Feed Water Treatment with CapDi for Breweries

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Feed Water Treatment with CapDi

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31-Jan-20

CONTENTS AND AIMS

- Main components of beer
  - Water!
- What's in your water?
- Water treatment review
- Membrane Capacitive Deionisation
- Case study
  - Wellington Brewery

Voltea

MAIN COMPONENTS OF BEER

- Grain
  - Source of sugar
- Hops
  - Flavour and preservative
- Yeast
  - Conversion of sugars to alcohol
- Water
  - Makes up >90 % of beer!
- Brewer!

WATER!

- 71 % of Earth's surface is covered with water!
  - 4 % fresh water
  - 0.3 % accessible fresh water
- 60 % of the human body is made up of water
- Made up of hydrogen and oxygen - H_2O
- Defies the rules
- Universal solvent
- You can use it to make BEER!

WHAT IN YOUR WATER?

- Total Suspended Solids (TSS)
  - Particulate
  - Organic matter
- Disinfectants
  - Chlorine/chloramine
- Total Dissolved Solids
  - Mineral content

WELLINGTON BREWERY – WATER ANALYSIS

Analysis					
		Analysis			Lab
	Accredited	By	Date Extracted	Date Analyzed	261-18
Date Sampled					15-Mar-18
Time Sampled					13:30
Sample Matrix					PW

Calculated Parameters

Ion Balance (%)	Yes	P	23-Mar-18	23-Mar-18	0.7

General Inorganics

Total Alkalinity (mg/L)	Yes	P	20-Mar-18	20-Mar-18	279
Hardness (as CaCO3 mg/L)	Yes	P	21-Mar-18	21-Mar-18	462
Specific Conductivity (µs/cm)	Yes	P	20-Mar-18	20-Mar-18	897
pH (pH Units)	Yes	P	20-Mar-18	20-Mar-18	7.6
Total Disolved Solids (mg/L)	Yes	P	26-Mar-18	27-Mar-18	588

Anions

Bromide (mg/L)	Yes	P	20-Mar-18	20-Mar-18	<0.1
Chloride (mg/L)	Yes	P	20-Mar-18	20-Mar-18	71
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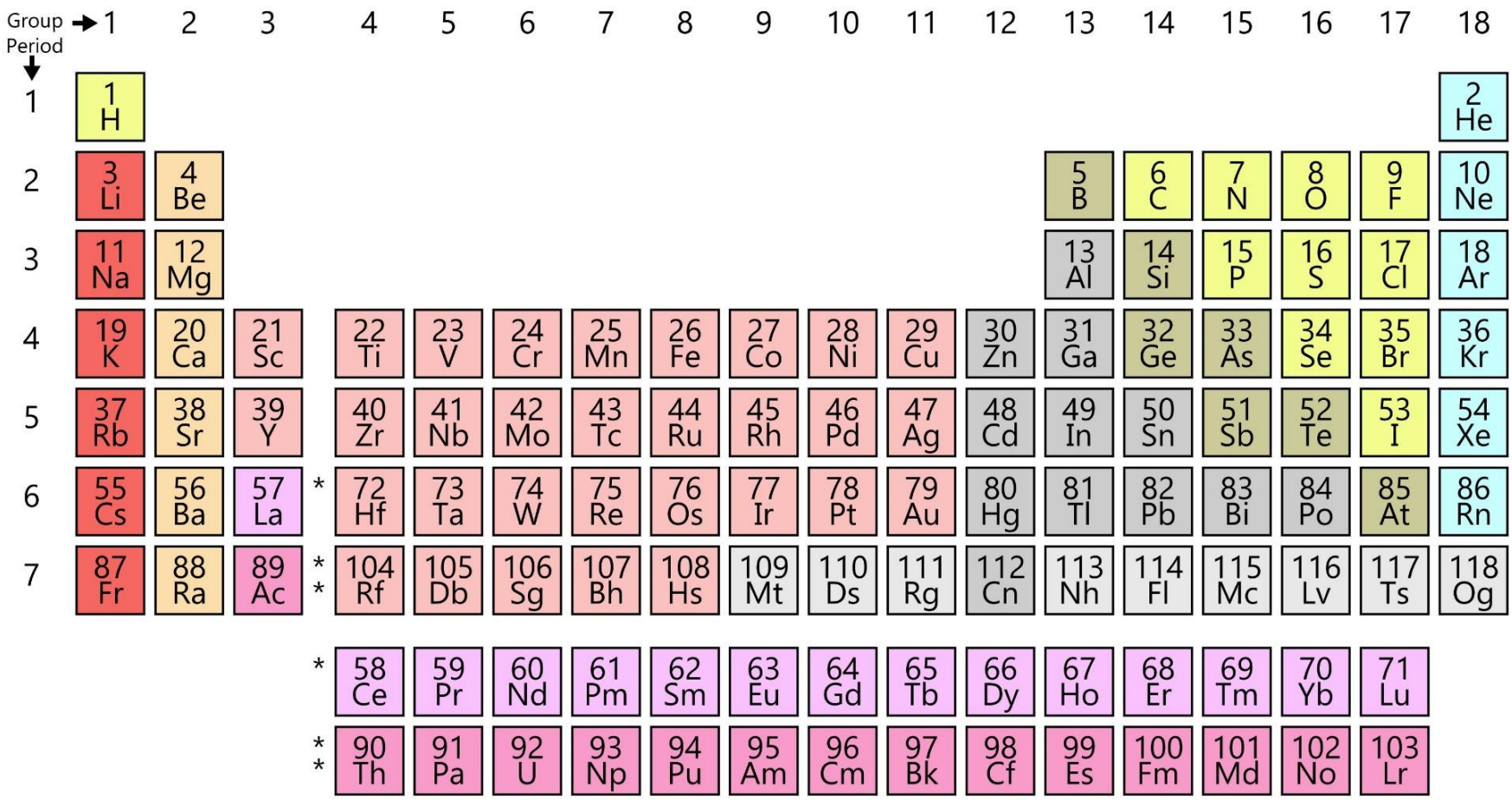
Nitrate (as N mg/L)	Yes	P	20-Mar-18	20-Mar-18	0.6
Nitrite (as N mg/L)	Yes	P	20-Mar-18	20-Mar-18	<0.05
Phosphate (as P mg/L)	Yes	P	20-Mar-18	20-Mar-18	<0.2
Sulphate (mg/L)	Yes	P	20-Mar-18	20-Mar-18	142

