

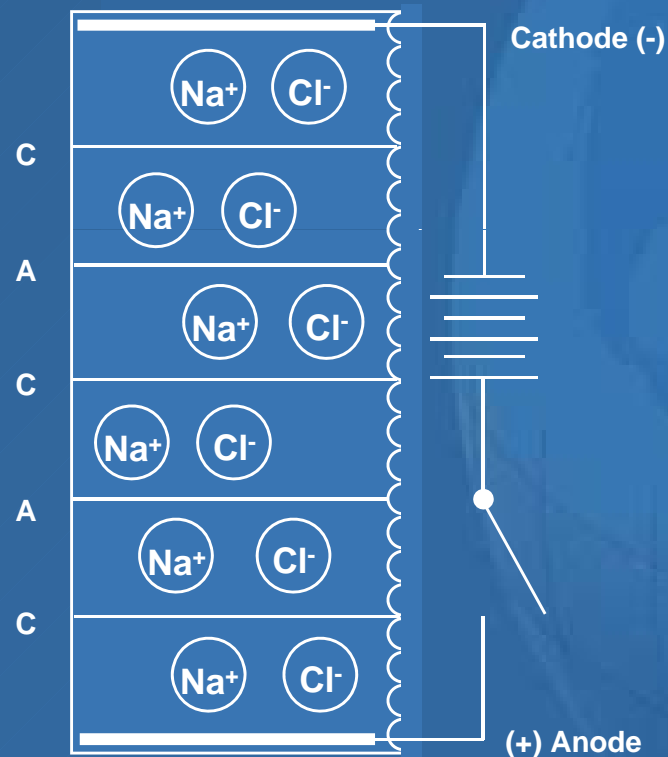
EDR (Electrodialysis Reversal)

What is Electrodialysis?

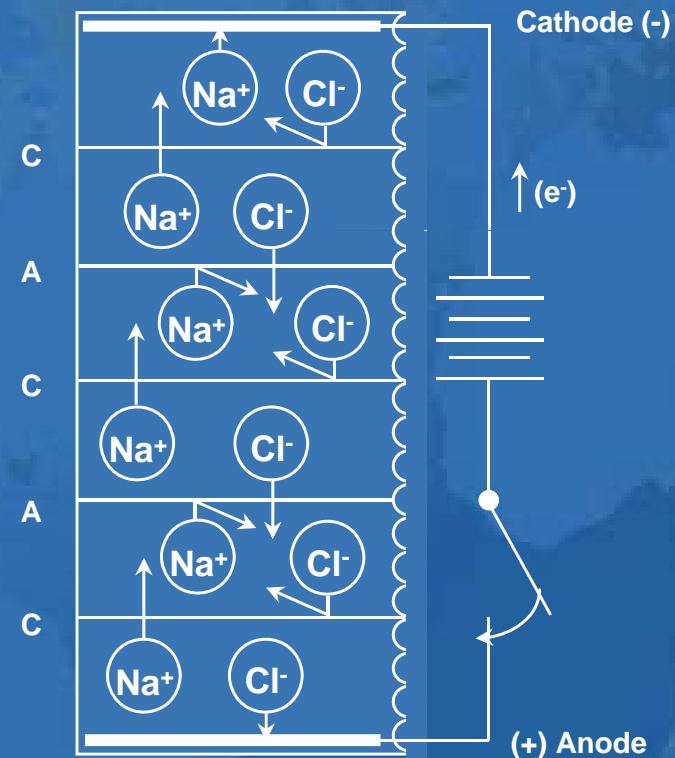
Electrodialysis is an electrochemical separation process in which ions are transferred through ion exchange membranes by means of a DC voltage

Electrodialysis:

N0 applied voltage

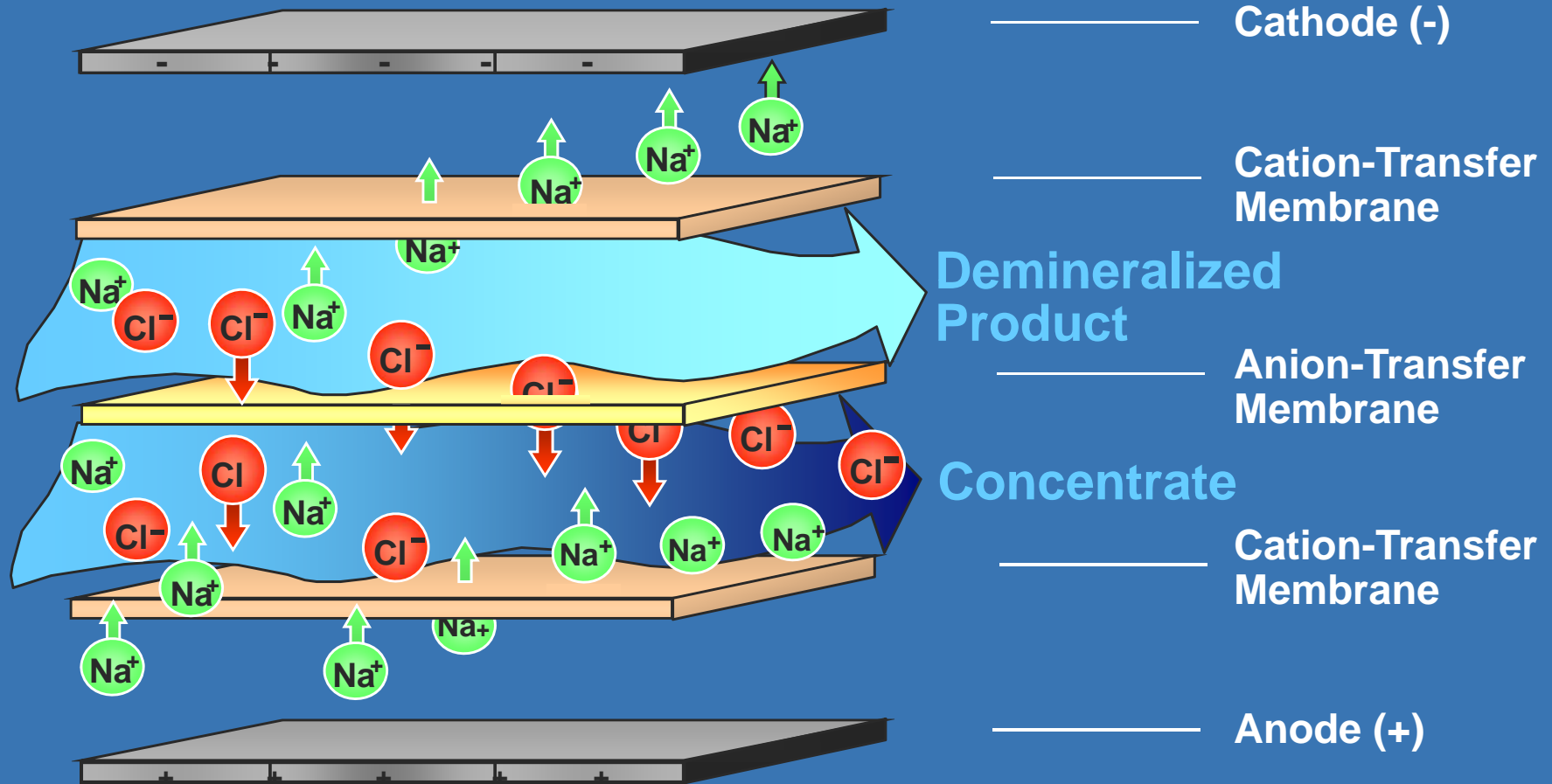


DC voltage applied



A = Anion membrane
C = Cation membrane

Electrodialysis



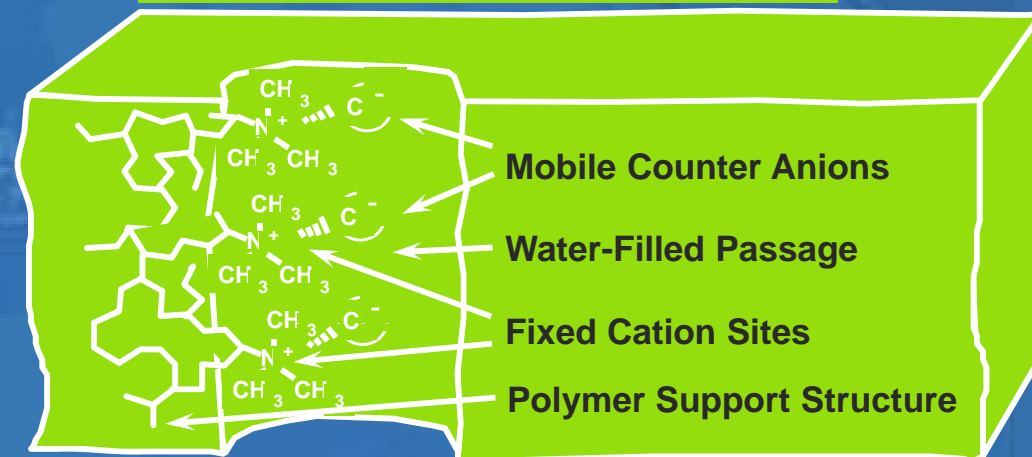
What is a Cell Pair?

- Basic building block of an ED membrane stack.
- Composed of
 - anion exchange membrane
 - concentrating spacer
 - cation exchange membrane
 - demineralizing spacer
- Several hundred cell pairs are assembled in horizontal layers between two electrodes to form a membrane stack

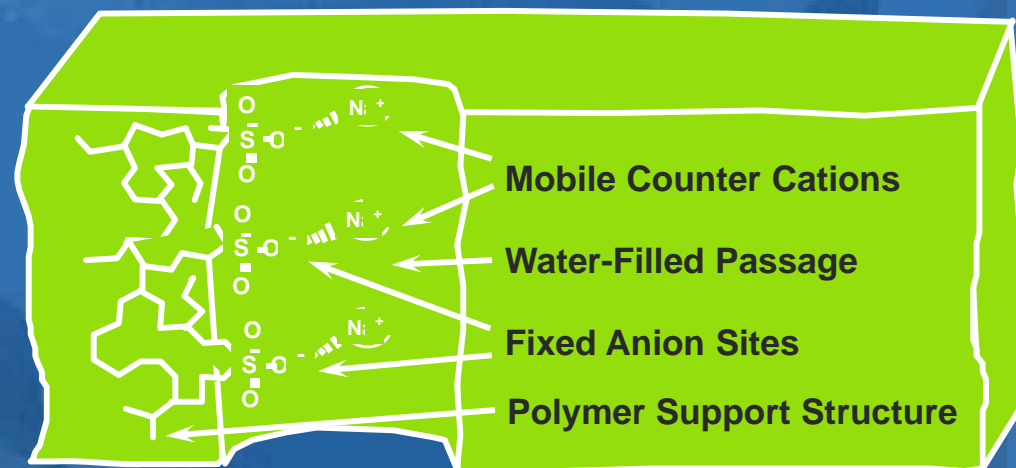
Tough Properties for Long Membrane Life

- Rugged membrane
- Resistant to organic fouling
- Chlorine stable
- pH 2 – 9, continuous
- pH 0 -10, cleaning

