




Advancements in Water Treatment

TIEEP Water Forum

May 7, 2020

Jim Wark

Culligan of Texas



Brought
to you by:

Culligan Water[™]
Culligan of Texas

 **Voltea**

The world's leading manufacturer of Membrane-Capacitive
Deionization (CapDI[®]), for salt-free, chemical-free
water purification.

OUR EVOLUTION

Founded in 2008 as a technology spin-out from Unilever



Transitioned from an R&D entity to a commercialization company, backed by institutional capital



Drive down production costs of developed product line. Currently focused on growth



PRODUCT LINE

Highly modular and scalable - using the same components across all products

*Point-of-Use
(Small Commercial)*



26"

*Point-of-Entry
(Residential)*



42"

*Industrial / Large Commercial /
Agriculture*



84"

One technology, four applications, countless solutions



C&I



AgTech



Appliances



Residential

Water Softening

Remove hardness: CaCO_3 , CaSO_4 ,

- ✓ Better water quality
- ✓ Protect equipment
- ✓ Optimize performance

Brackish Deionization

Control of salts: Na^+ , Cl^- , Fe^{3+} , HCO_3^-

- ✓ Improved quality and taste
- ✓ Increase process efficiency
- ✓ Reduce operation/maintenance costs

Waste-Water Treatment

Treat/recover: reduce/control salts

- ✓ Increase re-use/recycling
- ✓ Use water resource more efficiently
- ✓ Ensure regulatory compliance