UNITED WE BREW.

IONIC/MINERAL CONTENT

- Hardness (Ca^{2+}, Mg^{2+})
  - Clarity, flavor, stability
- Sodium (Na^{+})
  - Benign in low levels, can taste minerally or metallic
- Trace minerals: iron, zinc, copper
  - Support yeast health
  - Subtly affects flavor
  - Gives your beer its own uniqueness!

PERIODIC TABLE



IONIC/MINERAL CONTENT

- Alkalinity (HCO_3^-, CO_3^{2-})
  - pH and the buffer capacity of the water
- Chloride (Cl^-)
  - Flavour - fullness and sweetness
- Sulfate (SO_4^{2-})
  - Flavour - hop bitterness; dryness and crispness

CONTROL YOUR WATER - THEORY

- Physically
  - Barrier
- Chemically
  - Liquid chemistry, gas
- Electrically

- Do nothing!

CONTROL YOUR WATER - METHODS

- Total Suspended Solids (TSS)
  - Particulate filtration
- Disinfectants
  - Activated/catalytic carbon
- Total Dissolved Solids (TDS)
  - Ion Exchange Softener (IX)
  - Reverse Osmosis (RO)
  - **Membrane Capacitive Deionisation (CapDi)**

ION EXCHANGE SOFTENER

- Exchanges hardness (Ca^{2+} and Mg^{2+}) with soft salts (Na^{+}, K^{+})

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- Advantages
  - Cheap
  - Robust
  - Conventional

ION EXCHANGE SOFTENER

- Exchanges hardness (Ca^{2+} and Mg^{2+}) with soft salts (Na^{+}, K^{+})

Disadvantages

- Creates poor brewing water
  - No calcium/magnesium
  - High sodium/potassium
- Brine discharge

REVERSE OSMOSIS (RO)

- Uses high pressure and membranes to remove >99 % dissolved content from water

REVERSE OSMOSIS (RO)

- Advantages
  - Provides known ‘zero’ base from which to build a known water quality with salt addition/blending
  - Will remove solids, organics, viruses and bacteria
  - Competitive capital cost
  - Conventional

REVERSE OSMOSIS (RO)

- Disadvantages
  - Creates a generic water
  - Blending/salt addition adds additional work
  - High operational and maintenance cost
  - High water wastage (typically 40-70 % reject)
  - High pretreatment requirements

MEMBRANE CAPACITIVE DEIONISATION (CAPDI)

