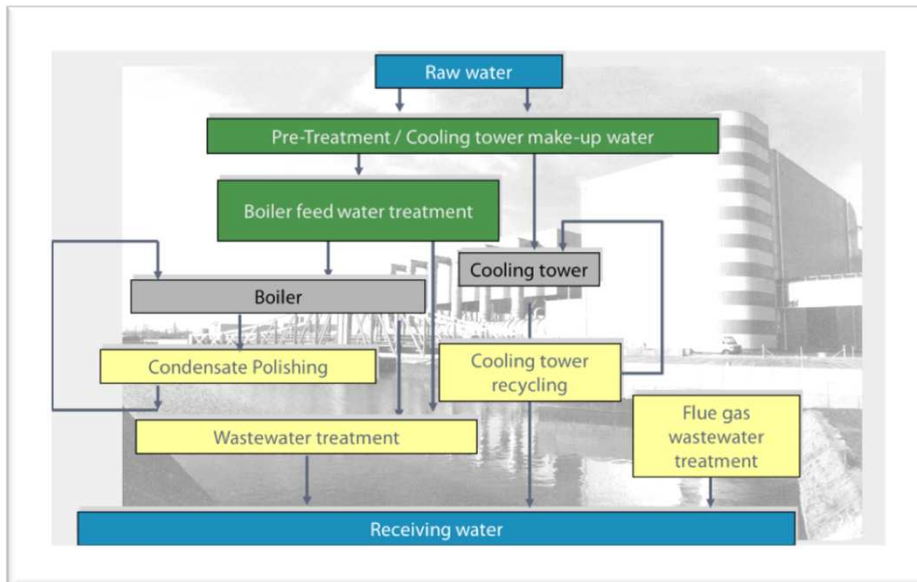


Competence and Experience

All Technologies

We develop customised water engineering solutions for your power stations, whatever their fuel and output. All raw water sources are feasible; whether surface, well or sea water, cooling tower discharge or sewage treatment plant effluent. Our treatment plan will always meet the most demanding requirements.

We implement treatment of cooling tower make-up water via physical, chemical and/or membrane processes. Condensate is treated by means of cartridge filters and/or ion exchangers. The deionisation plant for make-up water treatment is designed with ion exchangers, membrane processes or a combination of both. Our customised processes used for the treatment of waste water from flue gas desulphurisation and wet ash removal have proven successful in many plants.



All Fields of Use

Our valued clients include renowned utility companies, municipal works, industrial power station operators and general contractors. Our collaborative relationship with our customers and the successful implementation of diverse projects across the entire field of water treatment forms the basis of our success. Our premium objectives are: Maximum availability, optimal operational dependability and long plant service life at paramount cost efficiency.



Cooling Tower Make-up Water Treatment

The cooling water system of a power station mainly comprises; the natural draught wet cooling tower; the primary cooling water system with make-up water addition; and the secondary cooling water system with make-up cooling water system.

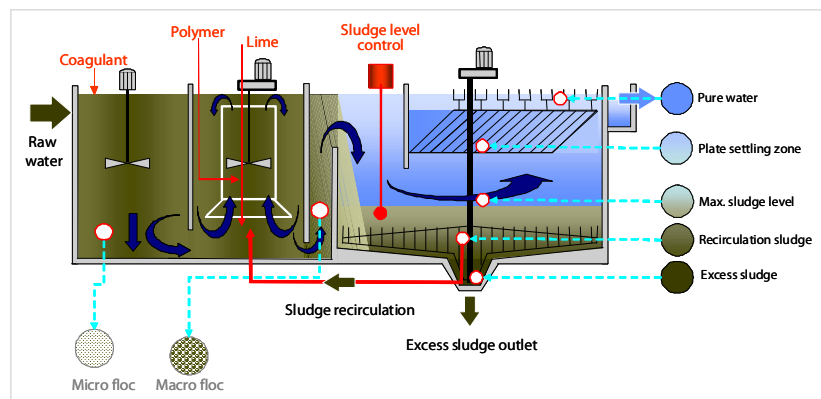
The expanded steam is condensed to water in the condenser. The heat of condensation released is discharged to the atmosphere via the circulating primary cooling water in the cooling tower. A portion of the cooling water is blown down in order to guarantee the required cooling water quality. The evaporation and blow-down losses are made up by adding treated cooling tower make-up water.