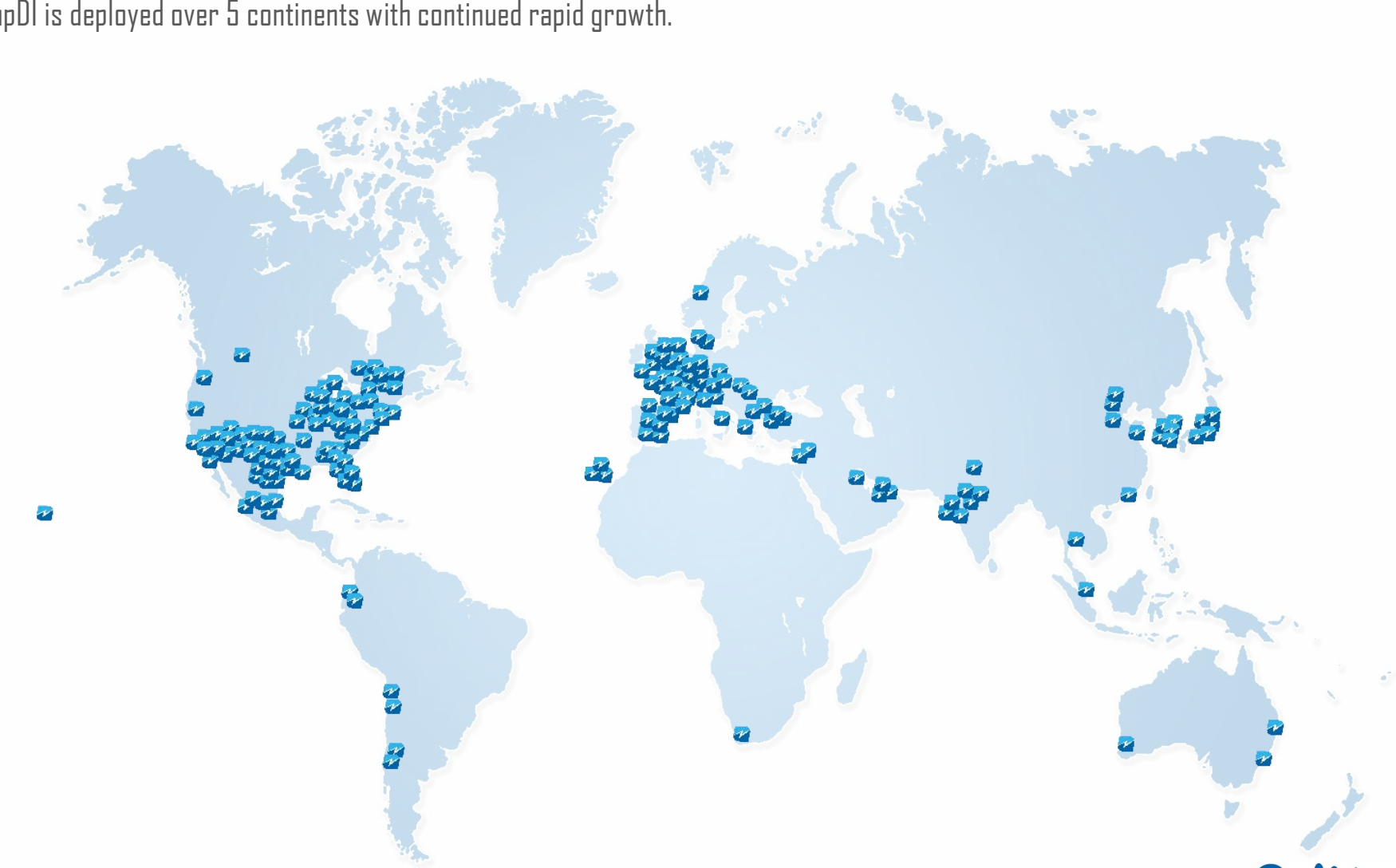


CapDI[®] Latest Installation



CapDI[®] Global Installations

CapDI is deployed over 5 continents with continued rapid growth.



Recent Company Developments



NSF/ANSI 42 certified and listed



Installed systems in 27 countries on 6 continents
> 100 global patents



2018 GWS Global Water Breakthrough Technology
of the Year winner



Deployment Examples

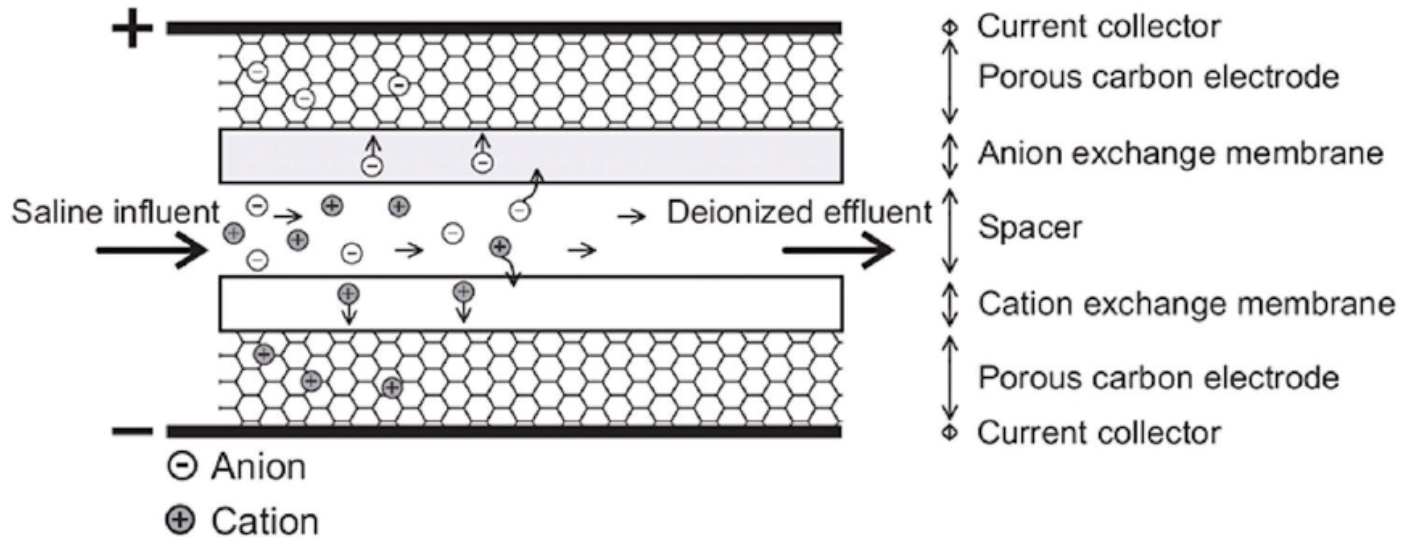
Voltea's CapDI is winning in multiple industries and multiple applications

