

Multi-port valve blocks: Generation of ultra-pure water Ion exchanger, reverse osmosis and electrodeionization

As a world leading manufacturer of complex multi-port diaphragm valves made of stainless steel, GEMÜ has earned an excellent reputation in the Biotech and Pharmaceuticals markets. The skills and experience that GEMÜ has gained are now transferred to industrial applications and the company now designs and manufactures multi-port valve blocks from plastic materials.

Advantages of multi-port valve blocks

Since fewer pipes and fittings are required, using multi-port valve blocks makes it possible to build significantly more compact systems. At the same time, the number of welded or solvent cemented joints is reduced which leads to a considerable increase in plant reliability due to the avoidance of leaks. The fast and simple installation of the unit additionally reduces installation time and costs. Despite being compact, the GEMÜ pneumatic actuators are designed to be maintenance friendly.



GEMÜ multi-port valve block

Generation of ultra-pure water

Combining the subprocesses of softening by ion exchange, reverse osmosis and electrodeionization is considered today to be an established procedure for generating pure and ultra pure water in the pharmaceutical industry.

BWT Pharma & Biotech GmbH OSMOTRON PRO 1500 HPW's pure water treatment plant unites these three treatment steps in one system.



BWT OSMOTRON PRO 1500 HPW

Softening

Softening is effected by means of an ion exchange process consisting of two softening filters arranged in series connection. For softening, the feed water flows through the filter containers from top to bottom with the hardness components (calcium and magnesium ions) being replaced by sodium ions. At the end of this process step, there is soft water with the salt content remaining virtually unchanged. Depending on the quality of the feed water, the filter container is exhausted after a specific throughput amount and operating time. Regeneration is then carried out by means of sodium chloride (common salt) in the form of brine.

Reverse osmosis (RO)

In downstream reverse osmosis, the soft water is desalinated. With this diaphragm separation process, the soft water is fed to the permeators (membrane carriers) under high-pressure. While retaining the contained salts and organic ingredients, approximately 75% of the water leaves the permeators as permeate. The concentrate that contains virtually all the salts and impurities in the feed water is discarded. After reverse osmosis, the residual salt content is less than 2% of the feed water salt content. The system works on a continuous basis and does not need to be regenerated.

Electrodeionization (EDI)

For residual desalination, the generated permeate then goes to the electrodeionization modules. This procedure combines the membrane separation process and ion exchange. The modules comprise two chambers with the pure water chamber being filled with a special ion exchange resin. Apart from this, the system consists of cation- and anion-permeable membranes. Applying power starts the ionogenic substances migrating in water. The ions can only get through the membranes in accordance with their charge; the water is held back. When flowing through the pure water chamber, the system almost completely removes the ions that are still located in the permeate. The draining diluate is fed into the ultra-pure water storage tank and corresponds to Highly Purified Water quality (HPW) when using BWT SEPTRON(R)-BioSafe-modules.

The ions migrate into the second (concentrate) chamber that is filled with rinse water that is routed in the ring main and takes the ions that were removed from the permeate to the sewage system.

Principle of operation of the multi-port valve block

The block solution groups virtually all the diaphragm valves that are attached in the classical ion exchanger design upstream of the two softening filters to one unit. This unit is now attached as a multi-port valve block above the softening filters and constitutes the main part of the plant. With all the softening subprocesses, all of the media currents are routed via the block: the feed water, the pure water and the regeneration agents. When doing this, the feed water and pure water currents are always kept separate from one another. This is a reliable way to prevent a short-circuit current, i.e. non-softened water from getting to reverse osmosis. The multi-port valve block also safely regulates the switchover process – if a softening filter is switched over from service to regeneration or vice versa. The two multi-port valve blocks make it possible to change over the water softening column for operating mode 1-2 or, if required, 2-1. You can easily select this using the S7-300 controller via the touch panel.



Ion exchanger with GEMÜ multi-port valve block



GEMÜ 687 diaphragm valve



GEMÜ 1434 positioner