Normally, surface water is available as the raw water source. The main tasks of a cooling tower make-up water treatment plant are the reduction of suspended matter and solids and of the hardness.

- Pressure filter (multimedia filter), or ultrafiltration as an alternative
- Open filter: FILTRO-G system
- Flocculation/precipitation/sedimentation: FLOCOPAC system with sludge treatment by means of a chamber filter press or belt-type filter press
- Biocide, sulphuric acid and hardness stabilizer dosing

FLOCOPAC-LC

In order to obtain very low discharge values in a reliable and cost-effective way, we have been successfully using our FLOCOPAC-L or FLOCOPAC-LC compact flocculator for treatment of the cooling tower make-up water for many years.



In addition to the flocculation reaction, optimised by sludge recycling, and the high sedimentation rate, the FLOCOPAC-LC also offers the advantage of being insensitive to raw water quality variations. Furthermore, thanks to the compact design, up to 90% of the area which would be needed for a conventional flocculation, sedimentation and filtration plant can be saved.



Condensate Polisher

State-of-the-art power station boilers need feed water with a low salt and corrosion product content. Normally, a condensate polisher is installed to provide boiler feed water of the required quality in the water-steam circuit of a power station.

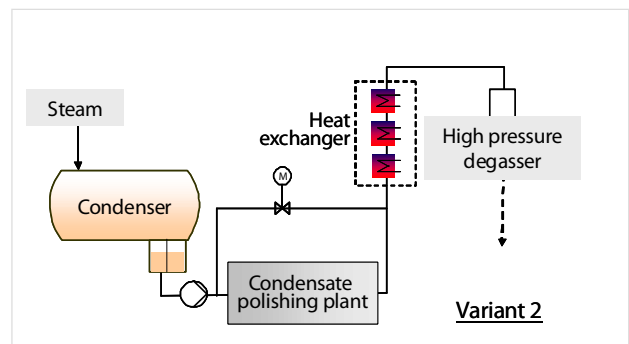
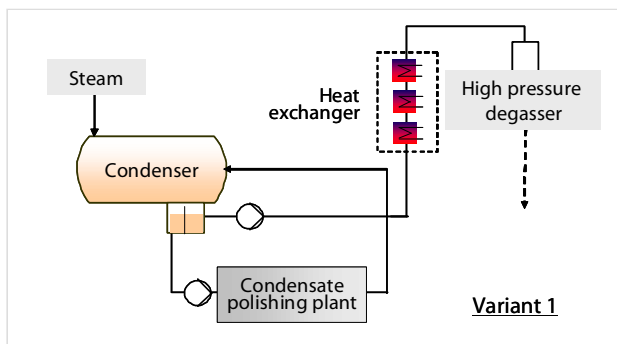
The following equipment is used for this:

- Pressure filter (cartridge filter)
- Ion exchanger
- Adsorption (activated carbon) process

Both the circuitry and the necessary process stages and throughput are influenced by a number of boundary conditions. These include, in particular:

- Use of the power station in the base-load range, or in the medium or peak load range
- Conditioning of the water-steam circuit (alkaline or combined operation)
- Use of the power station for power and/or heat generation or steam displacement
- Materials and fuel used.

Two circuits for the condensate polisher in the water-steam circuit are shown below. These also result in the necessary boundary conditions for the plant concept.



The condensate polisher is either connected directly to the main condensate stream or as a bypass. In addition to the operational dependability, the economic aspects (capital and operating cost) are thoroughly assessed within the scope of plant selection and planning. Especially in the selection and operation of ion exchangers, Hager + Elsasser can rely on comprehensive experience and thus propose the optimum alternative from parallel flow/counterflow processes and internal or external regeneration.