- Example 1** **Automotive paint line rinse water re-use**
- Example 2** **Cooling tower (CT) make-up water**
- Example 3** **Brewery feed water**
- Example 4** **Horticulture irrigation water for yield increase**
- Example 5** **TDS reduction from membrane bioreactor (MBR) effluent**

What is CapDI Technology?

CapDI (Membrane Capacitive Deionization) is an electrical process allowing the removal of ions from water. This process is based around the CapDI cell, made up of electrodes separated by ion exchange membranes and a flow channel.

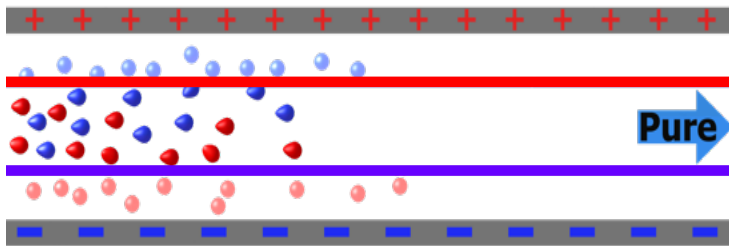
CapDI Cell



How Does CapDI Work?

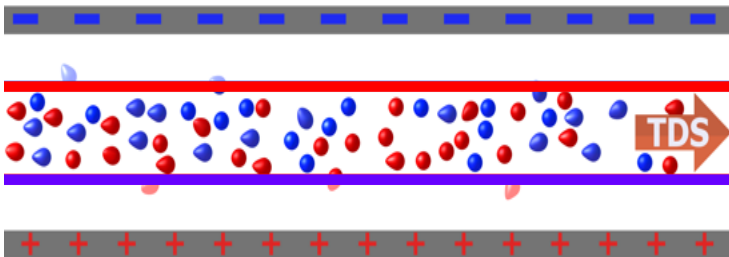
CapDI is an electrical process allowing the removal of ions from water. This process is based around the CapDI cell, made up of electrodes separated by ion exchange membranes and a flow channel.

Step 1 - Purification:



Feed water passes between oppositely charged electrodes which electrostatically remove dissolved ions, leaving pure water flowing out of the cell.

Step 2 - Regeneration:



Feed water flushes through the cell at a lower flow rate, while electrode polarity is reversed. Ions are rejected from the electrode surface, concentrated in the flow channel and flushed from the cell before the cycle is repeated.



CapDI - Purification

Why is deionization/purification necessary? And what causes it?

Example Constituents

Hardness

CaCO_3 , CaSO_4 ,
 MgSO_4

Ionic Species

Na^+ , Cl^- , K^+ ,
 Fe^{2+} , HCO_3^-

Toxic Components

Chelating agents,
Arsenic, Selenium,
Cyanide, Lead,
nitrates

High Value Components

Metals & precious
metals

Why Remove?

