

3M Separation and Purification Sciences Division Customer Application Brief

3M Solution Offering for the DI-Water Treatment Market

Background

Many industries from Pharmaceutical, Microelectronics and other industrial producers require high purity ingredient or process waters to avoid contamination or damage to processes and products. De-Ionised (DI) water is achieved by the removal of conductive ionic species from the water, which at its 'purest' level will have a resistivity close to 18MQ/cm.

From the incoming water source there are typically a sequence of treatment steps to achieve the final DI-water quality required. There can be variation in the processes employed, but generally there are technologies to remove solid particles, organic matter, conductive ionic species and dissolved gases in the production flow.

The process diagram below highlights some of water treatment steps that are common in a DI-water production plant. From the incoming feed water source to the final point of use there are multiple Filtration and Gas Separation technologies used to treat the water to help protect and ensure effective operation of de-ionization equipment (membranes or resin beds). When optimised the combination of the treatment steps helps deliver a reliable quality of DI-water.



Challenges

Depending on the origin of the water (towns, well or river) and in some cases the time of the year, the incoming quality is variable and requires several treatment stages before entering the main storage tank and process lines. The first challenge is to effectively control and remove any entrained particles and solids from entering and contaminating the treatment plant.

Dissolved minerals, namely MgCO₃ and CaCO₃ in water form Mg+, Ca+ and HCO₃- (bicarbonate). Their concentration is often expressed by alkalinity or temporary hardness and removed with ion exchange or reverse osmosis technologies. Free CO₂ gas formed in the dissociation of HCO₃- at pH<8,2 will slip through reverse osmosis and is a substantial load to resin beads within the lon exchange columns or Electrodeionization (EDI). Left untreated, the beds regeneration frequency and chemical consumption increases or results in a source of contamination and acid corrosion problem.

3M Solutions

From the initial point of water inlet into the plant a series of pre-treatment steps act as a barrier to mass particulate ingress, which may include a combination of Coarse Screens, Mechanical or Sand Filters. Downstream of the pre-treatment and prior to any initial demineralization (pre-RO), a Micro-Filtration step is installed to further reduced the solids burden and afford adequate protection to the membranes. Micro-filtration downstream of the lon exchange columns will also remove any resin attrition from final ion exchange treatment (IXCH). **3M™ High Flow Filter systems** are designed to meet these Micro-filtration needs with its compact design and High Flow rate capabilities.

An important part of the purification process is the effective removal of alkalinity. To reduce the ionic load prior to and extend the life of the lon exchange columns, a series of RO membranes and De-gasification steps can be employed. **3M™ Liqui-Cel™ Membrane Contactors** (with their small footprint, capital and running costs) are one of the leading technologies in removing CO₂ levels to below 1 ppm*. In doing so this in turn improves the efficiency of the lon Exchange columns and reduces the frequency of regeneration leading to a lower chemical demand per m³ of treated water.

Finally, all the membrane-based systems and Ion Exchange columns used in the water processing periodically require a remedial regeneration treatment which often calls for cleaning chemicals to be flushed through the installations in-situ. The chemicals deployed (typically acids and / or bases) themselves need to be of a high purity to ensure they themselves do not foul the membranes during the cleaning cycles. Depending on scale once again these Micro-filtration needs can be met by **3M[™] High Flow Filter Systems** or **3M[™] Betafine[™] XL Series** pleated cartridges.

Recommendations

In today's demanding DI-water generation market there are several specific process steps which are needed to deliver a consistent water quality and run at the capacity levels in order to meet customers' needs. 3M Filtration and Gas Separation technologies are able to meet these requirements with cost effective innovative solutions.

* CO² removal depends on pH, cations and alkalinity. If your water is not Reverse Osmosis (RO) or Nanofiltration (NF) permeate, projected CO² removal may not be accurate plus scaling may occur. In that case, please contact your 3M representative.

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