Deionisation plant

A further increase of the efficiency of power stations requires, among other things, higher steam parameters (pressure and temperature). Besides the appropriate materials for the turbine, ever higher requirements are placed on steam purity, and thus on the quality of the boiler feed water in the power station's water-steam circuit. Very low residual conductivities and low silicic acid concentrations must be achieved as a priority. The same applies to organic substances.

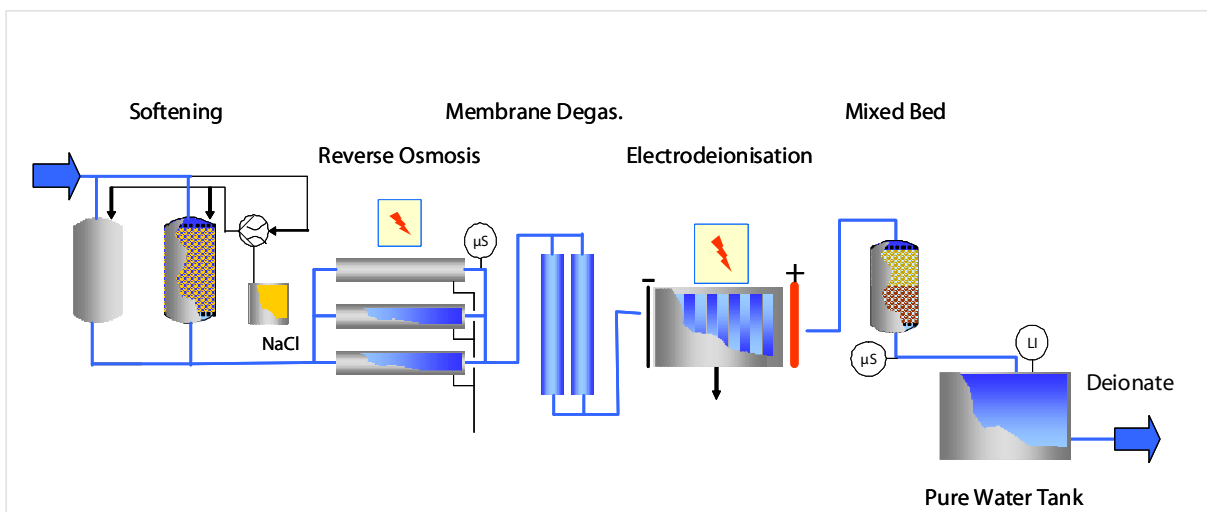
Boiler feed water losses in the water-steam circuit are covered by a deionisation plant (boiler feed make-up water or deionised water). Hager + Elsasser provides concepts for optimised solutions for your specific requirements. These concepts are based on ion exchange, membrane, physical degassing technologies and applicable combination. This allows for the provision of deionised water of the appropriate quality, even from difficult raw waters.

Ion exchange systems have multiple potential applications for deionisation. For example, the classical process stages, such as water softening by means of a strong-acid ion exchange resin in the sodium cycle, decarbonisation by means of a weak-acid ion exchange resin, deionisation in combination with different resin types. Furthermore, cascade degassers, membrane degassers or vacuum degassers have proven successful.

For treatment of salt-containing and organically loaded raw waters, the use of **membrane technologies** is the best solution, e.g. reverse osmosis combined with mixed-bed ion exchangers.

ROCEDIS

Our continual efforts in further developing the membrane processes for deionisation have yielded a **modular and chemicals-free solution: ROCEDIS - the perfect combination of reverse osmosis, membrane degasification and electro-deionisation.**



