

INTRODUCTION TO ELECTRODEIONIZATION

Jeff Tate
Agape Water Solutions, Inc.



WQA Aquatech 2009

AGAPE WATER SOLUTIONS

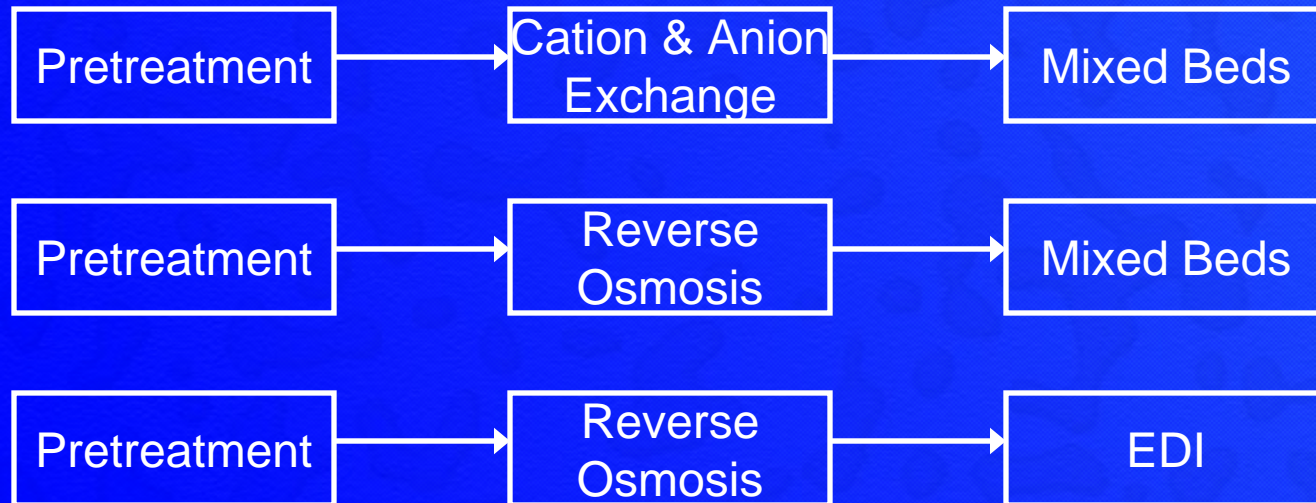
- Jeff Tate
 - Application & System Design Engineer
 - Glegg Water Conditioning Sales Engineer
 - E-Cell Sales Manager 1997-2002 (GE)
 - Omexell President 2002-2005 (Dow)
- Ionpure Master Service Provider
 - Assist OEMs and End Users with RO & EDI
 - Provide Modules, Systems, Tech Support

Electrodeionization

- Polishing Technology
 - Follows RO
- Chemical Free
 - No acid or caustic regeneration
 - No onsite or offsite regeneration
 - Continuous
- Trade names: Ionpure, CDI, E-Cell, etc.



Ultrapure Water Treatment Options



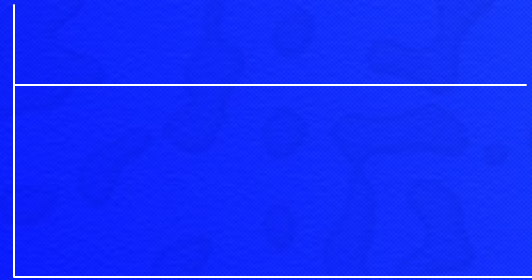
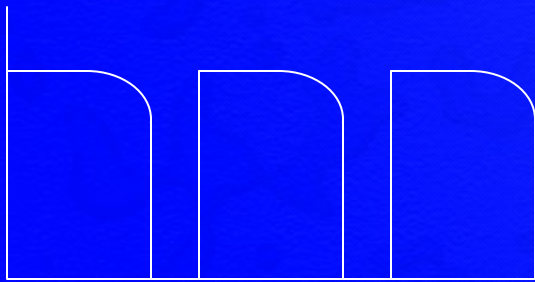
EDI water purification

- Alternative to Mixed Bed Deionization
- Environmental Friendly and Safer Chemical free process
- No chemical corrosion
- No hazardous waste stream
- Simple operation