Water Softening

- Improve water quality
- Protect & optimize equipment

Water Deionization

- Taste, reduce & reuse
- Equipment performance
- Meet process/feed requirement

Water Detoxification

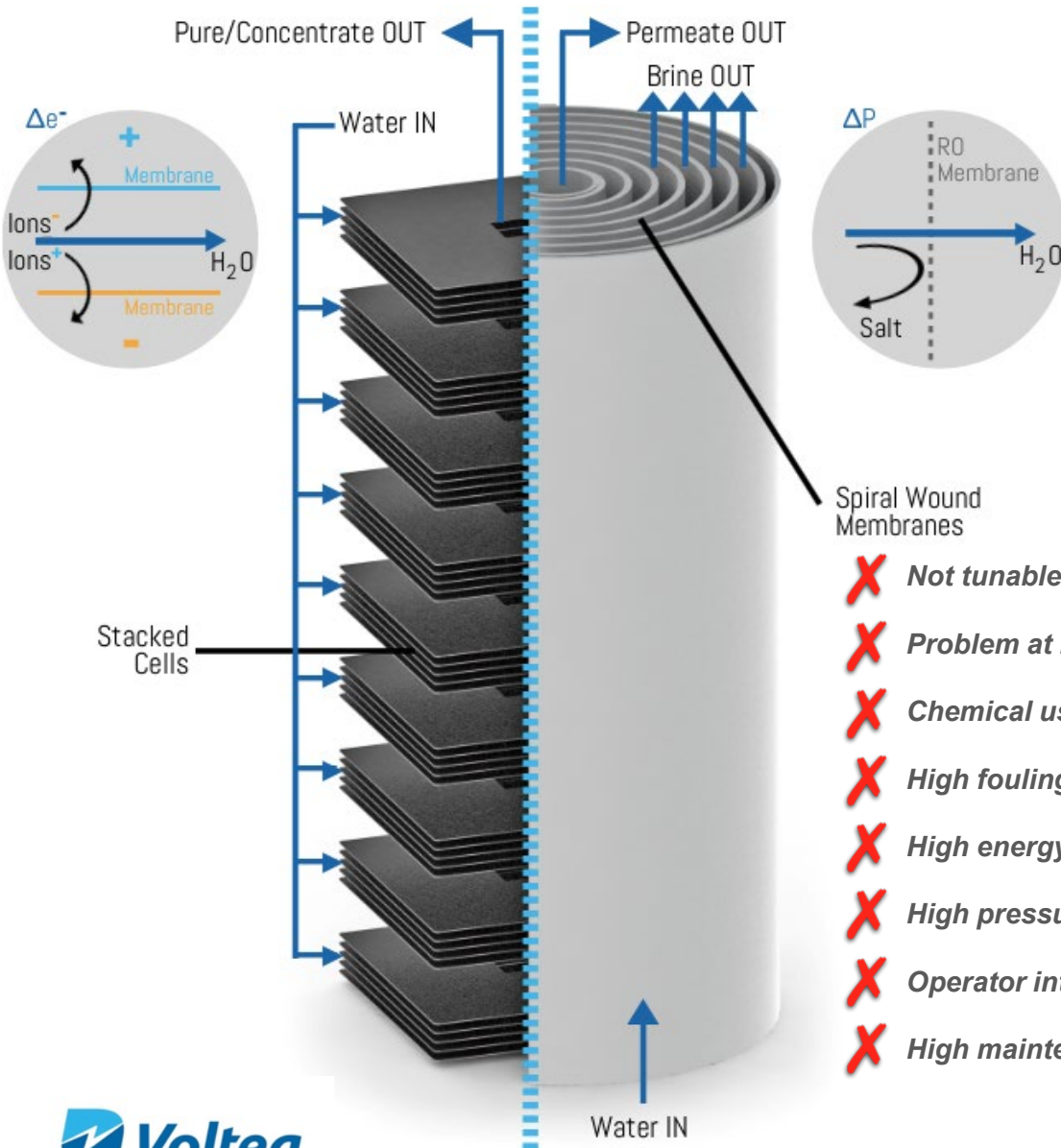
- Improve water quality for health

Waste Water Treatment

- Recovery of valuable materials
- Reduce expensive waste disposal
- Discharge regulatory compliance