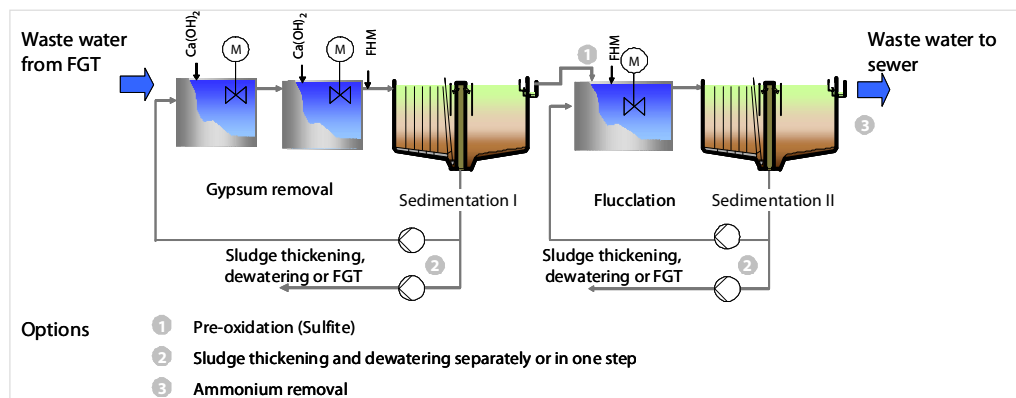
Waste Water Treatment from Flue Gas desulphurisation Plants

Flue gas desulphurisation (FGD) plants mainly operate on the wet absorption principle with calcium hydroxide or limestone suspension as the absorbent and reusable gypsum as the end product. Waste water is produced during this process, the composition and volume of which are influenced by many factors.

FGD waste waters are oversaturated with gypsum, may have very high solid matter concentrations, frequently have a high chloride content and contain dissolved metals. In addition, these waste waters are highly abrasive so that the selection of suitable treatment steps and appropriate materials is of great importance.

Our treatment concepts are tailored to your specific needs. Our references from numerous projects comprise the following treatment steps, depending on the task:

- sulphite oxidation
- Removal of the gypsum oversaturation and sulphate precipitation in steps
- 2-stage flocculation/precipitation/sedimentation plant with neutralizing precipitation of the metals and their conversion into poorly soluble hydroxides, or partly into basic carbonates, as well as organo-sulphide precipitation in the second stage
- Sludge thickening
- Sludge dewatering



The treated waste water is discharged directly into the receiving water; the quality to be achieved in Germany being regulated in Annex 47 to the Waste Water Ordinance. FGD waste waters with higher ammonium concentrations may require secondary treatment. We have appropriate solutions for the required desorption of the ammonium with the absorption system connected downstream.

Inhaltsstoffe	Grenzwerte (mg/l)
Abfiltrierbare Stoffe	30
CSB	
-Einsatz von Branntkalk	80 oder TOC 26
-Einsatz von Kalkstein	150 oder TOC 50
Sulfat	2000
Sulfit	20
Fluorid	30
Giftigkeit gegenüber Fischeiern G_{Ei}	2 oder Chlorid+Sulfat in g/l / 3

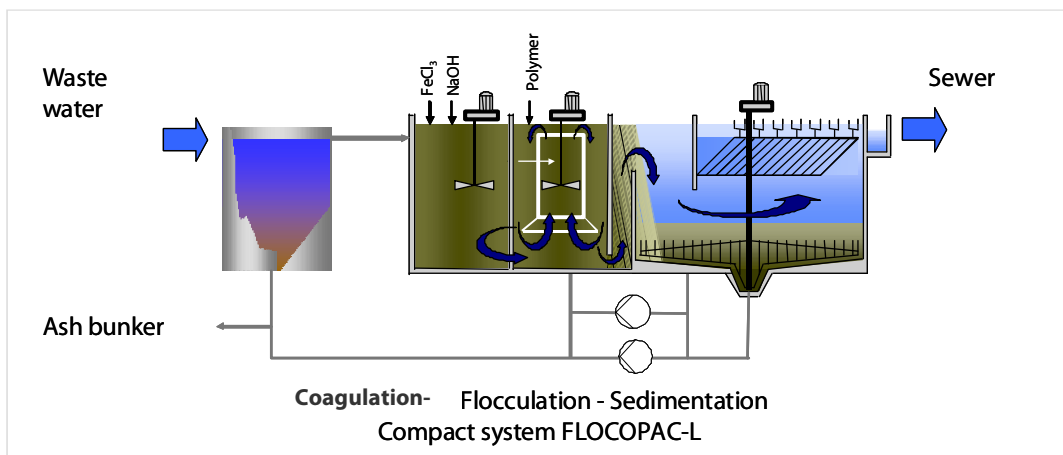


Process Waste Water Treatment Plant

The ash deposited at the boiler bottom is collected in the wet ash removal system. This solid-containing waste water is usually treated in a waste water treatment plant. The water is first fed into a preliminary clarifier, into which further solids-containing partial waste water streams are fed as required.

