



1 *CDI process with membrane adsorbers.*

## CAPACITIVE DE-IONIZATION (CDI)

### Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB

Nobelstrasse 12  
70569 Stuttgart  
Germany

#### Contact

Dr.-Ing. Berta Spasova  
Phone +49 711 970-4092  
berta.spasova@igb.fraunhofer.de

Dr.-Ing. Carsten Pietzka  
Phone +49 711 970-4115  
carsten.pietzka@igb.fraunhofer.de

[www.igb.fraunhofer.de](http://www.igb.fraunhofer.de)

Capacitive deionization is based on the ion storage in porous electrode adsorbers under the effect of an applied electric field. When the adsorbers are completely charged, the ions are released by electric field reversal or short-circuit between the electrodes and removed by a short flush to the salt concentrate. The CDI operates at low cell voltages of about 1.5 V and without gas evolution reactions at the electrodes, which enables low energy consumption in the range of 1 kWh/m<sup>3</sup> of water product.

Fraunhofer IGB is cooperating with its industrial partner Idropan Dell'Orto Depuratori S.R.L. (Italy) in CDI technology optimization for industrial applications. Idropan is already selling CDI systems (Plimmer-CDI) mainly for drinking water treatment and is owner of the relevant IP rights.

#### Examples for industrial applications of CDI technology

- Drinking water production
- Desalination of industrial process water
- Ultrapure water production
- Removal of pollutants including nitrates, arsenic and heavy metals
- Recovery and concentration of raw materials from aqueous solutions
- Water softening



### Performance data of CDI systems commercially available by Idropan

The main advantage of CDI compared to competing water desalination technologies like reverse osmosis (RO) is the reduced energy consumption in combination with high deionization efficiency. The CDI systems can be designed and adjusted according to the respective customers' specifications:

- Conductivity of the inlet solution up to 2000  $\mu\text{S}/\text{cm}$
- Reduction of the salinity up to 95%
- Minimum conductivity of the product water down to 2–5  $\mu\text{S}/\text{cm}$
- Water efficiency in the range of 85%: About 85% of the inlet water is recovered and only 15% rejected to the brine.
- Low energy consumption in the range of 1 kWh/m<sup>3</sup>
- Throughput of current commercial systems up to 1 m<sup>3</sup>/h
- Low sales costs of 1500–7500 € depending on the system size (competitive to comparable RO systems)
- Minimum maintenance effort to the user and no scaling due to automatic selfcleaning based on minimum amounts of environmentally uncritical organic acids
- No additional consumption of chemicals

For comparison, RO systems typically reach water efficiency not higher than 70% at energy consumption of 2–4 kWh /m<sup>3</sup>.

### Our current development together with Idropan

- Scale up of CDI systems in throughput
- Dimensioning and adjustment for water inlet conductivities above 2000  $\mu\text{S}/\text{cm}$
- Further reduction of energy consumption
- Design of CDI systems according to customers' specifications
- Integration of CDI with other water treatment technologies (e.g. electro-dialysis)

### Our service offers

- Consulting and recommendation for water and wastewater treatment applications
- Pilot tests for customer-specific application cases including techno-economic validation
- Design and optimization of CDI systems according to the customer's needs together with our partner Idropan
- Integration of the CDI technology into complete water treatment processes

- 2 *Demonstration unit for capacitive de-ionization (CDI) at Fraunhofer IGB in cooperation with Idropan Dell'Orto Depuratori S.R.L.*
- 3 *One application for CDI is water softening.*

In cooperation with

**IDROPAN-DELL'ORTO**  
DEPURATORI S.R.L.