- Uses electricity to tunably reduce the mineral content from water

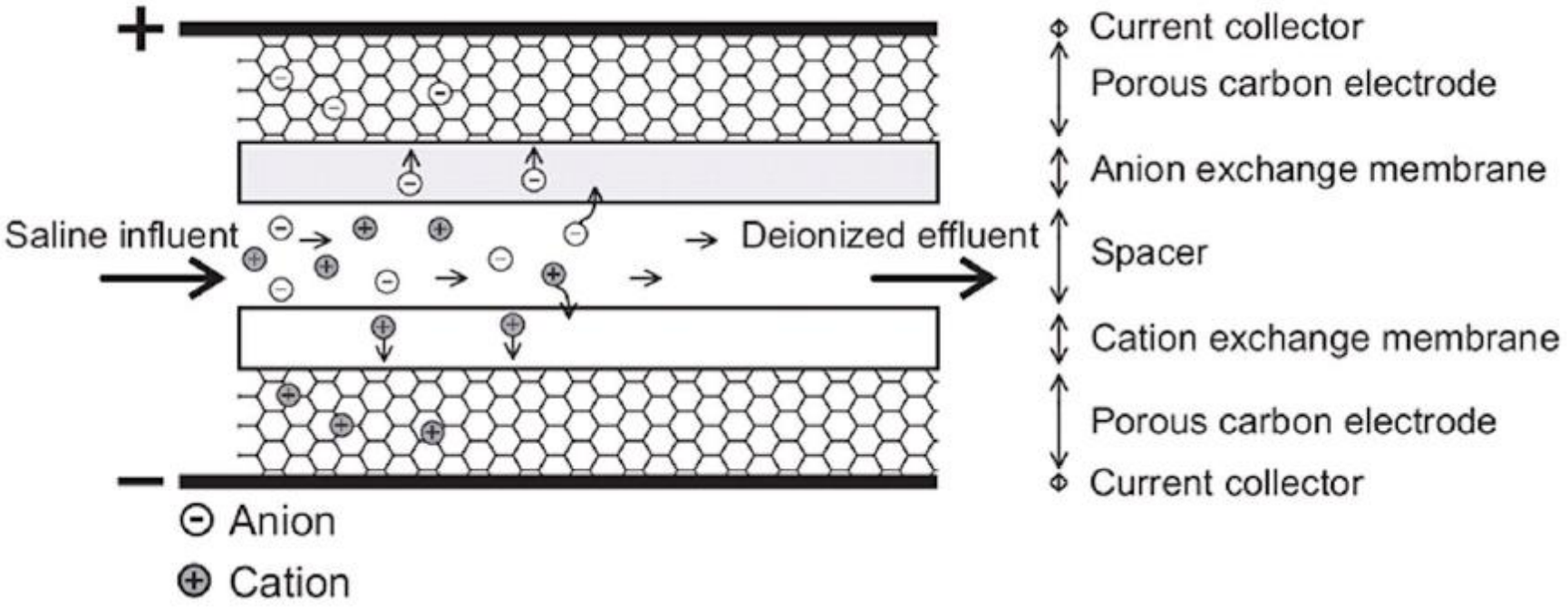
MEMBRANE CAPACITIVE DEIONISATION (CAPDI)

- Advantages
  - Ability to target require TDS level
  - Consistent, constant water quality
  - Low operational and maintenance requirements
  - High water recovery
  - Simplified pretreatment
  - High degree of automation, feedback and monitoring

MEMBRANE CAPACITIVE DEIONISATION (CAPDI)

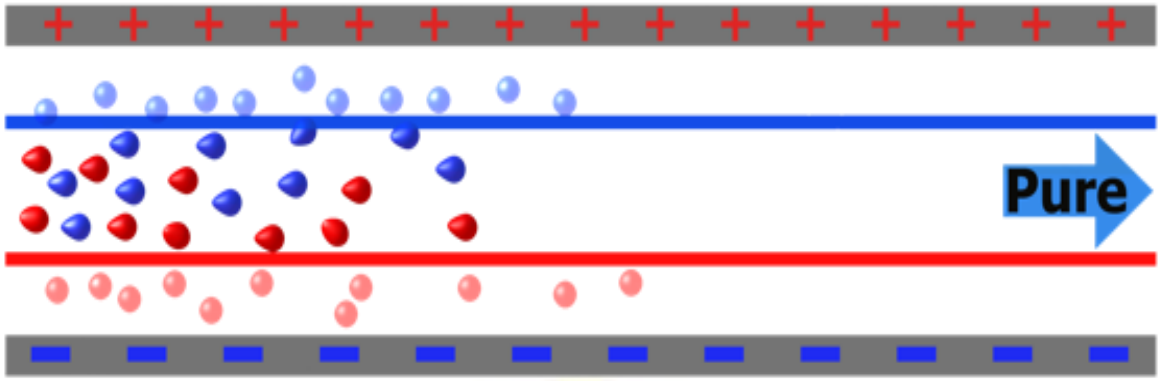
- Disadvantages
  - Potentially higher capital cost
  - New technology, sole source
  - Does not remove solids, organics, viruses and bacteria

WHAT IS CAPDI?



