UNSW SYDNEY

An Innovative Desalination Technology

Containerized Membrane Capacitive Deionization (mCDI) Water Treatment Units

Technical Brief

UNSW Centre for Transformational Environmental Technologies

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Membrane Capacitive Deionization (mCDI)

Technology Overview

Membrane Capacitive Deionization (mCDI) uses an electric field to remove charged ions from water. The extent of salt removal can be "customized" to client needs and adjusted for different feed water qualities. mCDI technology involves both an "electro-sorption" purification step followed by a "discharge" or regeneration step.

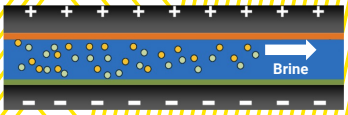
01

Purification

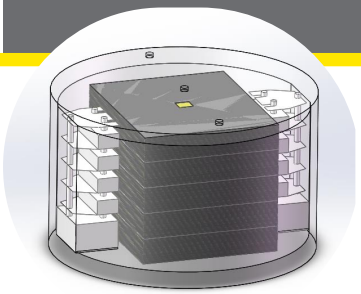
Salty water flows through pairs of oppositely charged electrodes. Dissolved ions are retained within the electrodes to generate purified water.

02

Regeneration



Reverse current is applied to discharge the electrodes. Ions stored by the electrodes are desorbed to generate brine which is discharged after completion of the regeneration stage.



Applications

mCDI can be used in a variety of different scenarios

- Desalination of brackish water
- Recycling of industrial wastewater
- Treatment of cooling tower water
- Softening of household water

Advantages

- Low feedwater pressure and low energy consumption
- High water recovery (70-85%)
- Adjustable salt removal (25-85%)
- Low risk of hardness scaling
- No chemicals required during the regeneration stage
- Low maintenance requirements

Containerized Plants

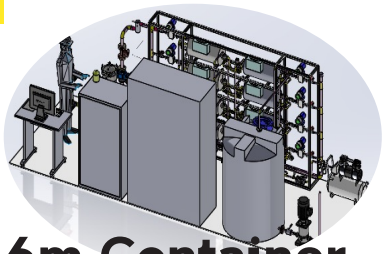
Our mCDI plants are housed in standard shipping containers with both 6 metre and 12 metre units available. The different sized containers hold different numbers of electrode modules with the size of choice depending on water production and water quality required.

Minimal pre-treatment of source waters is required with only removal of solids that could block the flow channel necessary. The process has high tolerance to hardness ions and organic content.

Initial installation and testing of the internal equipment will be completed before delivery of containers. Professional electricians, plumbers and technicians are only required for commissioning of the containerized unit on site. Depending on different site conditions, labor demand for commissioning is approximately 2-5 days.

The tables and graphs below show performance when meeting Australian Drinking Water Guidelines (TDS < 500 mg/L) and at a minimum 75% of water recovery.

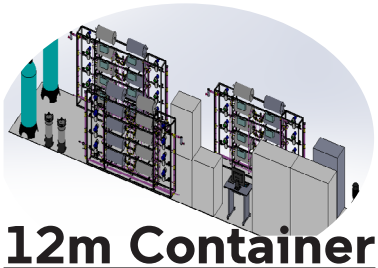
01



6m Container

VS

02

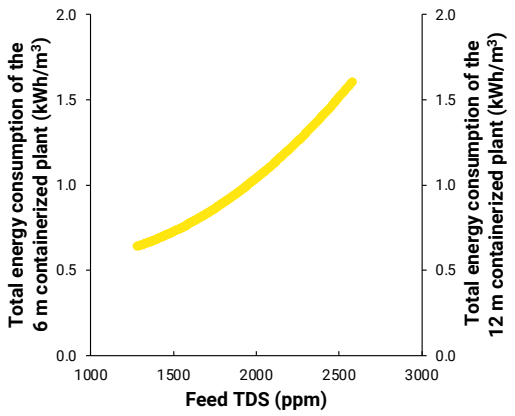


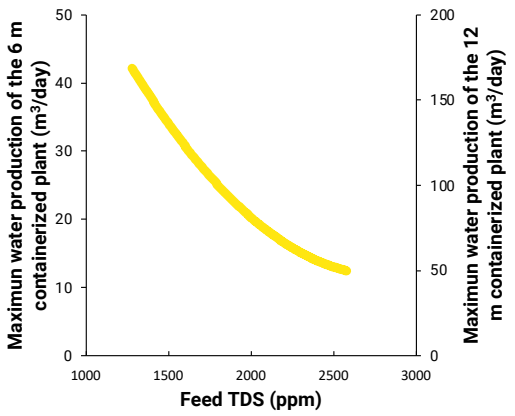
12m Container

Feed TDS (ppm)	Maximum Water Production (m^3/day)*	Electrode Energy Consumption (kWh/m^3)	Total Energy Consumption (kWh/m^3)
~1000	~45	<0.16	<0.63
~1500	~25	<0.30	<0.91
~2000	~20	<0.43	<1.24
~2500	~15	<0.60	<1.63

Feed TDS (ppm)	Maximum Water Production (m^3/day)*	Electrode Energy Consumption (kWh/m^3)	Total Energy Consumption (kWh/m^3)
~1000	~170	<0.16	<0.79
~1500	~100	<0.30	<1.10
~2000	~65	<0.43	<1.43
~2500	~45	<0.60	<1.83

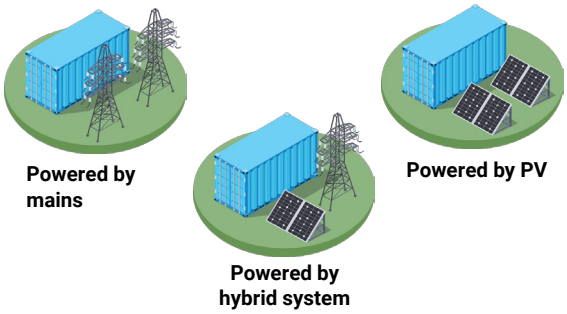
** Assume 20 hours of operation per day, running on mains power or PV with sufficient battery storage.*





Through the programmable logic controller (PLC) and the supervisory control data acquisition (SCADA) system of our containerized plants, remote automatic operation can be achieved. Three power supply options are available with the option of choice dependent upon the particular region:

- powered by mains
- powered by hybrid system
- powered by PV



Powered by mains

Powered by hybrid system

Powered by PV

Operation & Maintenance

mCDI plants are usually equipped with two different automatic cleaning systems: automatic air scouring system and automatic clean-in-place (CIP) system. Labor demand for plant maintenance is approximately 2-4 hours every two months.

Automatic air scouring system (to reduce the risks of particulate fouling and accumulation of bacteria)

- *Frequency:* once every two months, controlled by the PLC

Automatic CIP system (to remove inorganic scaling and accumulation of bacteria)

- *Frequency:* once to twice every two months
- *Dosage:* requires 50 mL, 10%~15% hydrochloric acid per cubic metre water produced

Digital Twins

The Digital Twin of the plant enables teleoperation of the containerized unit and effective unit operation without the need for on-site specialists.

- System visualization
- Operator training
- Remote control
- AI for performance prediction

About CTET

The UNSW Centre for Transformational Environmental Technologies (CTET) is an R&D Centre established in December 2017, focusing on the development and commercialisation of innovative environmental technologies.

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