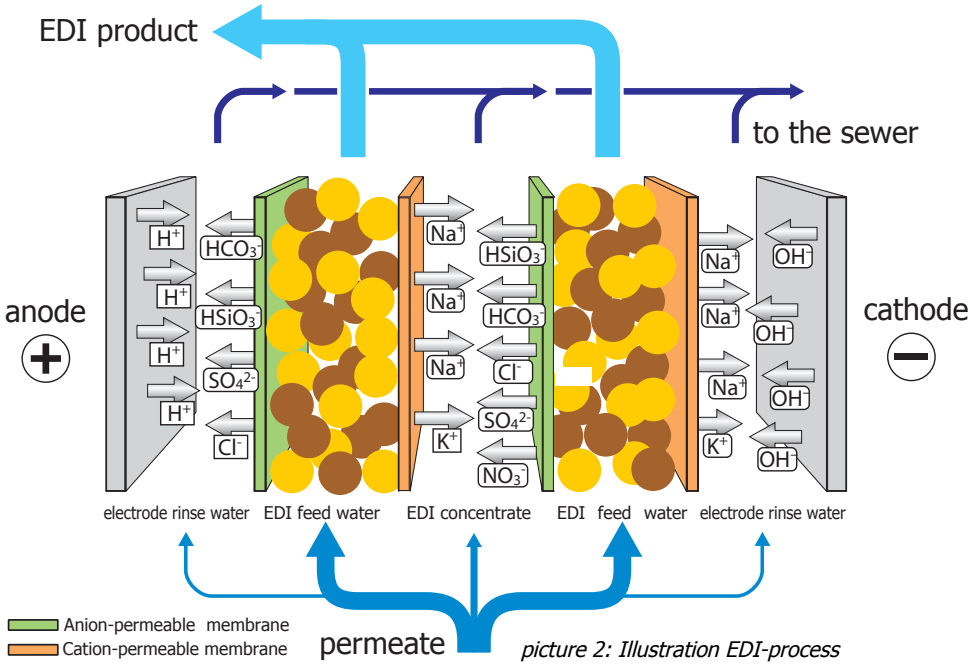
Controller RO 1000

picture 1: UP 11000

Electro-DeIonisation for ultrapure water production

What is Electro-DeIonisation (EDI)?



picture 2: Illustration EDI-process

The process of electro-deionisation combines **two well-known water treatment** processes, **electrodialysis** and **ion exchange** using ion exchange resins.

This process makes it possible to remove dissolved salts (ions) almost entirely without using chemicals and at low energy cost.

Process description

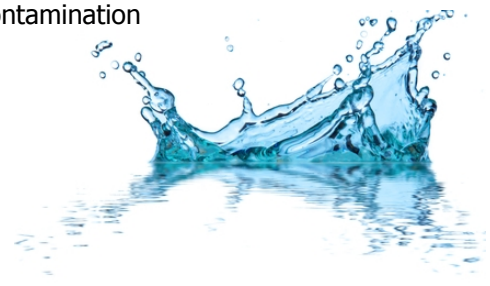
Permeate generated by reverse osmosis is separated into **three flows** before being **fed into** the electro-deionisationmodule: **EDI feed water** flows through the diluate chambers filled with **exchange resins.** Due to the electric field, the **anions** migrate through the resin bed towards the anode. They flow through the anion-permeable membrane and enter the adjacent concentrate flow. The **cations** migrate through the resin bed towards the cathode, pass the cation-permeable membrane and also enter the **concentrate flow**. The **ions** are transported out of the module with the concentrate flow. **Electrode rinsing water** rinses **gases** that accumulate on the electrodes and transports them out of the module. Applying electrical current results in hydrolysis of the water into H+ and OH-ions in the resin bed. The H+ ions regenerate the cationic exchange resin while the OH-ions regenerate the anionic ex-change resin. This regeneration process runs continuously and in parallel to the operation of the module.

Applications

- high pressure steam generator
- laboratories
- pharmaceutical industry
- semiconductor manufacturing
- optical industry
- glass coating
- metal processing industry
- ultrapure water applications

Advantages compared to chemically regenerated ion exchangers

- no chemicals for regeneration
- no waste water contaminated with chemicals
- continuous operation
- uniform ultrapure water quality
- no bacterial contamination



Make-up of an EDI module

picture 3: EDI cell Illustration

The basic element of an EDI module is the EDI cell. An **EDI cell** consists of **three chambers**: one **diluate chamber** and **two concentrate chambers** separated by alternating **cation- and anion-selective membranes**.

The **membranes** are **impermeable to water** and allow only anions or cations to pass through.

The **resin bed** is composed of **both anionic and cationic exchange resins** (mixed bed). **A number of these cells** arranged **one after the other** between the two elec-trons form **an EDI module.**

The **electrical field** required for the electro-deionisation process is generated at the electrodes by applying a DC voltage.

Achievable water quality

The electro-deionisation principle can be used to produce **completely demineralised** ultrapure water with a conductivity of < 0.1 µS/cm, corresponding to a specific resistivity of >10 MΩ x cm. The quality of the ultrapure water depends on the pre-treatment of the feed water.

Influence of CO2 and SiO2 on ultrapure water quality

Slightly charged ions such as CO2 and SiO2 have a **major influence** on **ultrapure water quality**. They are **absorbed less** by the exchange resin than other ions because of their low charge. These ions are also only **weakly attracted** by the electrodes. Both together lead in less migration of the ions across the resin bed through the membranes into the concentrate flow, resulting in a **loss of quality** in ultrapure water. To prevent this, **free CO2** has to be removed by **binding with caustic soda** or **degassing** with a membrane degasser.