In most cases, a sedimentation plant with lamella separators is suited for treatment of this type of waste water. Here, our tried-and-tested FLOCOPAC-L system is used.

Usually, a thickener is connected downstream of the sedimentation stage. In specific cases, further COD reduction may become necessary in an additional stage.



Besides reliable compliance with discharge limit values, a high-efficiency design with optimised chemical demand and little space requirement is especially relevant for cost-effective plant operation.

The process waste waters from the wet ash removal plant are covered by Annex 31 Para. 2.4 of the Waste Water Ordinance.



“Effluent free” Water Concepts for Any Site

In arid zones, the raw water available for operation of the entire power station is frequently **sea water**, **brackish water** or biologically treated water from municipal **sewage treatment plants** because the fresh water resources are exclusively reserved for drinking water production. By combining the optimum process chains, reliable treatment is possible for any case.

Due to the growing global ecological awareness, the limit values for discharge of waste water into rivers are continually becoming more stringent. In some arid zones, no receiving water is available to receive the treated waste water. For such cases, we have developed and realized **Zero Liquid Discharge concepts**.

Zero Liquid Discharge

In 2006, a boiler feed water treatment plant for an 800 MW power station in Italy had to be implemented under such difficult conditions: Effluent from a sewage treatment plant was available as the raw water source; the waste waters produced in the station, such as filter rinsing waters and boiler blow-down water, were also treated in order to obtain a Zero Liquid Discharge:

Pre-treatment

- Flocculator to reduce the filterable substances and organic load
- Multimedia and ultrafiltration for further reduction of the organic fouling potential and chlorine dioxide dosing

Demineralisation

- Activated carbon filtration, designed as a biofilter, to reduce the COD and DOC value and to reduce the ammonium
- Permeate-staged reverse osmosis system for demineralisation
- Working mixed-bed exchanger system for fine demineralisation

Waste water treatment

- Concentrate reverse osmosis treatment for further concentration of the waste water produced
- Batch neutralisation of waste waters upstream of the evaporator stage followed by a crystallization evaporator to produce a salt slurry that can be deposited on a landfill
- Sludge treatment for thickening of the sludge produced in the flocculator



Dependable Service Tailored to Your Needs

A professional customer service is vitally important to operate process water plants in a trouble free and cost effective manner for many years. Our offered services range from the elimination of faults up to plant management of your water plants.

Our expert local service engineers boast years of experience with water treatment and process control. They are your dependable partners and problem solvers for day-to-day plant operation.

Hager + Elsasser offers you practice-oriented services and wall-to-wall solutions. For temporary water supply at commissioning and during shutdowns, we plan your secure supply by means of mobile containers and plants.

- Available 24 hours a day and 365 days a year
- Individual contracts for extremely short standby on call
- Analysis service by our own laboratory
- Spare parts and operating supplies management by means of outlined agreements
- Warehouse in Stuttgart and local stocks of our service specialists to ensure short delivery times
- Optional deployment of other suppliers in order to maintain our competitiveness in terms of price and delivery time
- Service by local engineers, or plant management on site
- Online monitoring of water plants.

Within the scope of audits, we assess all aspects of water treatment and use to optimise potential savings, and we evaluate the state of the plants and the process technology used.

We assume responsibility for continuous improvement, optimization and conservation of the value of your plants by means of a sophisticated service concept under plant management models.



H+E ranks among the world's leading suppliers in the fields of: water & wastewater treatment, and energy efficiency. Based on its global presence, the H+E GROUP has completed projects in over 50 countries.



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