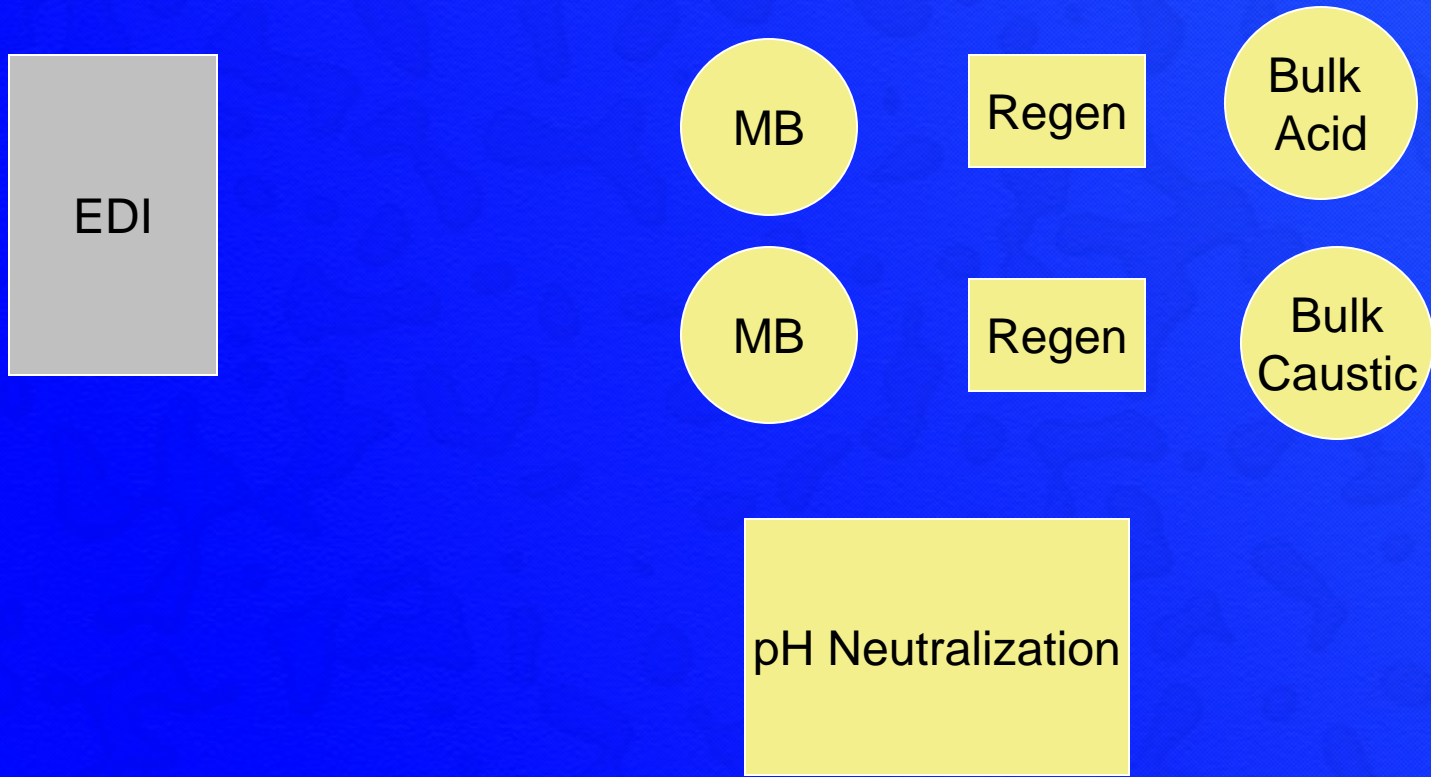
EDI water purification

- Continuous operation vs. Batch operation
- Reliable performance



RO-EDI delivers 5 to 18 Mohm.cm water continuously

Smaller Footprint & Lower Installation Cost



How EDI Works

EDI Module Components

2 Electrodes

Cathode (-)

Anode (+)

2 Ion Exchange Membranes

Cation Exchange

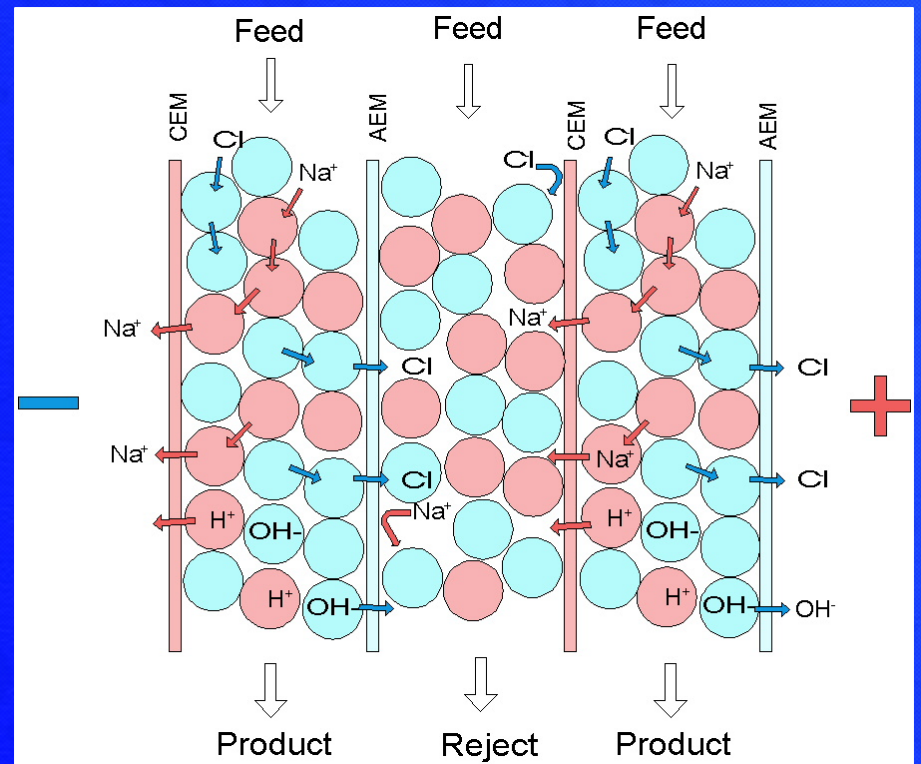
Anion Exchange

2 Chamber Types

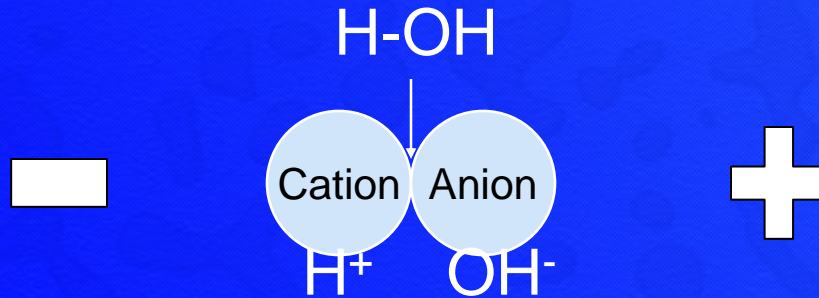
Diluting (D-Chamber)

Concentrating (C-Chamber)

Resin - Mixed

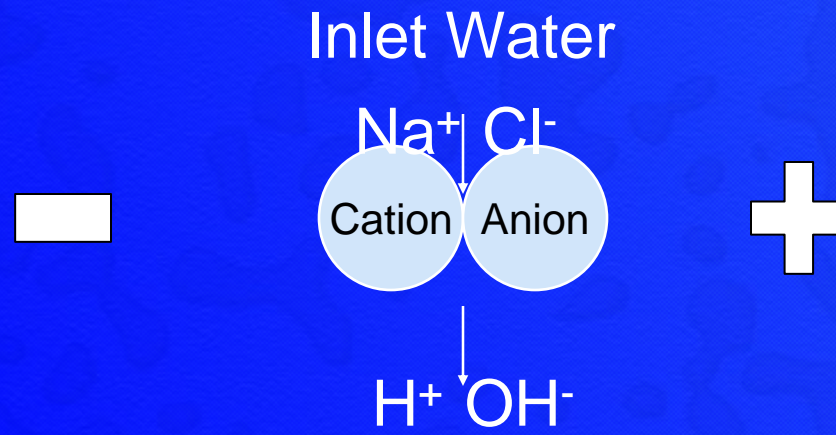


Resin Regeneration



- 💧 **No Chemical Regeneration**
 - 💧 **Water Splitting**
- 💧 **Normal Anion Resin Regeneration: NaOH**
- 💧 **Normal Cation Resin Regeneration: H₂SO₄ or HCl**