CapDI vs RO

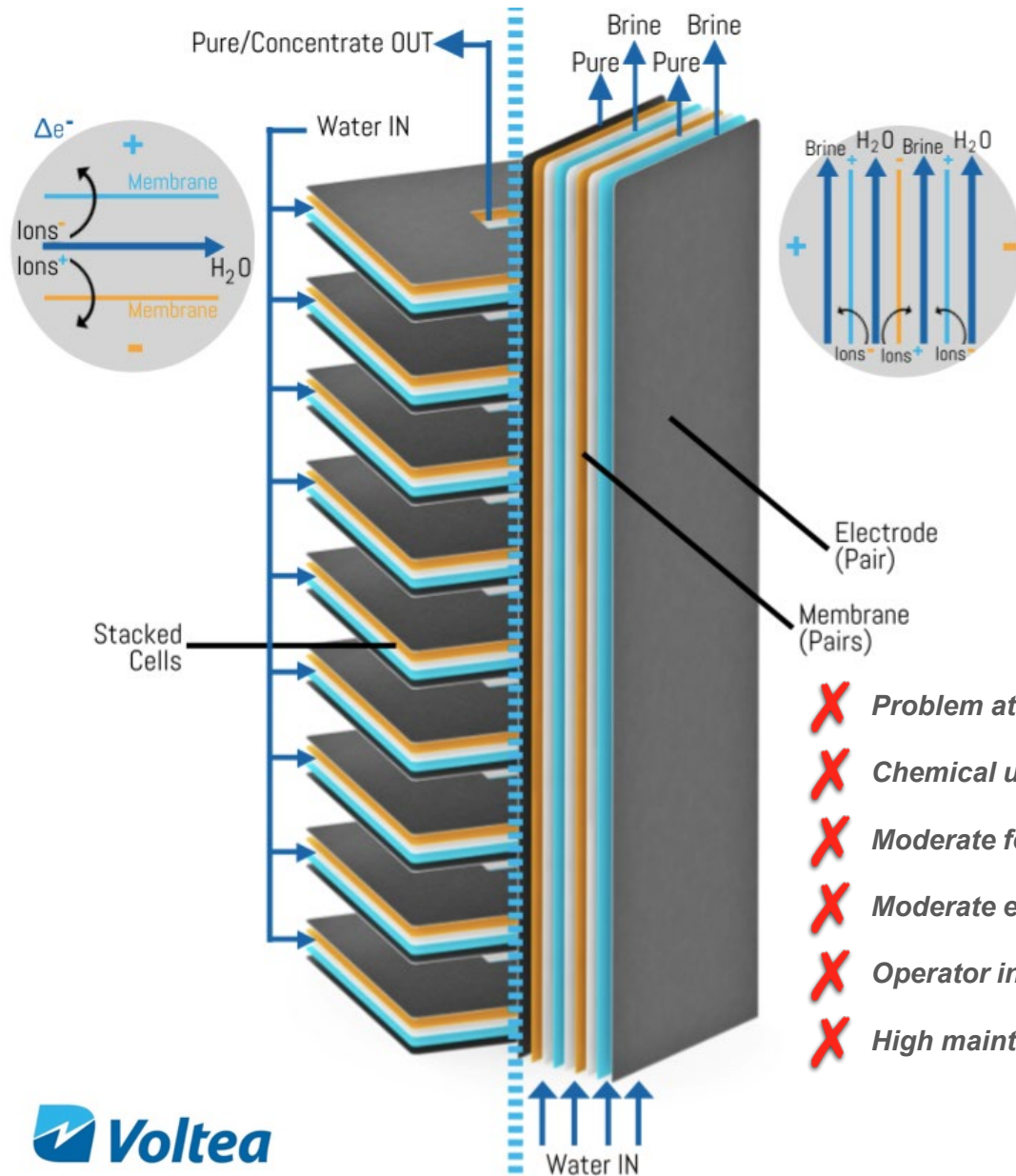


Spiral Wound Membranes

- X** *Not tunable*
- X** *Problem at high water temperatures*
- X** *Chemical usage*
- X** *High fouling potential*
- X** *High energy consumption*
- X** *High pressure across membranes*
- X** *Operator intervention*
- X** *High maintenance requirements*



