CASE HISTORY

SEMICONDUCTOR
SOLAR
PHARMA
POWER GENERATION
FOOD & BEVERAGE
PULP AND PAPER
CHEMICAL
OIL AND GAS
MINING
AEROSPACE AND TRANSPORT

HAGER+ELSÄSSER

An aquarion Group Company

SAFCO (Saudi Arabia)

Feed Water Demineralisation and Condensate Polishing Systems

Project:

The Saudi Arabian Fertiliser Company (SAFCO), is a subsidiary of SABIC, the Middle East's largest non-oil industrial company. Its Safco IV facility brought its total production capacity to 1.2 million t/ann of ammonia and 1.5 million t/ann of urea. The German-based engineering company Uhde Group was awarded the contract for the basic and detailed engineering, procurement of equipment and construction, project management, plant commissioning and training of plant operators.

Water Treatment:

Hager + Elsässer was awarded a contract to build the demineralisation and condensate polishing plants following a similar successful contract for the Qatar Fertilizer Company's expansion project Quafco-4.

The Condensate treatment plant includes:

- 3 cartridge filter, 5 µm, 3m diameter
- 3 mixed bed exchanger, 2.8m diameter

Technical data:

- Capacity 3 x 400 m³/h
- Operating flow 800 m³/h

The Demineralisation plant includes:

- Activated carbon filter
- Cation exchanger,
- Trickling degasser
- Anion exchanger

Technical data:

- Capacity 2 x 300 m³/h
- Operating flow 300 m³/h

Type of Contract:

- Engineering
- Procurement
- Pre-assembly of package units and piping skids
- Supervision of local installation
- Commissioning
- Training

Special Features:

- Cutting edge plant design
- Highest refinery and international design & engineering standards.
- Maximised system availability
- Reduced regeneration chemical consumption

Description of the Demineralisation Plant

1. Activated carbon filters

The mixed feed water is transferred to the activated carbon filters wherein oxidants are removed and organic matter converted. Each of the two 150m^3/h treatment trains is equipped with 1 x 100 % flow rate capacity for activated carbon filtration.

The economic design ensures that, during back washing of one carbon filter, full system capacity is still available to protect the following ion exchange stage from being damaged by free chlorine present in the feed water.

The water flows through the filters from top to bottom. Since there are almost no suspended solids in the feed, backwashing of the filter beds is not frequently required and the wastewater produced can be discharged directly into a sewer.

2. Cation exchanger

The feed water contains dissolved salts in ionic form. The calcium, magnesium, sodium and potassium ions are exchanged for hydrogen ions using cation exchange resin. This forms the corresponding strong acid from the sulphates, chlorides and nitrates present in water, whilst the bicarbonates have been split to such a degree that there is a corresponding content of free CO_2, in gaseous form, in the water.

This ion exchange process continues until the adsorption capacity of the resin is exhausted, at which time the unit is taken out of operation and subjected to "regeneration" with H_2SO_4. In this process, the calcium, magnesium, sodium and potassium ions are removed from the resin and substituted by hydrogen ions, thereby recovering the capacity of the resin to exchange cations again. In order to obtain a good residual quality and a high adsorption capacity of the resins, an "excess" of the regeneration (sulphuric acid) is used.

The ion exchangers operate on the counter-current principle. During operation the water passes through the unit from bottom to top, whereas during regeneration, flow is from top to bottom.

3. Degasser

The de-alkalised water from the cation exchangers passes to the degasser to eliminate the carbonic acid formed by the free CO_2 in the water:

$H_2CO_3 = CO_2 + H_2O$

The feed water is sprayed inside the degasser over the packing, which comprises a very large surface area. The thin film of water on the surface of the packing allows the efficient removal of the CO_2 via a flow of air in the opposite direction.

4. Anion exchanger

The free residues of the strong acids are exchanged for OH ions in the anion exchanger, producing a new water molecule. Weak acids such as carbon dioxide and silicic acid are retained by the strongly basic anion exchange resin.

The ion exchangers operate on the same counter-current principle as the cation exchangers.

5. Regeneration station

The cation and anion exchangers are regenerated regularly when the resin capacity is exhausted.

The regenerants are pumped from the chemical storage tanks and diluted to the required concentration through blending with demineralised water.

Regeneration is carried out with demineralised water pumped from the demin-water storage tank.

In order to ensure the optimum treated water quality the chemicals used must conform to international standards, such as DIN.

The effluent produced by the regeneration process contains the neutral salts adsorbed during operation as well as an excess of 50 to 80 % of the chemicals applied for the demin-plant which can be utilised for mutual neutralisation.

Description of the Condensate Plant

1. Cartridge filter

A 5 µm cartridge filter is installed upstream of mixed bed filter to protect the ion exchange resin from any solid contaminants. Backwashing of the filter is completed by an air / water mix after the operating pressure drop has reached a pre-set value.

2. Mixed bed exchanger

In order to meet the high quality demands made on the demineralised water system the demin-water is passed through a mixed bed polisher. By this stage, most of the salts contained in the raw water have been removed by the cation and anion exchangers. Only low concentrations of certain chemicals are left, that "slip" easily off the resin, and are retained by the mixed bed exchanger. This is filled with intimately mixed strongly acid and strongly basic exchange resin, that produce innumerable cation / anion exchange stages within the exchanger, thereby increasing the efficiency of impurity removal exponentially.

When the mixed bed resin is exhausted, the cation and anion exchange resins have to be separated prior to being regenerated. By applying an upward flow of water, the cation and anion resins are separated, due to their different specific gravities. The anion exchange resin settles above the cation exchange resin, which has a higher density. Specially designed pipe systems ensure separation of the regenerants and associated rinse water. The NaOH solution passes through the exchanger from top to bottom, and the H_2SO_4 solution from bottom to top. The two exchange resins are then rinsed separately, in order to remove the excess regeneration chemicals. This has to be done very efficiently to ensure that the regenerated resins are in a completely pure state.

The final rinse stage is followed by an intense mixing stage using air. This guarantees that the two resin types are intimately mixed again, ensuring that the high efficiency impurity removal continues.

At this point the mixed bed exchanger is ready to be put back on line when the second unit needs to be taken off-line to be regenerated. The mixed bed effluents will be neutralised.

3. Regeneration Station

The cation and anion exchangers have to be regenerated at regular intervals when their capacity has been exhausted during the service cycle. Sulphuric Acid and Sodium Hydroxide (caustic soda) is pumped from the chemical storage tanks and automatically diluted to the required concentration on blending with demineralised water.

The entire water treatment plant is controlled fully automatically by an advanced plc driven system that also provides full real-time monitoring of water quality. Each control system is designed to meet our client's requirements and the necessary software is developed according to H+E process requirements.

4. Control System

Pre-Assembly

Installation

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.

HAGER+ELSÄSSER

An aquarion Group Company

Tel: +44 1403 272772

sales@he-water.co.uk
www.he-water.co.uk