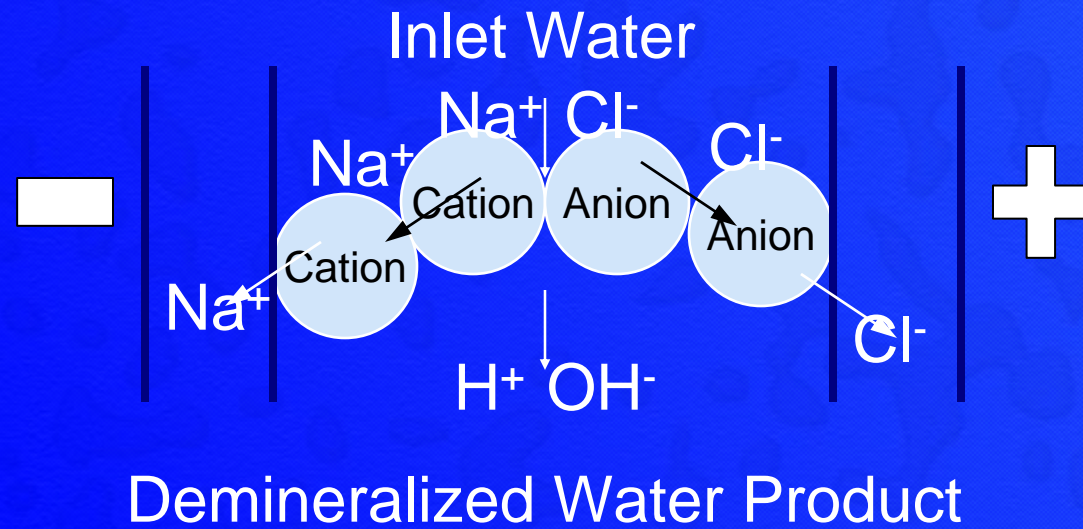
Water Purification



Demineralized Water Product

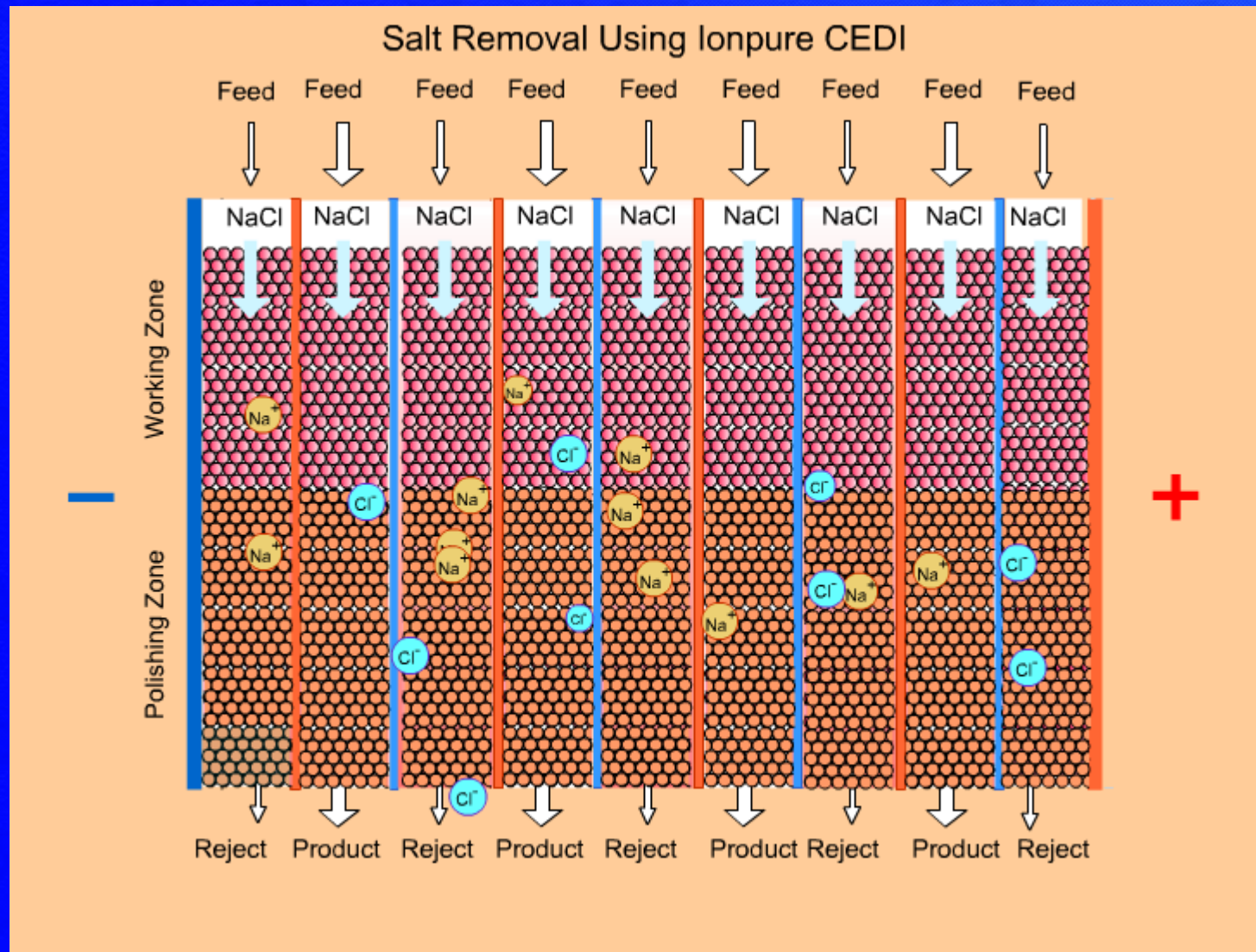
💧 **Same Ion Exchange Process as Mixed Beds**