CapDI vs EDR

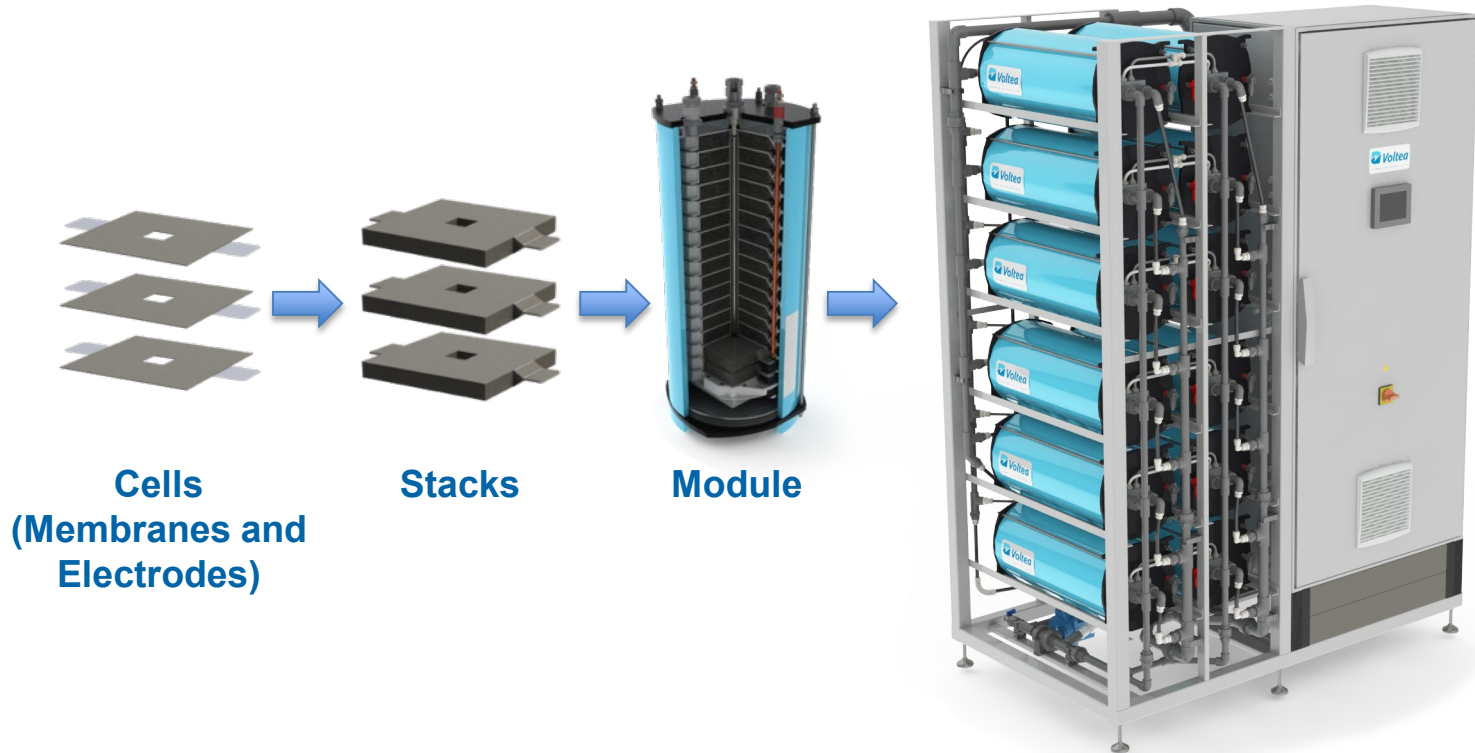


- X** Problem at high water temperatures
- X** Chemical usage
- X** Moderate fouling potential
- X** Moderate energy consumption
- X** Operator intervention
- X** High maintenance requirements



System Composition : From Cells to Systems

Our CapDI Systems are composed of modules, which are built from stacks comprising of membrane and electrode cells. Flow rate, feed salinity and targeted purified water quality will determine the number of modules required, while our systems allow easy expansion to meet any increased water demands.