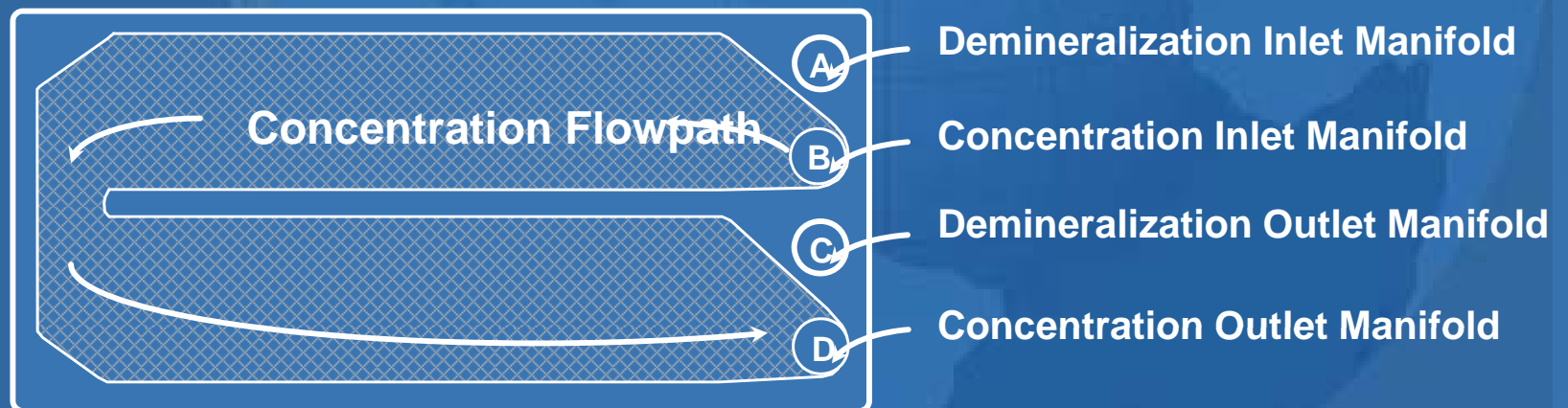
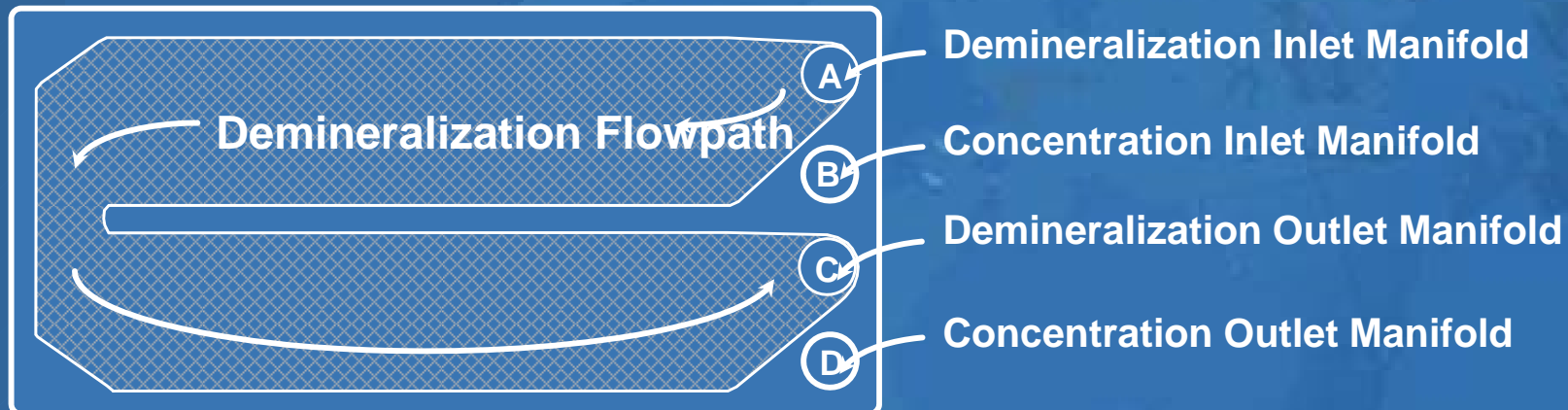
Anion-Exchange Membrane