Continuous Removal



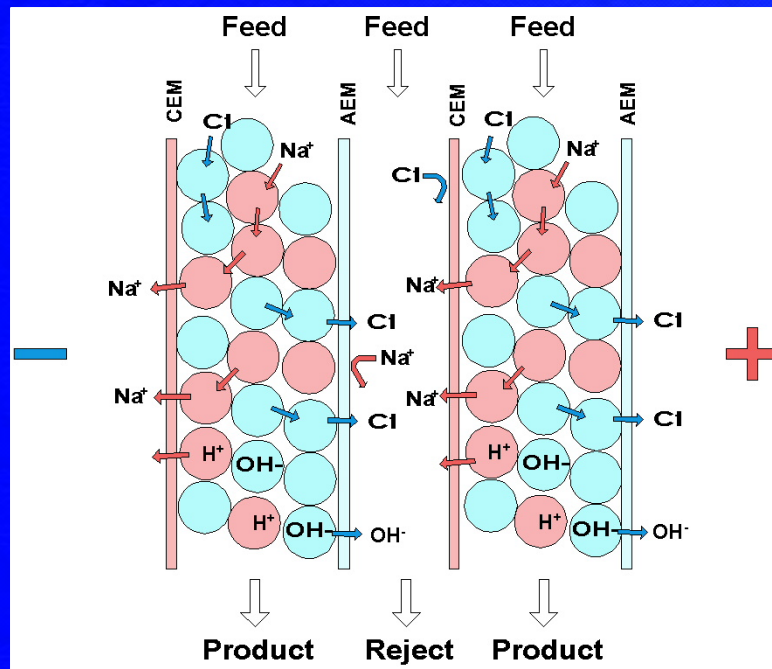
💧 **No Need to shut down for regeneration**