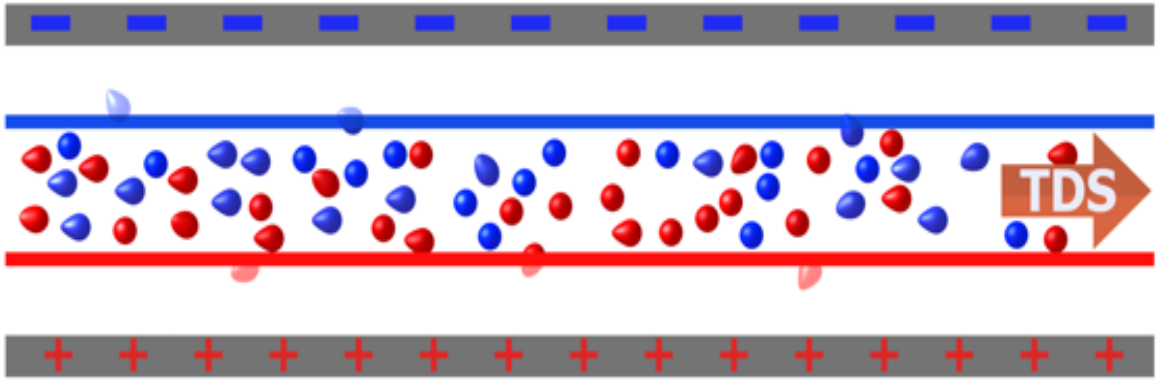
HOW DOES IT WORK?

- Purification
  - Feed water passes between oppositely charged electrodes which remove and store dissolved ions, leaving low TDS water



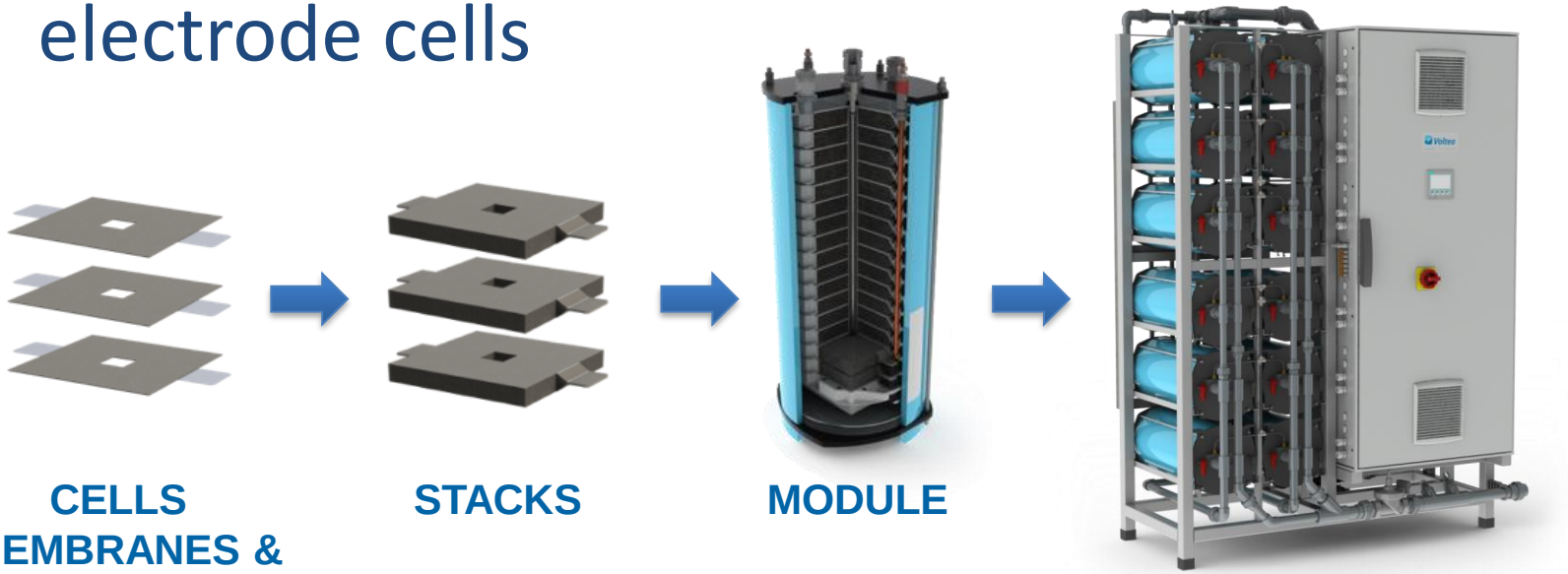
HOW DOES IT WORK?