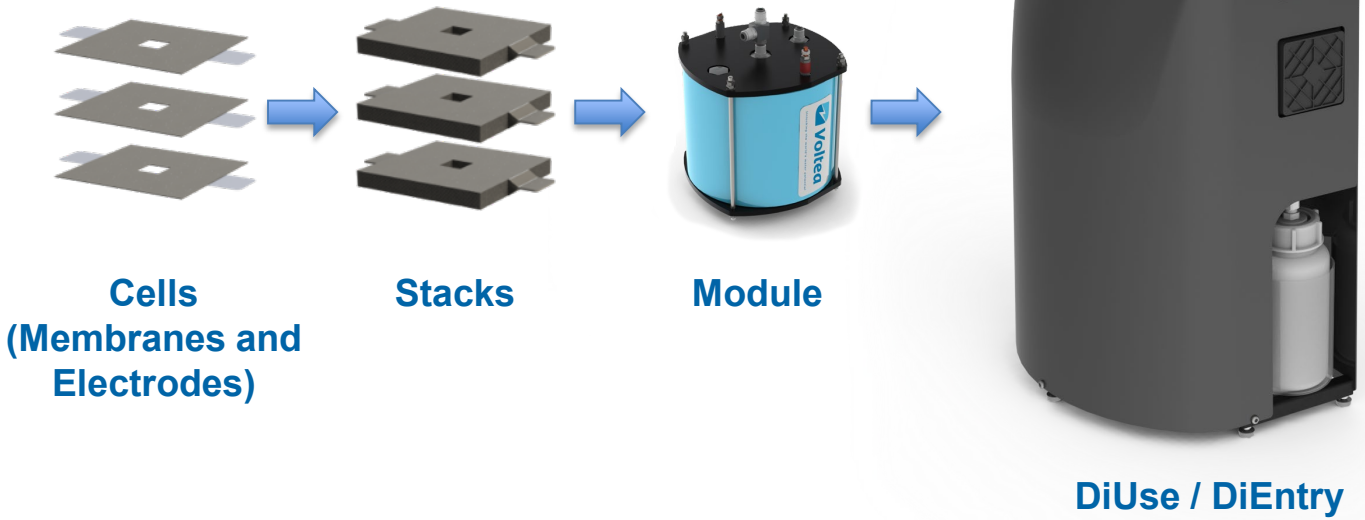


Industrial Series 12 System (IS-12H)
Culligan Water



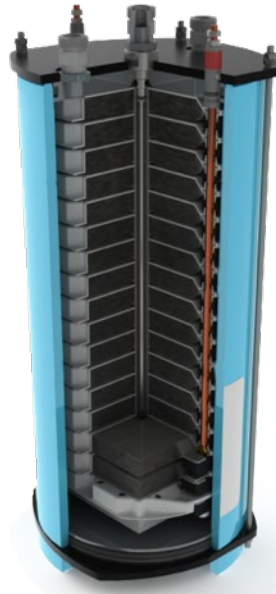
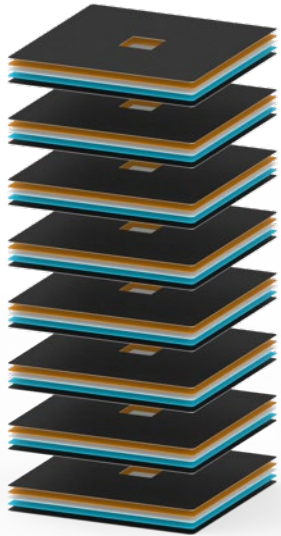
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CapDI - Patents

Voltea owns over 100 global patents pertaining to CapDI and how the technology is implemented into modules and systems. Voltea's patent portfolio ensures that the use of ion-selective membranes or coatings in any capacitive deionization device requires a legally binding supply and license agreement with Voltea.



CapDI - Clear Differentiation

CapDI is uniquely different from traditional deionization technologies:

- Salt-Free Softening* ▪ *Tunable Deionization*
- High Water Recovery* ▪ *Low Energy Consumption*
- Minimal Chemicals Use* ▪ *Modular Installation*
- No Additional Discharge Permitting* ▪ *Built-In Remote Monitoring and Control*
- Minimum Maintenance* ▪ *Removal at High Temperatures*
- Low Fouling Potential* ▪ *Unaffected By Silica*



Industrial Series (IS) Product Line

Voltea's IS Systems employ a simple, cost effective modular design providing flexibility to align with both your current and future demands. The IS Systems feature real-time, remote monitoring and control capability, and are used in commercial and industrial applications, from cooling towers to commercial laundries, for water reuse and any other application that benefits from water with controlled TDS.