Ion Removal in An EDI Module

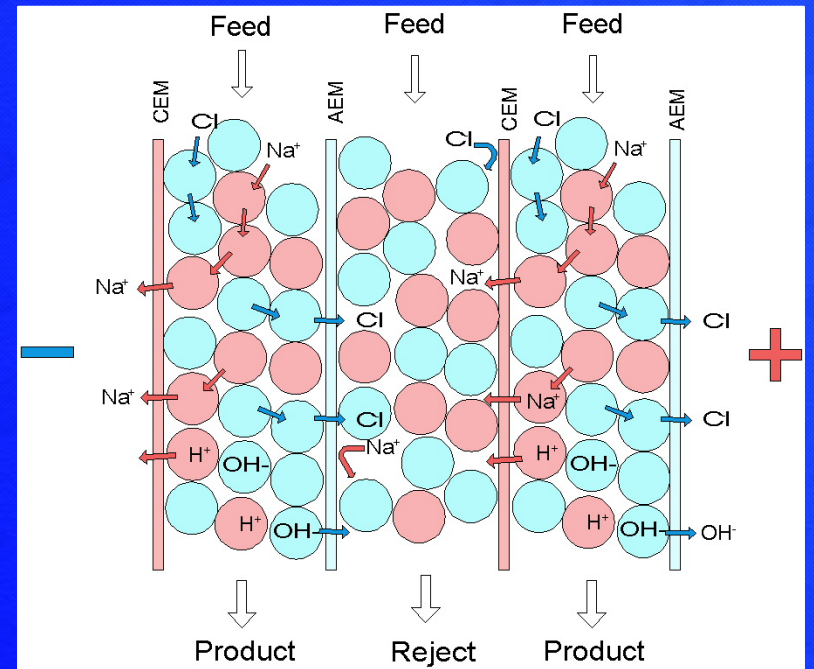


Dilute Filled vs. All Filled

Dilute Filled

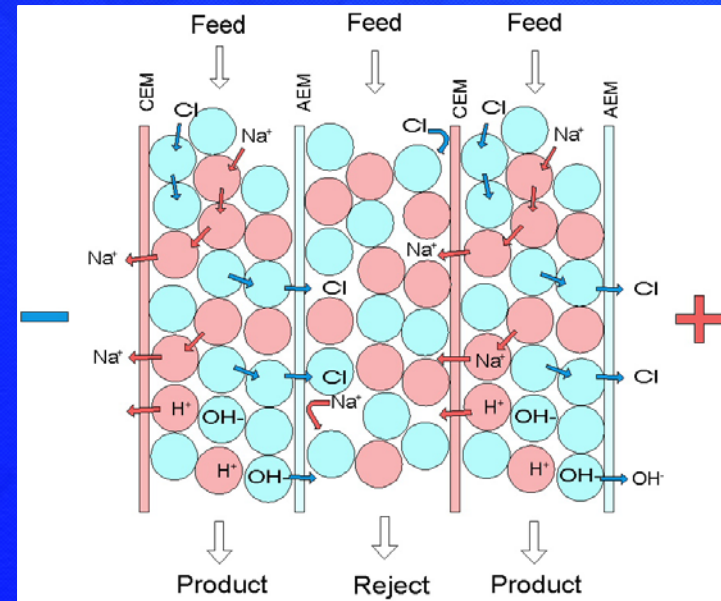


All Filled

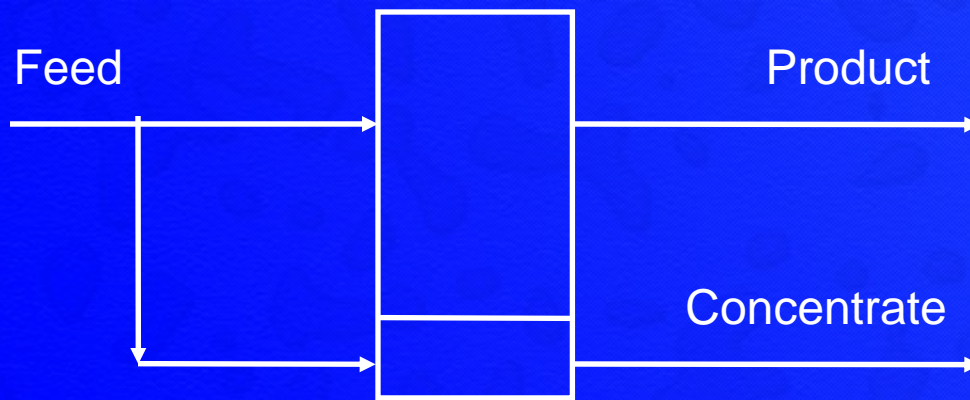


All Filled Design

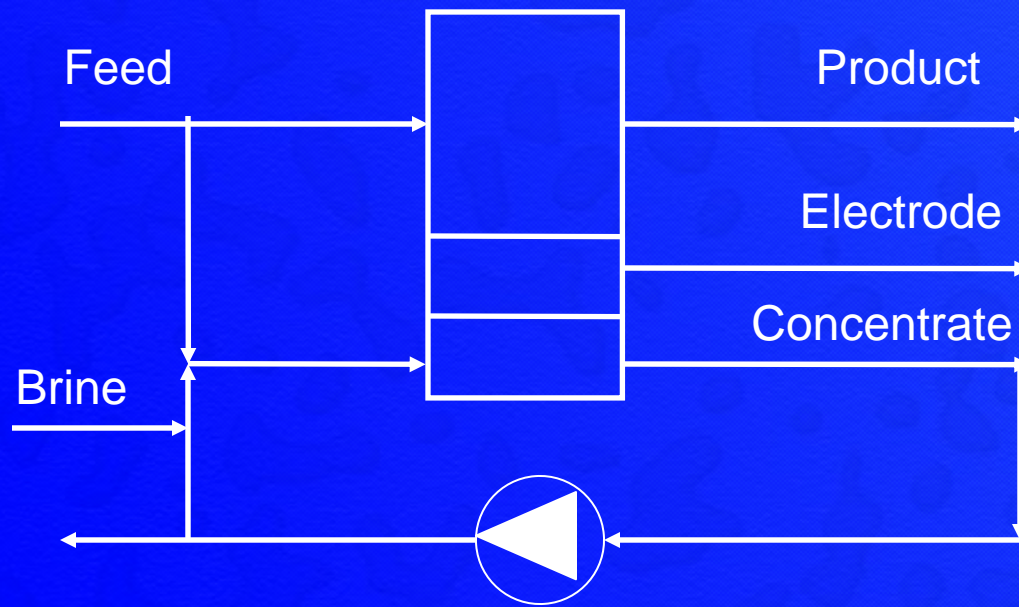
- Ion exchange resin in both the diluting and concentrating compartments
- Resin acts as a conductive bridge for both ions and current
- Result: Extremely low module electrical resistance and efficient use of power for ionic removal



Resin Filled Concentrate Flow



Mesh Filled Concentrate Flow



- Salt conducts electricity in concentrate stream
 - Concentrate Recirculation
 - Brine Injection