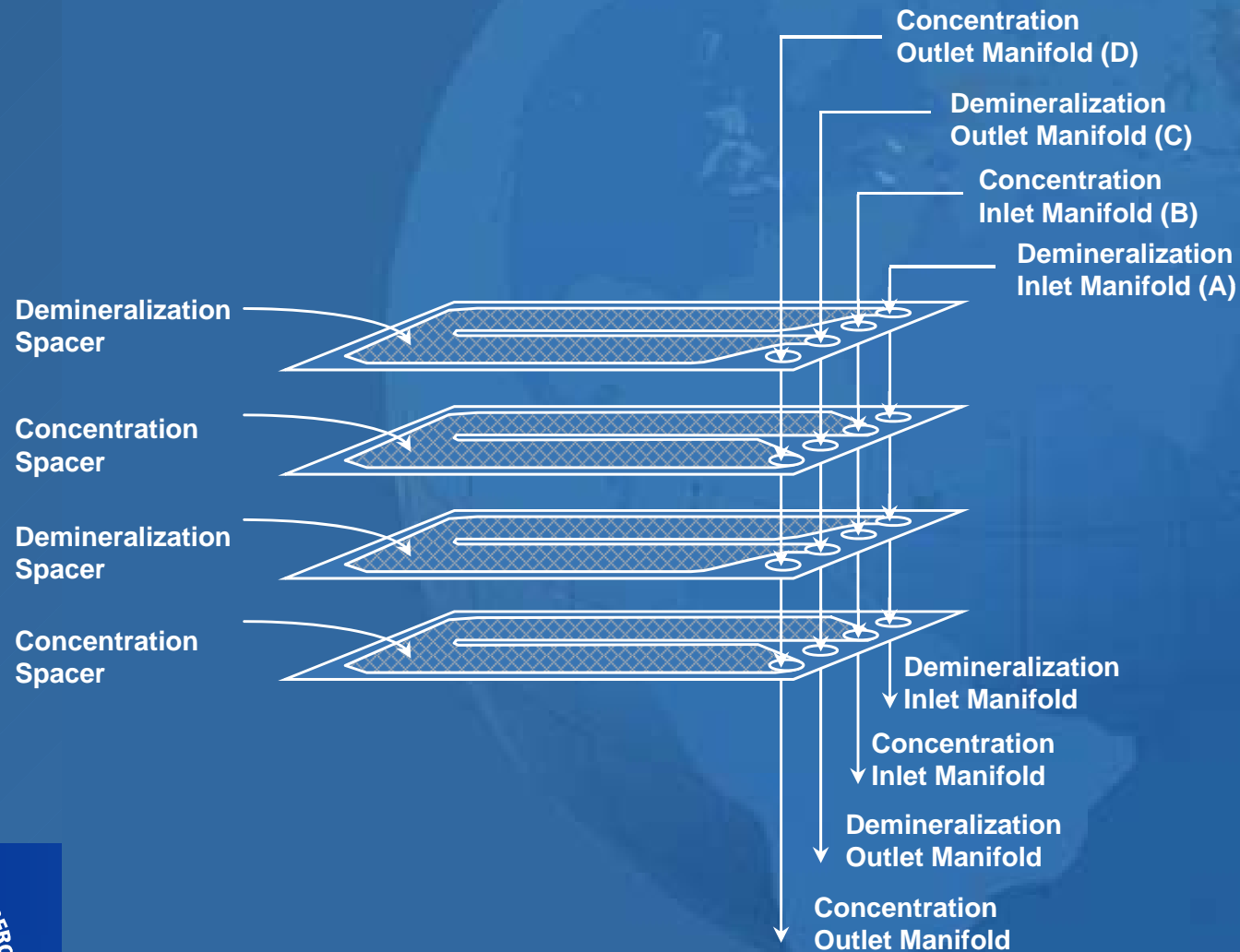
Cation-Exchange Membrane



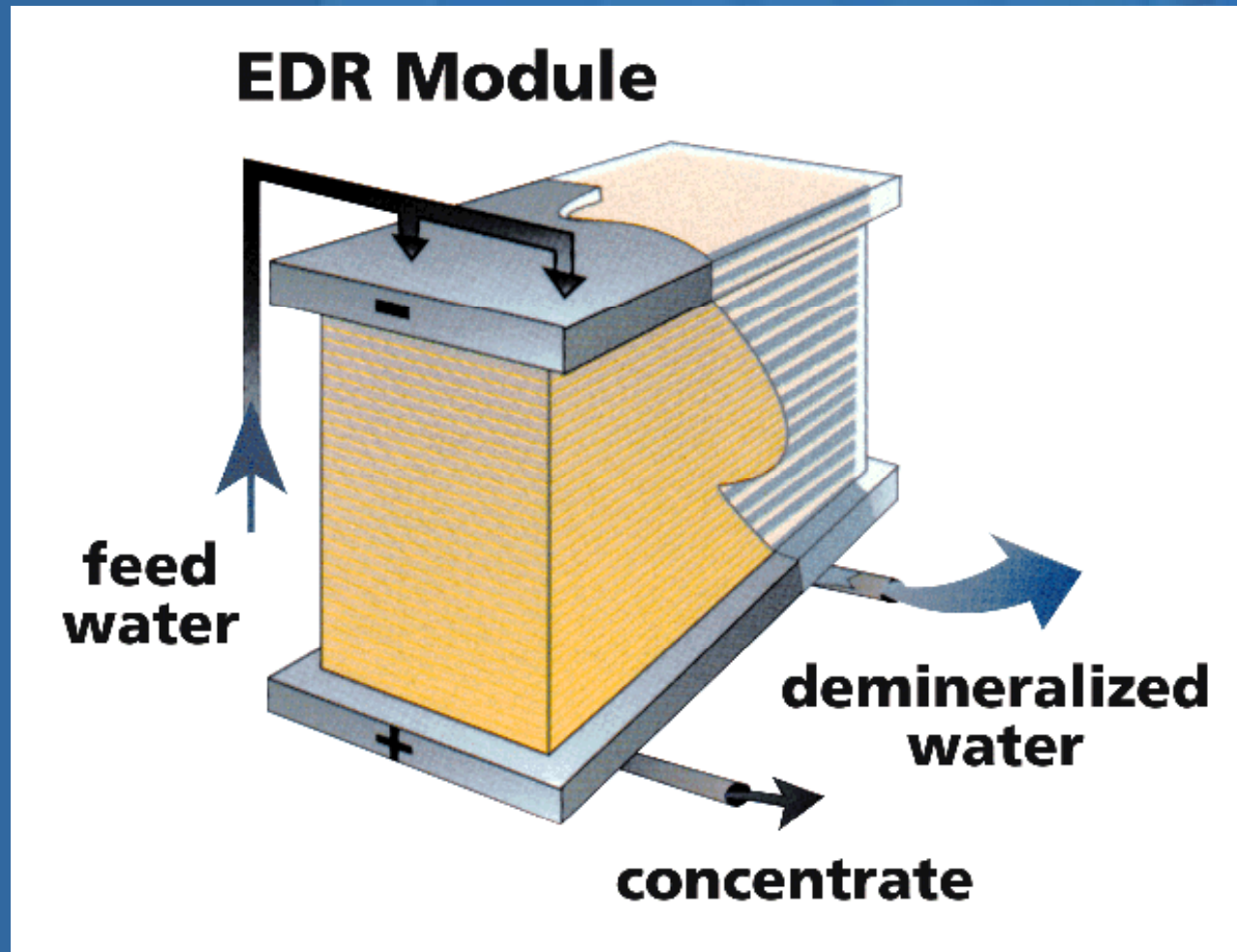
Flow Spacers



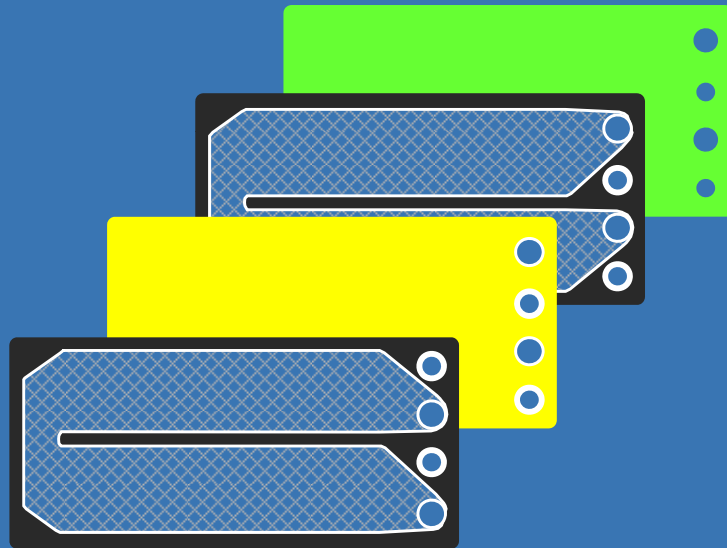