Benefits of the system at a glance

- ✓ high salt retention
- ✓ simple construction
- ✓ easy to use
- ✓ space-saving
- ✓ low maintenance

picture 4: UP 1500

Ultrapure Water Units serie UP

UP 150 - UP 20000 for product flow rates from 150 to 20000 l/h

The stand-alone units on a **robust stainless steel frame** produce ultrapure water from softened drinking water. For this purpose, the well-established and environmentally friendly **reverse osmosis process** is **combined** with downstream **electro-deionisation**. The operating and display elements as well as the RO 1000 controller are mounted on a user-friendly plastic front panel. Further technical specifications can be found in our detailed documentation.

Feed water requirements

The units are designed for softened water (< 0.1°dH) with a maximum TDS of 1.000 mg/l, a water temperature of 15°C, a maximum colloidal index of 3, a CO2 content of 10 mg/l and a SiO2 content of 15 mg/l. Under these conditions, the units still reach design product flow after three years of operation. The EDI product recovery depends on the raw water quality and the type of pre-treatment.

picture 5: UP 1350

picture 6: CAD-Drawing UP 1500

Unit design

1 **fine filter**
2 **pressure reducer**
3 **solenoid inlet valve**
4 **pressure switch**
5 **centrifugal pump**
6 **control valves RO**
7 **pressure pipes w. membranes**
8 **flow meters RO**
9 **control valve EDI concentrate**
10 **flow meters EDI**
11 **EDI module**
12 **sampling EDI product**
13 **resistance transmitter**
14 **digital voltage display**
15 **digital display of current**
16 **controller RO 1000**
17 **error displays with confirmation button**

type	product flow rate	operating pressure	power consumption	dimensions h x w x d	weight approx.
UP 150	150 l/h	12.0 bar	1.3 kW	1710 x 1160 x 690 mm	150 kg
UP 250	250 l/h	12.0 bar	1.3 kW	1710 x 1160 x 690 mm	160 kg
UP 550	550 l/h	15.0 bar	4.1 kW	2000 x 1340 x 890 mm	220 kg
UP 800	800 l/h	15.0 bar	4.1 kW	2000 x 1340 x 890 mm	250 kg
UP 1100	1100 l/h	15.0 bar	4.1 kW	2000 x 1340 x 890 mm	270 kg
UP 1500	1500 l/h	15.0 bar	4.1 kW	2030 x 2530 x 890 mm	320 kg
UP 2200	2200 l/h	16.0 bar	6.1 kW	2030 x 2530 x 890 mm	420 kg
UP 3000	3000 l/h	18.0 bar	11.5 kW	1900 x 3490 x 820 mm	600 kg
UP 4100	4100 l/h	18.0 bar	13.5 kW	2180 x 3140 x 850 mm	700 kg
UP 6000	6000 l/h	18.0 bar	18.5 kW	2210 x 3870 x 850 mm	800 kg
UP 8200	8200 l/h	18.0 bar	20.0 kW	2210 x 4750 x 850 mm	850 kg
UP 11000	11000 l/h	18.0 bar	26.0 kW	2200 x 3865 x 1000 mm	1100 kg
UP 20000	20000 l/h	18.0 bar	45.0 kW	2200 x 4750 x 1500 mm	2000 kg

Table 1: technical data UP units

Ultrapure Water Units serie EP

EP 150 - EP 2200 for product flow rates from 150 to 2200 l/h

Electro-deionisation can be used to generate ultrapure water downstream of an **existing reverse osmosis system**. It is an economically efficient and convenient alternative to **mixed-bed ion exchangers**.

Advantage: Ultrapure water is always available with constant quality.

Unit design: The unit is on a stable stainless steel frame, completely wired, pre-assembled and ready for installation. It continuously demineralises RO permeate while the resin is permanently regenerated by the applied voltage.

picture 7: EP 900, front

Feed water requirements

The units are designed for a permeate conductivity of 4–20 µS/cm, a CO2 content of 10 mg/l, a SiO2 content of max. 0.5 mg/l and a colloidal index of max. 0.25. The feed water has to be softened (< 0.1°dH) and pretreated by means of a reverse osmosis unit (without intermediate permeate tank*). The EDI product quality depends on the quality of the permeate.

*Deviations from this require special testing and, if necessary, the use of optional components.

picture 8: EP 900, back

Retention rates of EDI

(starting from UO permeate)

ions > 99%
free CO2 > 99%
silicate > 90%
TOC 60-90%
bacterial contamination no

picture 9: EDI cell

type	product flow rate	operating pressure	power consumption	dimensions h x w x d	weight approx.
EP 150	150 l/h	max. 1.5 bar	0.8 kW	1610 x 1040 x 690 mm	90 kg
EP 300	300 l/h	max. 1.5 bar	2.1 kW	1610 x 1040 x 690 mm	95 kg
EP 900	900 l/h	max. 2.0 bar	2.1 kW	1610 x 1040 x 690 mm	100 kg
EP 1500	1500 l/h	max. 2.5 bar	2.1 kW	1610 x 1040 x 690 mm	105 kg
EP 2200	2200 l/h	max. 2.5 bar	3.3 kW	1610 x 1040 x 690 mm	110 kg

Table 2: technical data EP units