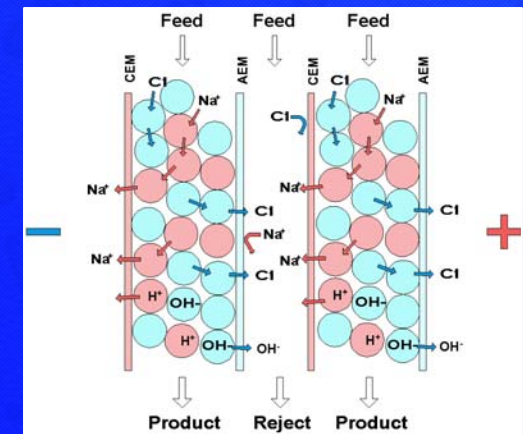
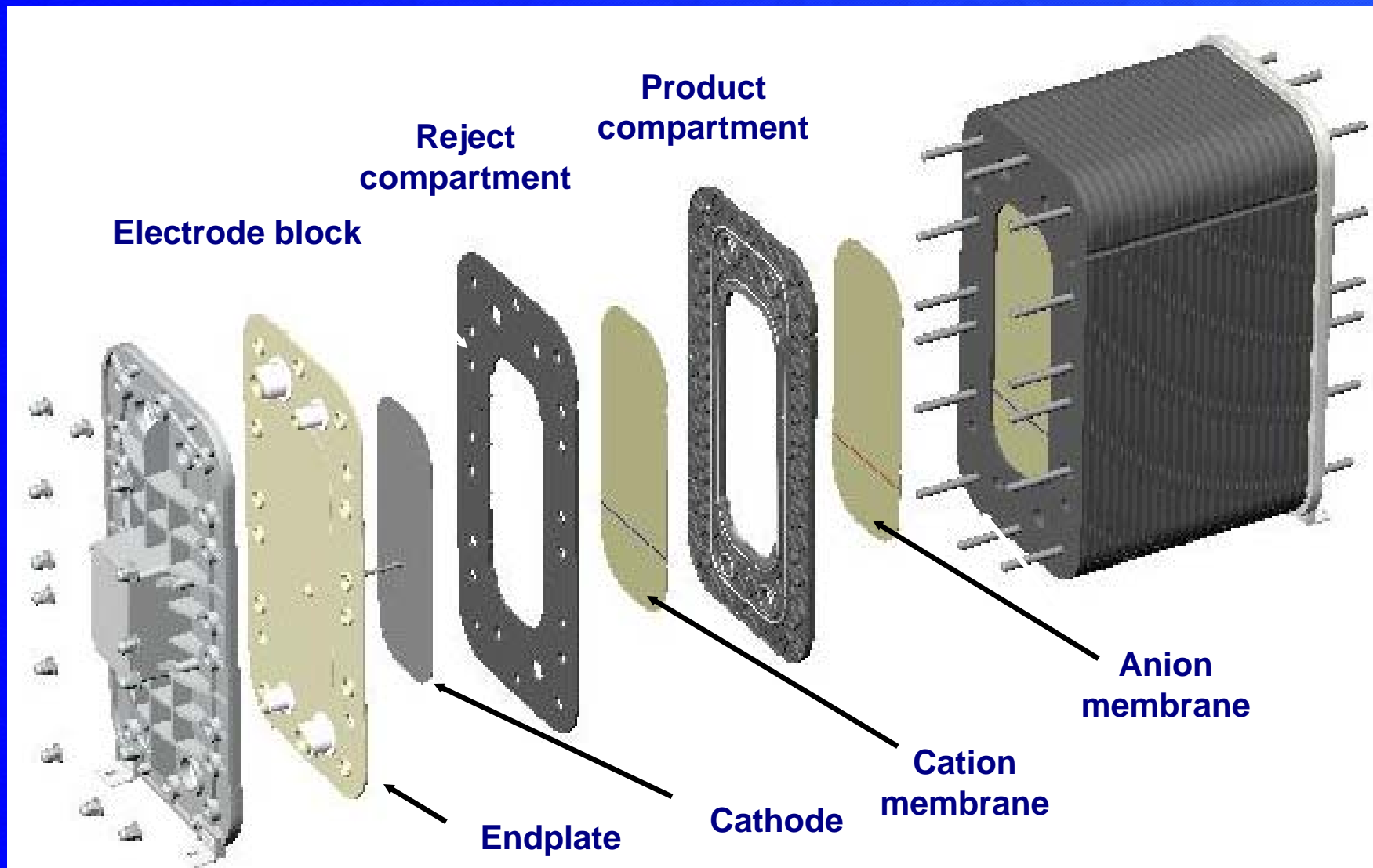
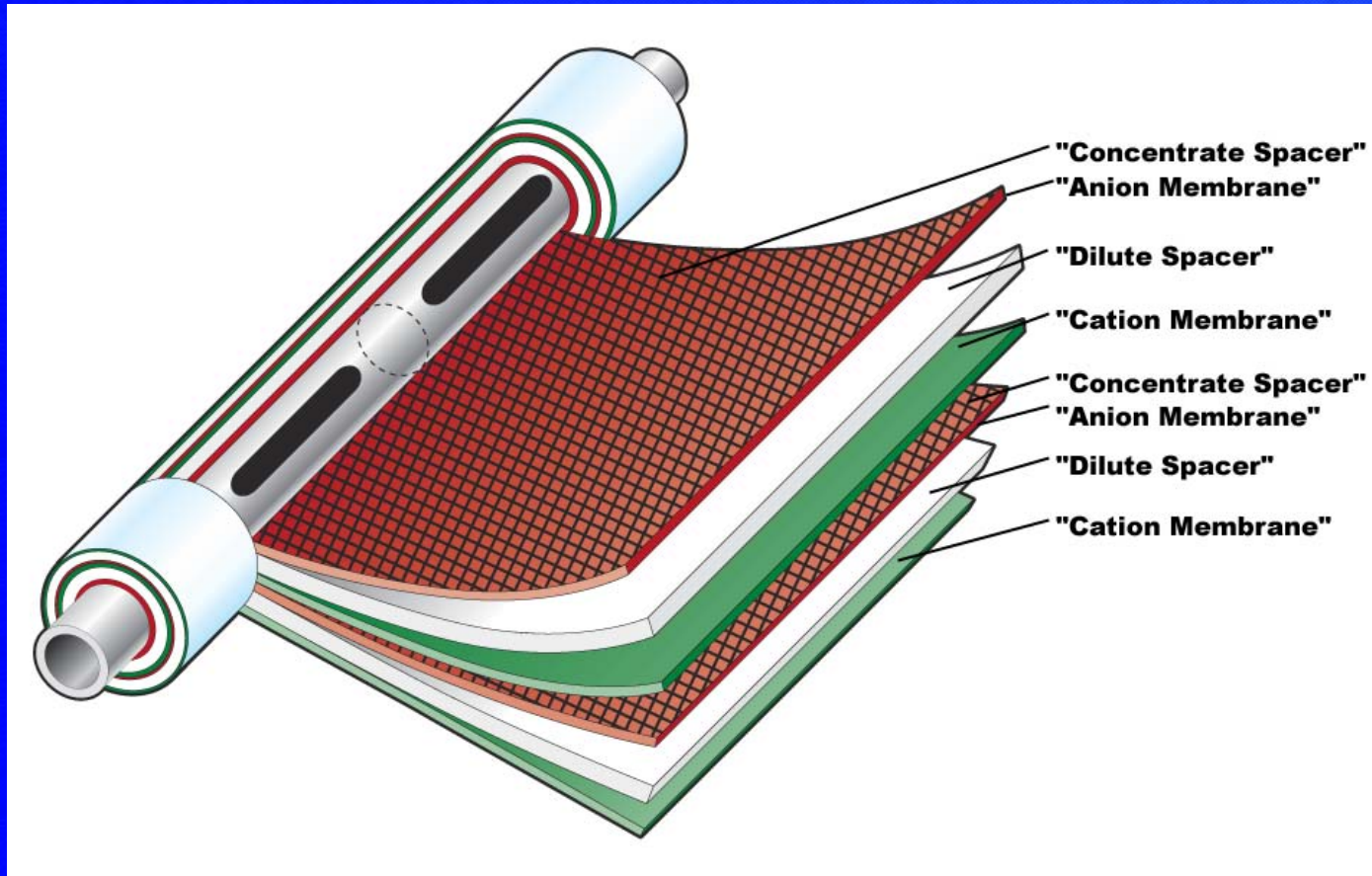