Spacer Configuration



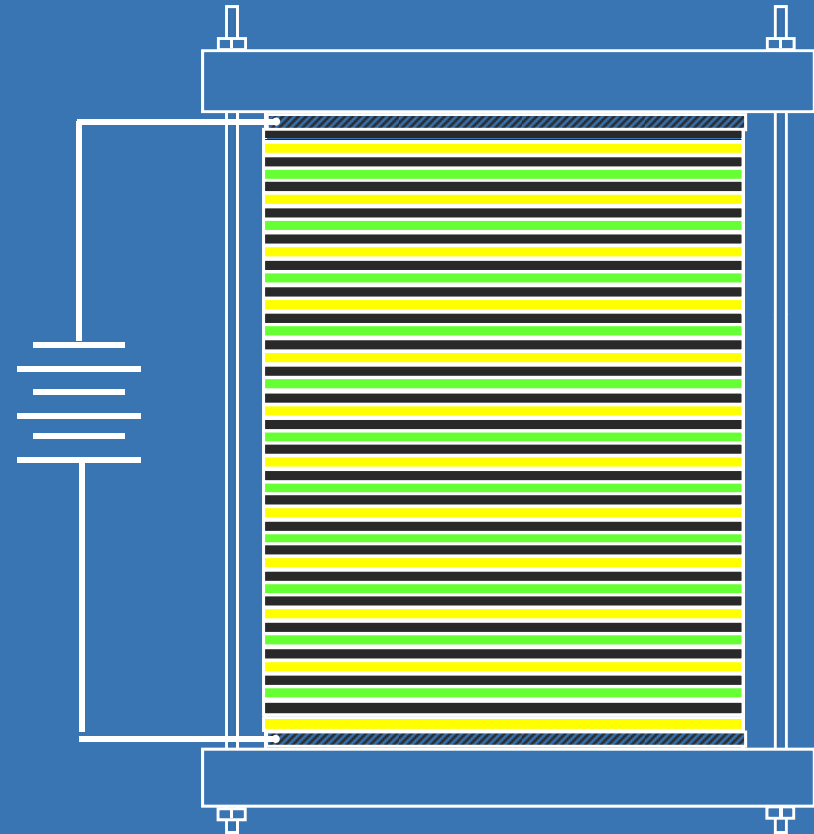
Multiple layers of membranes and flow spacers are configured into stack module