IS-1 – 2
(IS-2H Frame)



IS-4 – 6
(IS-6H Frame)



IS-8 – 12
(IS-12H Frame)



System Evolution

Voltea's latest CapDI Industrial Series (IS) Systems feature horizontal modules, which minimize footprint while dramatically improving operational efficiency.



**Industrial Series
Systems (IS-24H, 36H &
48H)
IS-48H System Shown**



*Culligan
Water*



Exploratory CapDI : The Development Kit

The Development Kit (DK) System is a versatile evaluation tool coupled with technical support from Voltea experts. This allows for fast and simplistic exploration of the potential of CapDI for your application. Our DK System is a great way to start your deionization project with Voltea, where both Voltea and your company get a full insight into what our CapDI technology can do for you.

Included with every DK purchase is a tailored testing program to ensure clients experience the full capabilities of CapDI technology in relation to their specific application.



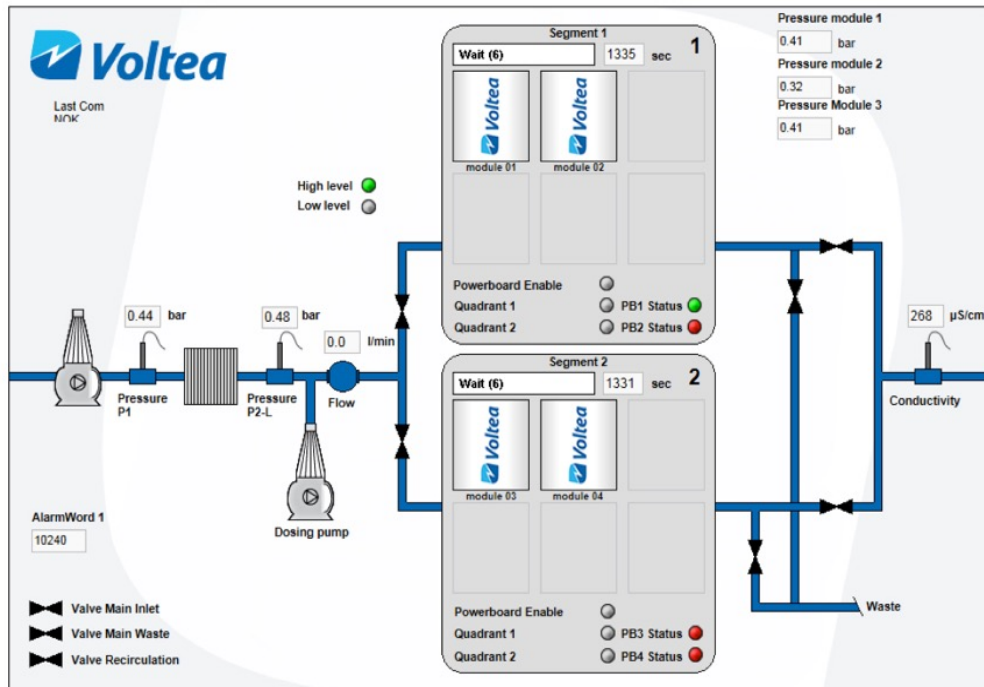
Customized Solutions

Voltea's customized solutions afford CapDI Systems that are tailored to your specific needs. Multiple systems, as well as pre-piped and pre-wired containerized systems are available. Our modular design allows you to easily expand as your operation grows and process flow requirements increase, or alternately, integrate with pre-existing water treatment technology.



Dynamic Control and Remote Monitoring

Our Dynamic Control feature enables automated continuous control of your product water quality to account for any variations in feed water. Voltea's CapDI Systems are equipped with remote monitoring and control capabilities and once subscribed; customers can enjoy peace of mind that the monitoring of their CapDI Systems is by qualified Voltea personnel to ensure optimized system performance.



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