- Regeneration
  - Reversal of electrode polarity rejects stored ions regenerating the system
  - Ions are flushed from the system with a low flow



FROM CELLS TO SYSTEMS

- Systems are composed of modules, which are built from stacks comprising of membrane and electrode cells



CELLS (MEMBRANES & ELECTRODES)

STACKS

MODULE

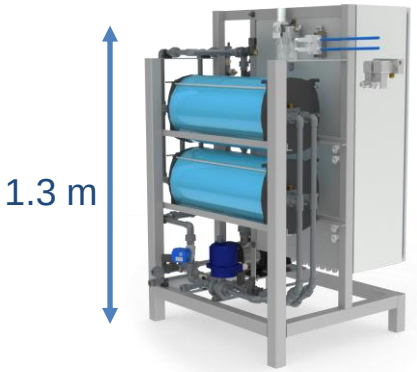
INDUSTRIAL SERIES SYSTEM (IS12)

CAPDI SYSTEMS

- Flow rate, feed TDS and targeted purified water quality determine the system and number of modules required

DiEntry

IS-2



IS-48

CURRENT CUSTOMERS

DURATION

WEST ACRE BREWING NORFOLK

DEYA

WELLINGTON BREWERY

Niles BREWING COMPANY SMALL TOWN BEERS

GALT, ON. EST.2019

FOUNDRY BREWING

MASTER BREWERS ASSOCIATION OF THE AMERICAS ESTD 1887

UNITED WE BREW.

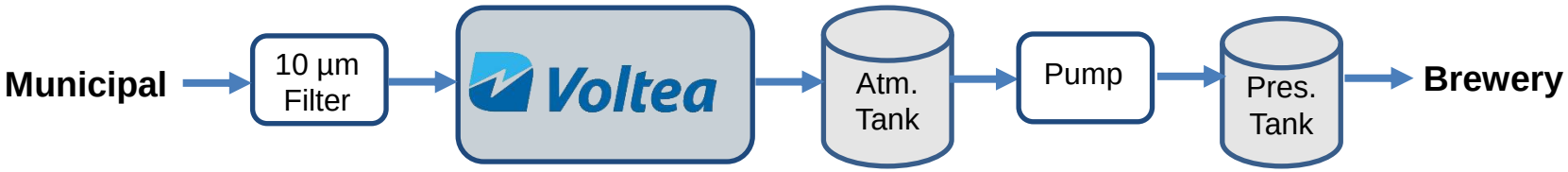
CASE STUDY: WELLINGTON BREWERY

MASTER BREWERS
ESTD 1887
ASSOCIATION OF THE AMERICAS

UNITED WE BREW.

CASE STUDY: WELLINGTON BREWERY

- Installed: Apr-19
- System: IS-24



Feed TDS (ppm)	Pure TDS (ppm)	Recovery (%)	Flow Rate (m^3/h)
734	168	77	6

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UNITED WE BREW.

WELLINGTON BREWERY – WATER ANALYSIS

Parameter	Unit	Feed Water	Treated
TDS	mg/L	588	128
Conductivity	uS/cm	897	286
pH		7.6	7.2
Hardness	mg/L as $CaCO_3$	462	108
Calcium	mg/L	118	28
Magnesium	mg/L	41	9
Sodium	mg/L	34	32
Alkalinity	mg/L	279	103
Chloride	mg/L	71	16
Sulfate	mg/L	142	26

WELLINGTON - BENEFITS

- Improved beer quality and consistency
- Ability to tailor water
- Local connection and water source
- Significant reduction in maintenance costs
  - Cleaning chemicals and labour
- Reduction in costs from water modification
  - Salts, lactic acid, labour
- High water recovery, low maintenance system

CAPDI - BENEFITS

- Dynamic feedback to maintain water quality
- Automated cleanings
- Remote monitoring and support
- Data collection and reporting
- Simple controls and alarms
- Low environmental impact
  - High water recovery, minimal chemicals, no salt

ANY QUESTIONS

???

THANKS!

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MASTER BREWERS ASSOCIATION OF THE AMERICAS

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