Membrane Stack Assembly

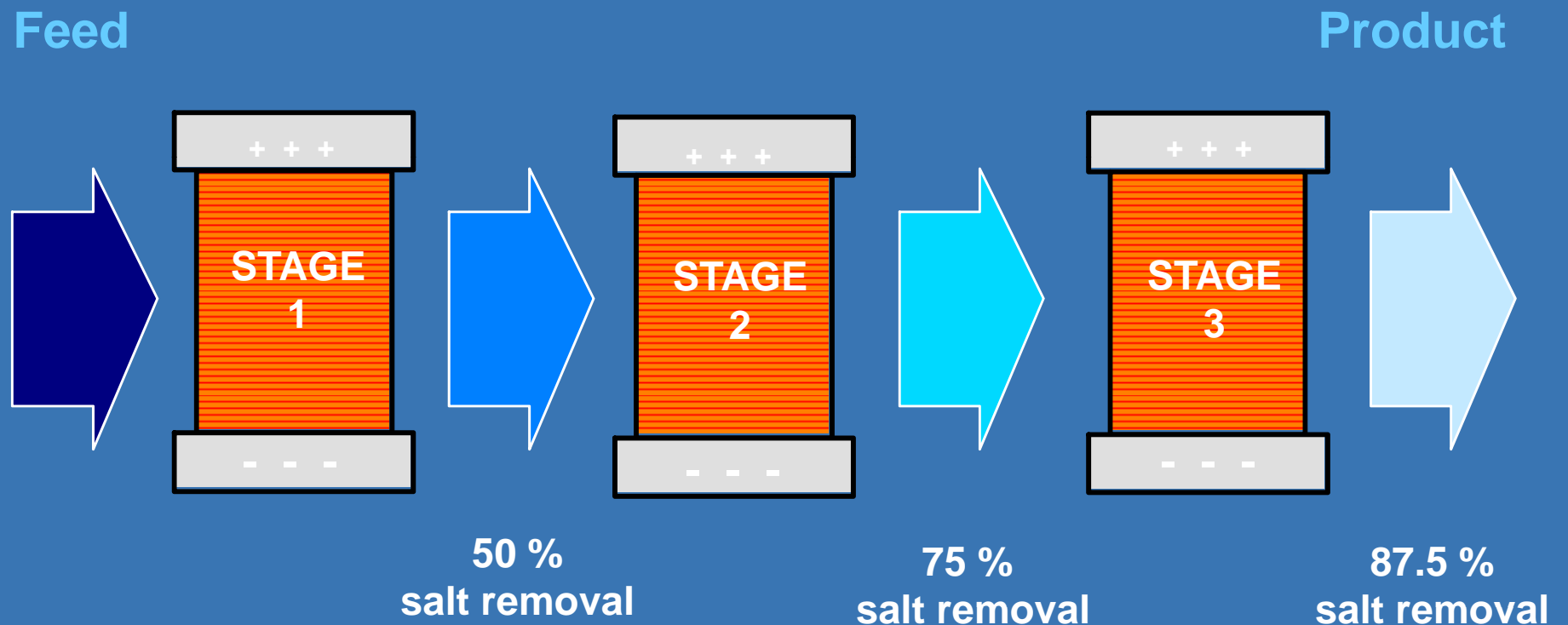


Basic Cell Pair



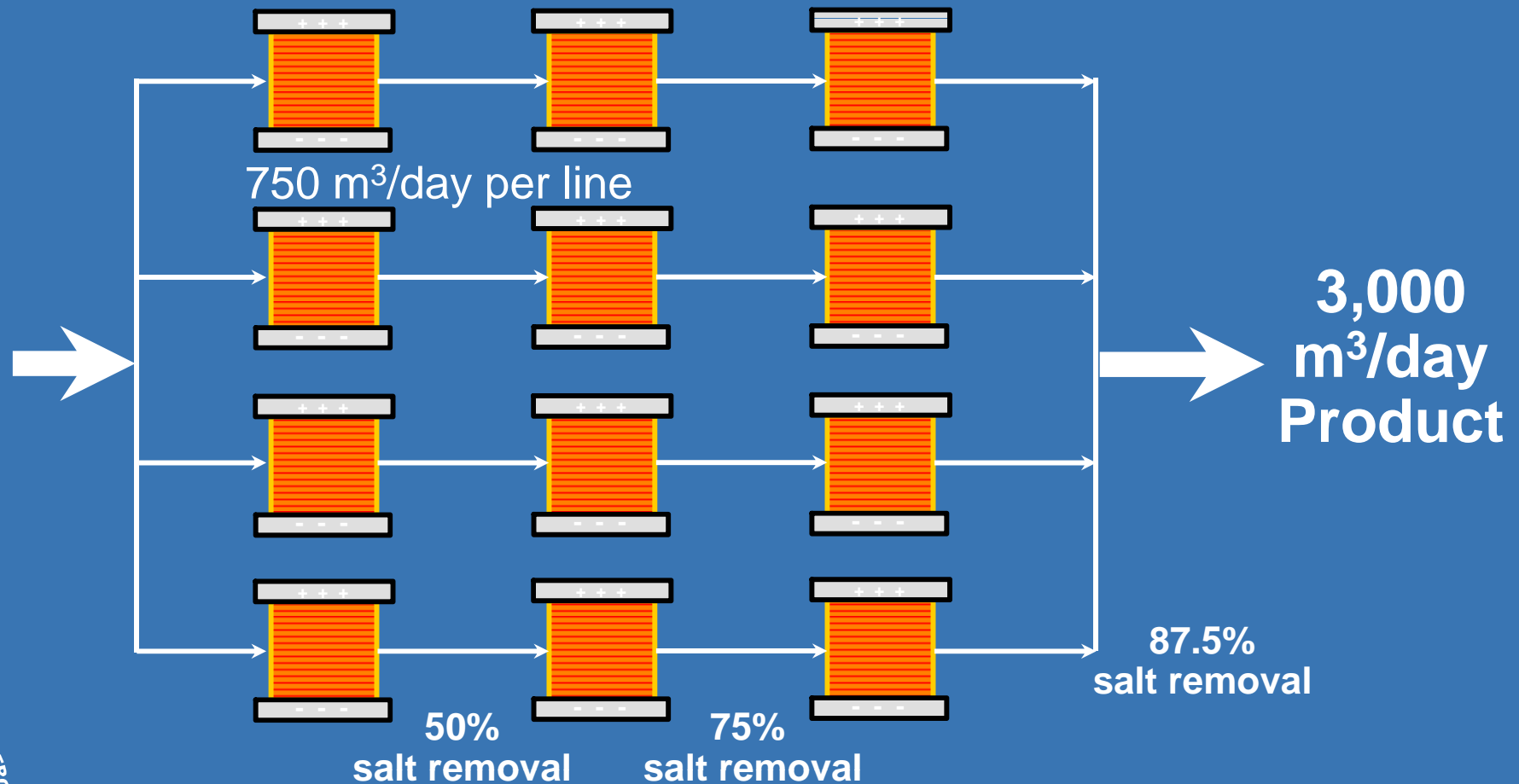
Membrane Stack

Optimal Salt Removal (50 – 95%)



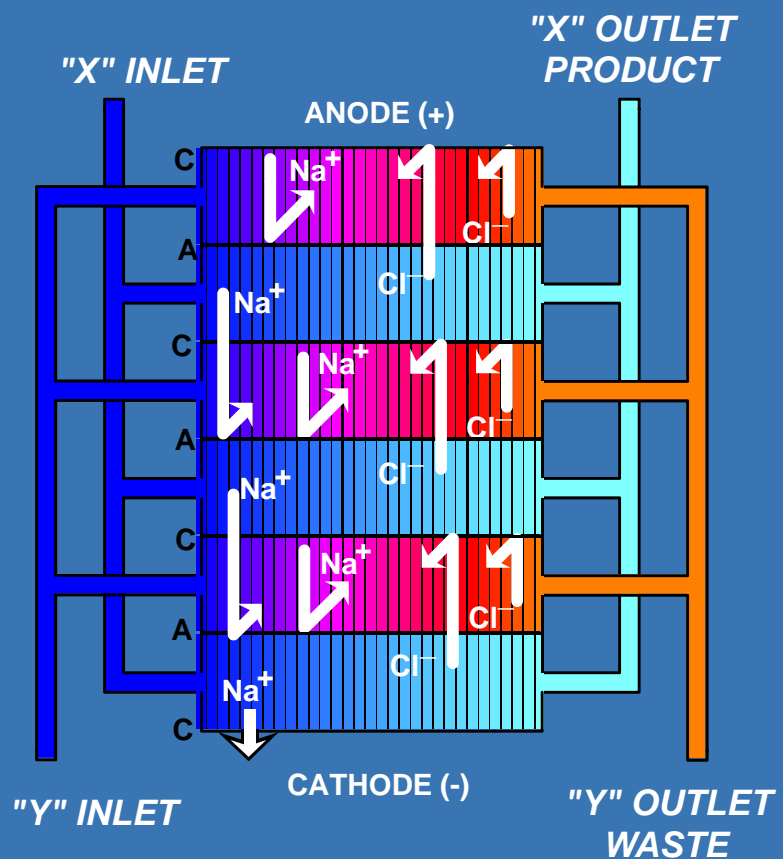
Customizable for Large Range of Capacities