Plate and Frame Construction



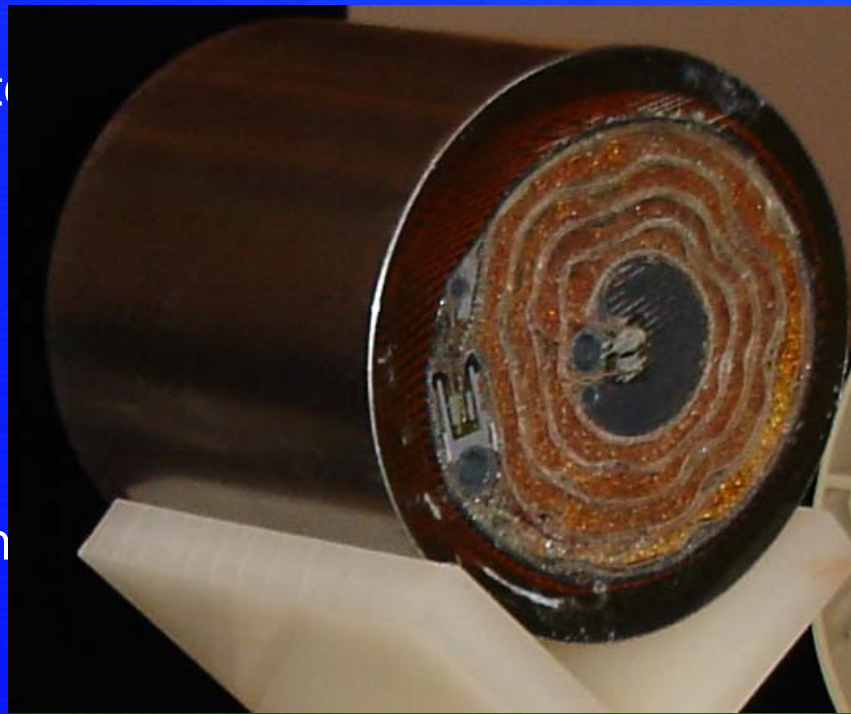
Source: Ionpure

Spiral Wound Construction

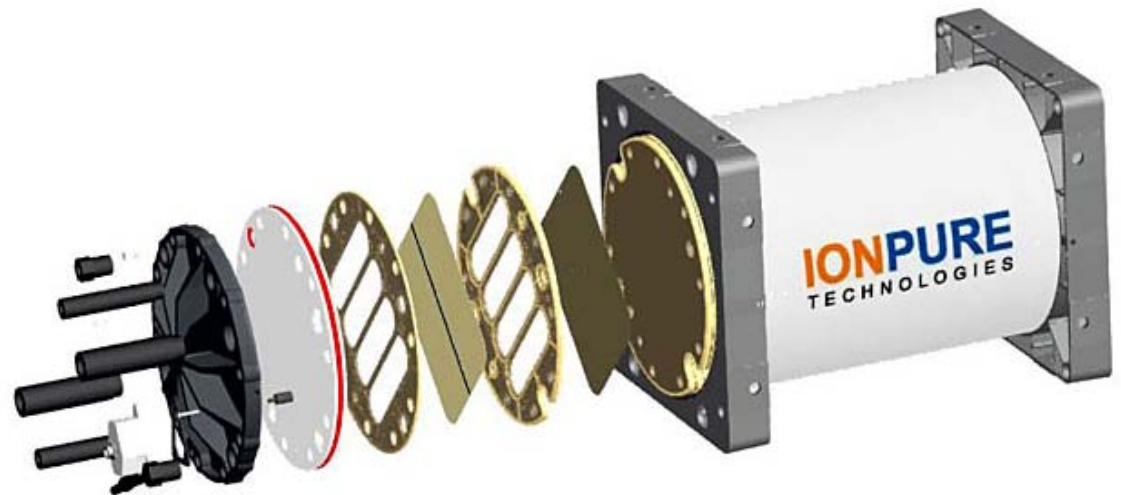
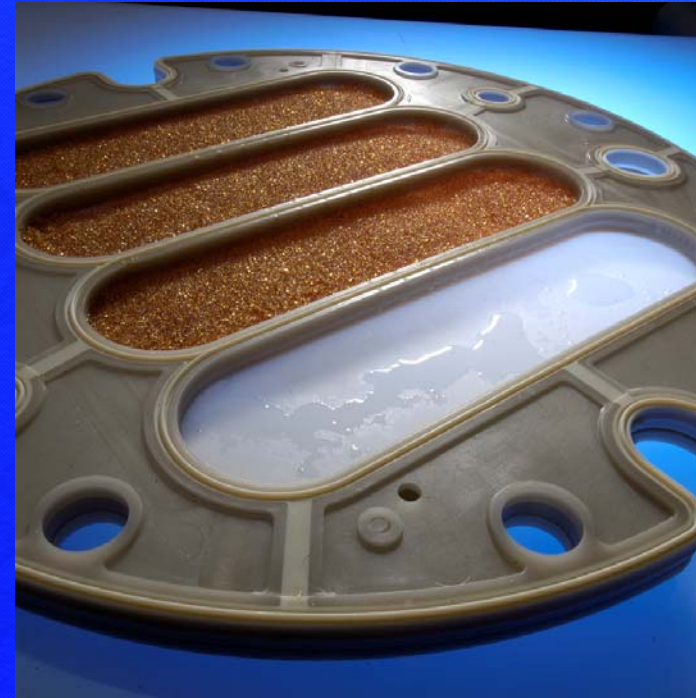
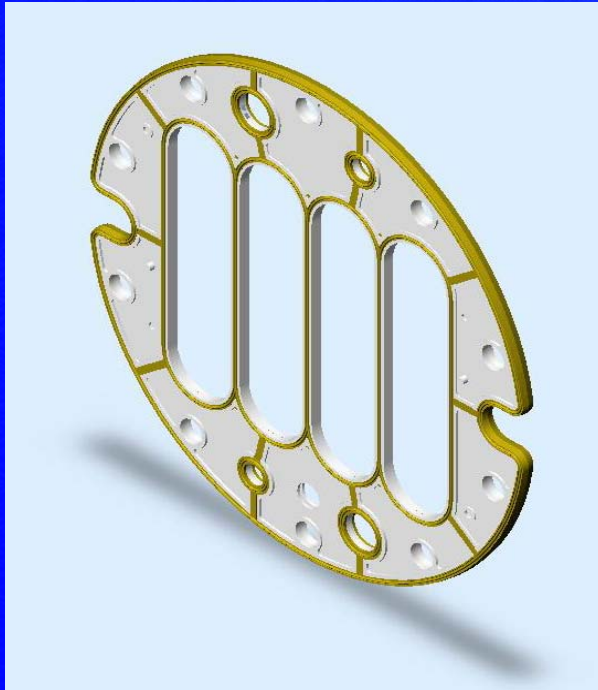