Example: 4 Line, 3 Stage System

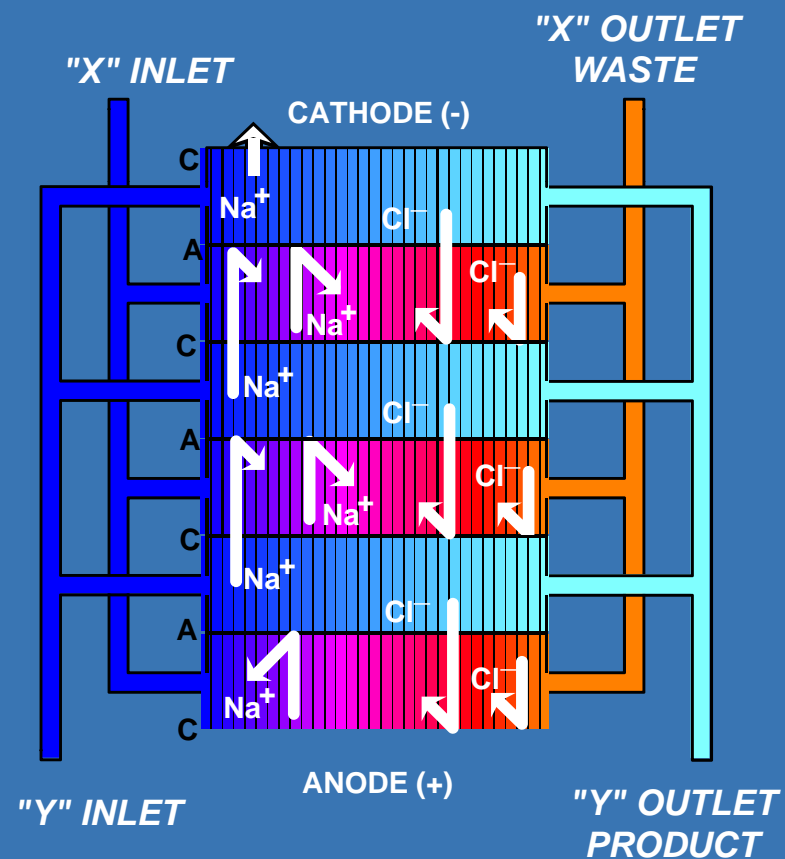


Polarity Reversal for Automatic Self-Cleaning

Low Chemical Usage



Negative Polarity

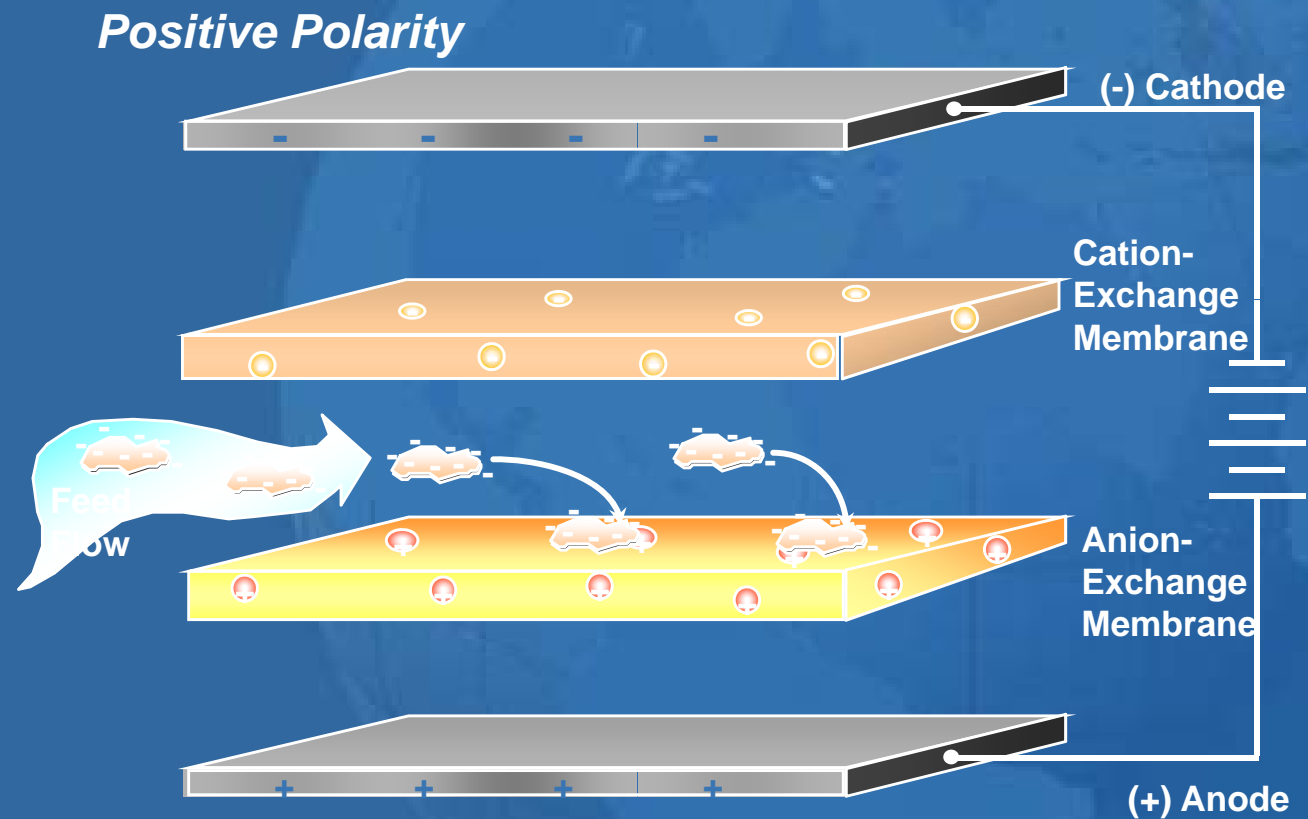


Positive Polarity

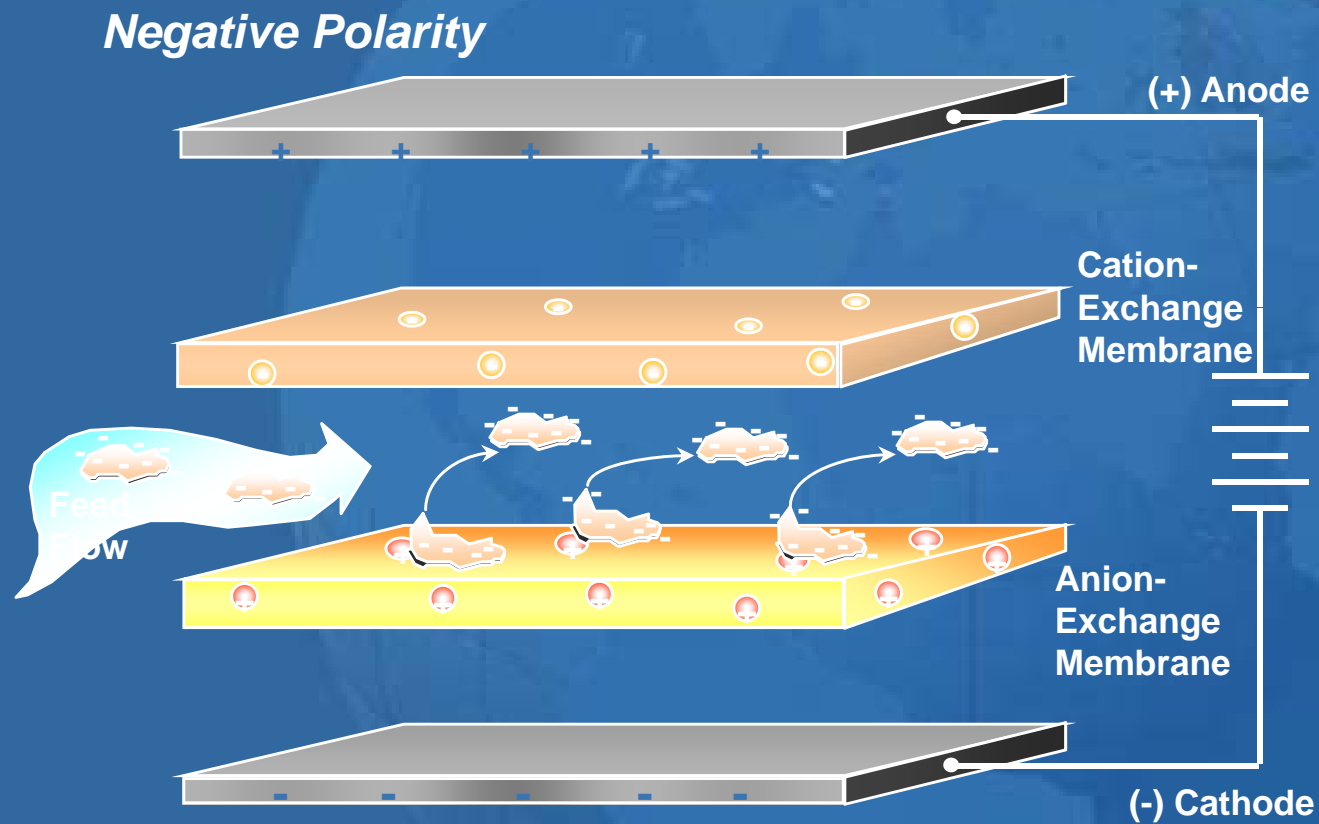
Polarity Reversal

- Breaks up polarization films 3 to 4 times per hour, preventing polarization scale
- Breaks up freshly precipitated scale or seeds of scale and flushes them to waste before they can grow or cause damage
- Reduces slime or similar formations on membrane surfaces
- Eliminates need for continuous chemical feeds