Spiral EDI Construction

- Uneven current density (amps/m² membrane area)
 - Higher current at center than at outside
- Uneven electrical resistance
 - Number of cells in current path varies
- Uneven flow distribution (gpm/m² membrane area)
 - Lower flow rate at center than at outside
 - Current & Flow Distributions are opposite



Round Disc Plate and Frame

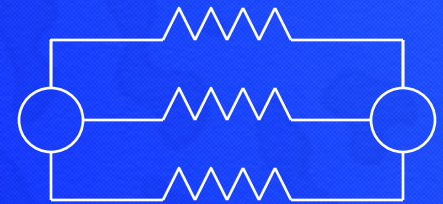


Thin Cell vs Thick Cell Designs

- Thin cell is older technology (2-3 mm)
 - Leaks
 - Not as robust due to thin spacer design
 - Extensive Bolt torquing required
 - “Dilute filled”
- Thick cell is newer technology (8-9 mm)
 - More robust construction
 - Allows more resin
 - Some have “Dilute filled” design
 - Only Ionpure has the “All filled” design

Electrical Power Supplies

- Electrical Current takes path of least resistance
- Standard rectifiers have only one current control for multiple modules
- EDI power control panels with individual power supplies allow current to be identical for each module

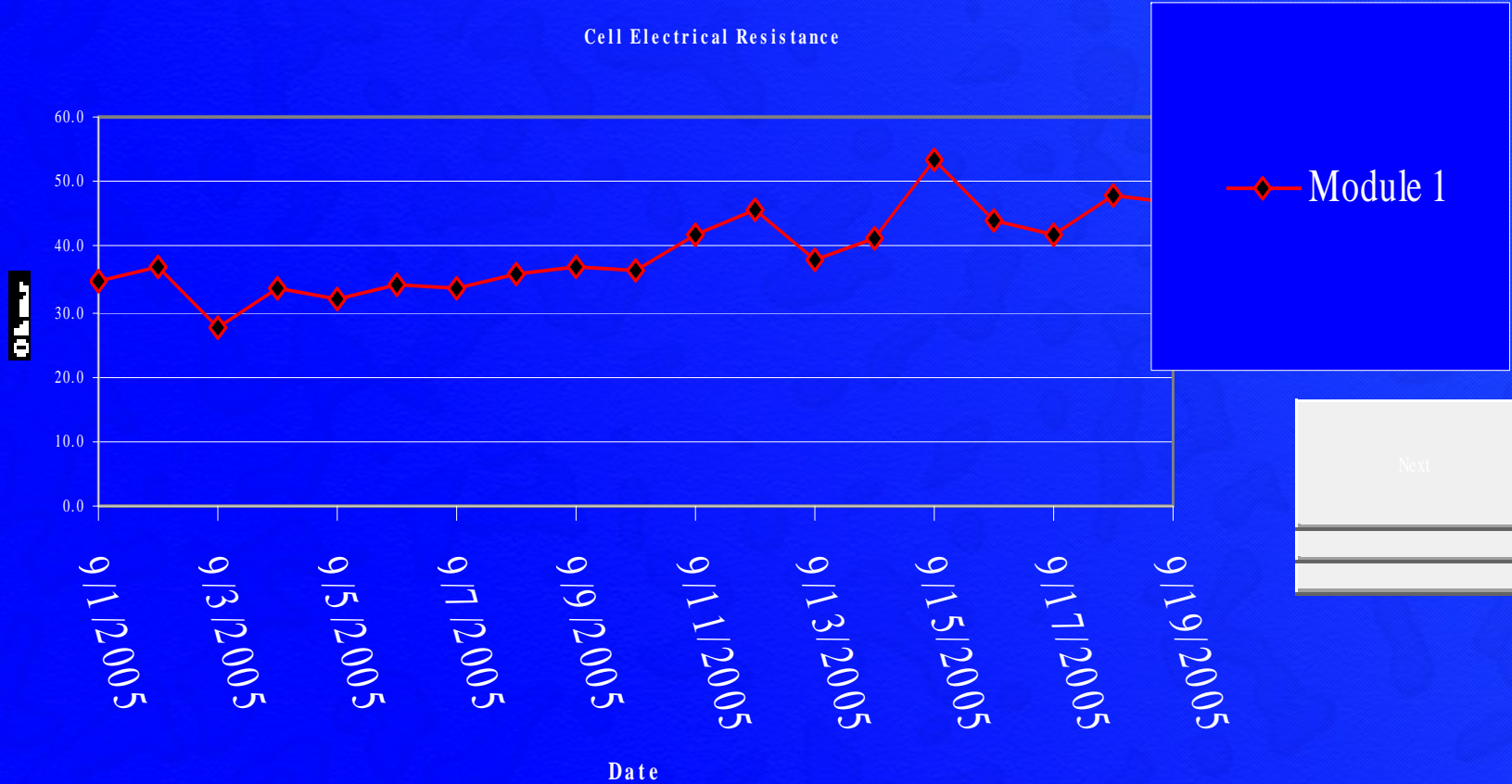


Optimal Design

- Feature: Performance
 - $< 40 \mu\text{S}/\text{cm}$ RO product water
 - 16-18 megohm-cm quality water guarantee.
 - Silica < 5 ppb guarantee
 - 1 ppm Hardness limit in feed
 - 1 ppm inlet Silica limit
 - Durability
 - 3 year warranty, 5-10 year module life
 - Consider number of previous installations

EDI System Maintenance

- Log Data & Adjust flows, pressure & current
- Trend Data: Calculate Electrical Resistance
- Identify Cleaning Requirements
- Clean as needed



Opportunities to sell EDI

- Customers with chemical regeneration
- Customers with off site service deionization
- New installations
- Laboratories
- Pharmaceutical manufacturers
- Power Plants
- Electronics
- General Industrial-
- anyone needed less than 1 uS/cm



Questions and Answers

Jeff Tate
Agape Water Solutions, Inc.
(215) 631-7035 x101
jtate@agapewater.com

Booth 106 at WQA Aquatech 2009