- Automatically cleans electrodes with acid formed during anodic operation

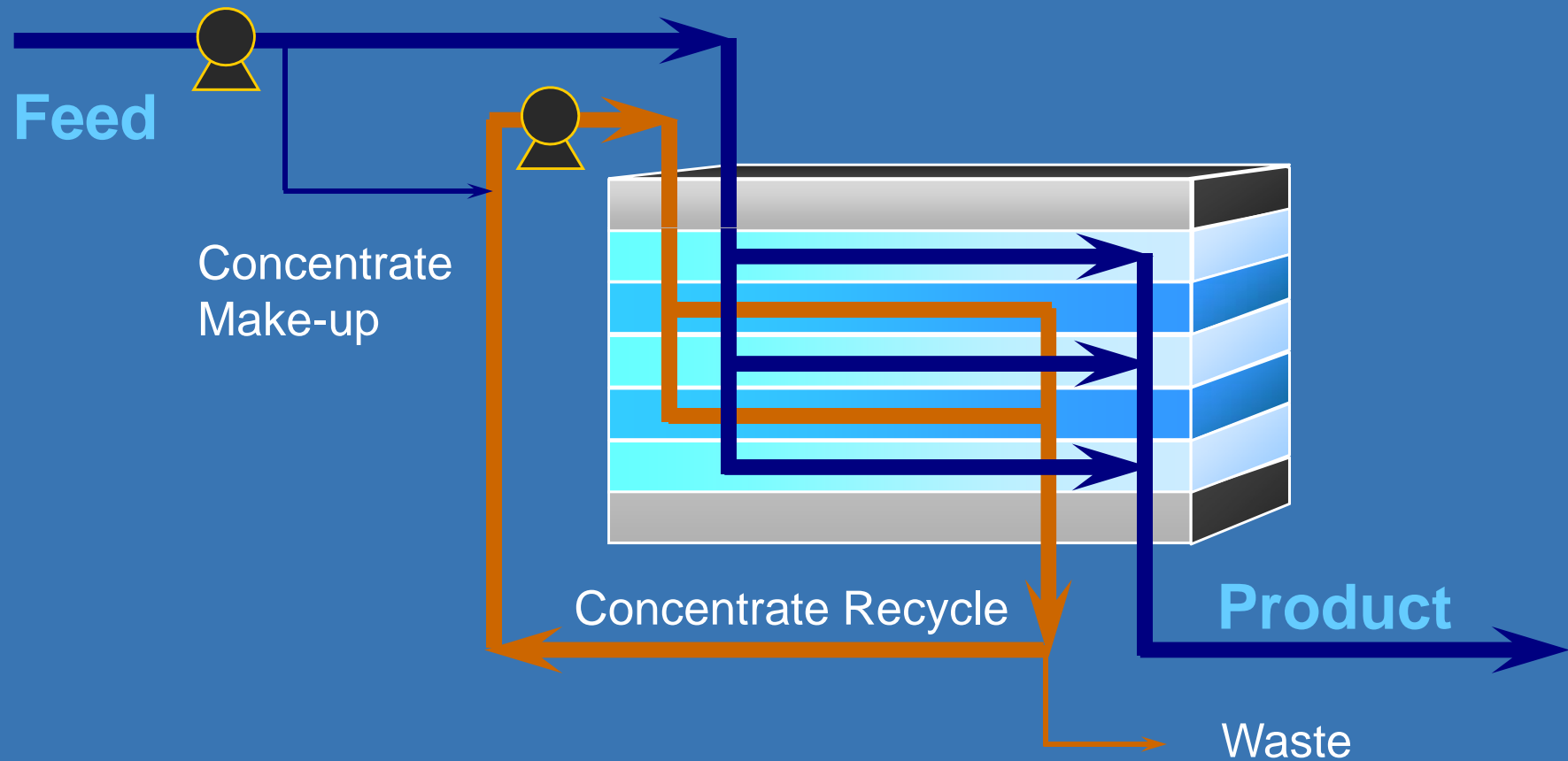
Colloidal Deposition



Colloidal Displacement



High Water Recovery (Up to 94 %)



Silica

- ED & EDR do not remove or concentrate silica
 - silica is not ionized below pH 9.5
- High silica levels in the feed
 - no impact on water recovery
- 5.3 mgd EDR plant in Gran Canaria
 - 85 % water recovery
 - 70 mg/l silica in the feed

Power Consumption

- Power is significant cost component of desalination plant
- RO has lower power consumption over 2,500 mg/l TDS
- EDR generally has lower power consumption at lower TDS values