



# EnviroPak™ Nitrate Removal Technologies

Nitrate Treatment Technology Workshop

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September 5, 2013

**MIEX**®



# Orica Watercare Inc.

Orica Watercare Inc. is based in Denver, Colorado.

Orica is a publicly owned **chemical company** employing around 15,000 staff **across approximately 50 countries** with **annual revenue** of more than **\$9.6 billion**.





## Message

At Orica Watercare we combine our chemistry expertise and our process knowledge with advanced water and wastewater treatment technologies.

These technologies which we own and manage as part of our business are carefully selected to enable us to bring global expertise and best practice to provide sustainable solutions to our customers water treatment challenges.

## Treatment Solutions

Watercare has developed and implemented treatment applications for:

- Potable water
- Wastewater treatment
- Process water
- Product recovery
- Recycle water streams
- Waste minimization

Advanced Technology, including:

- Ion exchange
- Membrane filtration
- Advanced oxidation processes
- Media filtration and more
- Residuals management



# Technology Overview

## **Membrane Systems**

- MF, UF, NF, RO
- Containerized and fixed installations

## **Metals Removal**

- IX, Coagulation, Softening, Filtration

## **Inorganics Removal**

- Nitrate, Arsenic, Bromide, Ammonia, Selenium, Radionuclides

## **Organics Removal**

- IX, GAC, Coagulation

## **Solids Removal**

- Media Filter, DAF, Coagulation

## **High Recovery Processes**

- Softening
- Evaporation
- Brine Concentration

# Global Case Studies

## Watercare experience

- Tailored solutions for water treatment focusing on site specific problems
- Ion exchange for the removal of organic and inorganic contaminants
- Concentration of brine wastes
- Use of membranes for removal of salts causing corrosion, mine water, and tailing dam water
- Separate oil from water and sediments in wash bays and machinery workshops
- Treated water can be recycled and / or meet discharge license

## Ion Exchange

- Advanced Ion Exchange Treatment Solutions
  - Removal of organic and inorganic contaminants
  - Nitrate, bromide, ammonia, lead, hardness, and other metals
- The Benefits of this revolutionary technology include:
  - Small footprint
  - Leaders in process efficiency
  - Enhancement of traditional processes
  - Environmentally Sustainable



*The Authoritative Resource on Safe Water*

- Winner of 2 consecutive green technology ribbon awards at the National Conference and Exposition (2011 and 2012)

# Installations



MIEX®

MIEX® Systems in Construction in Canada

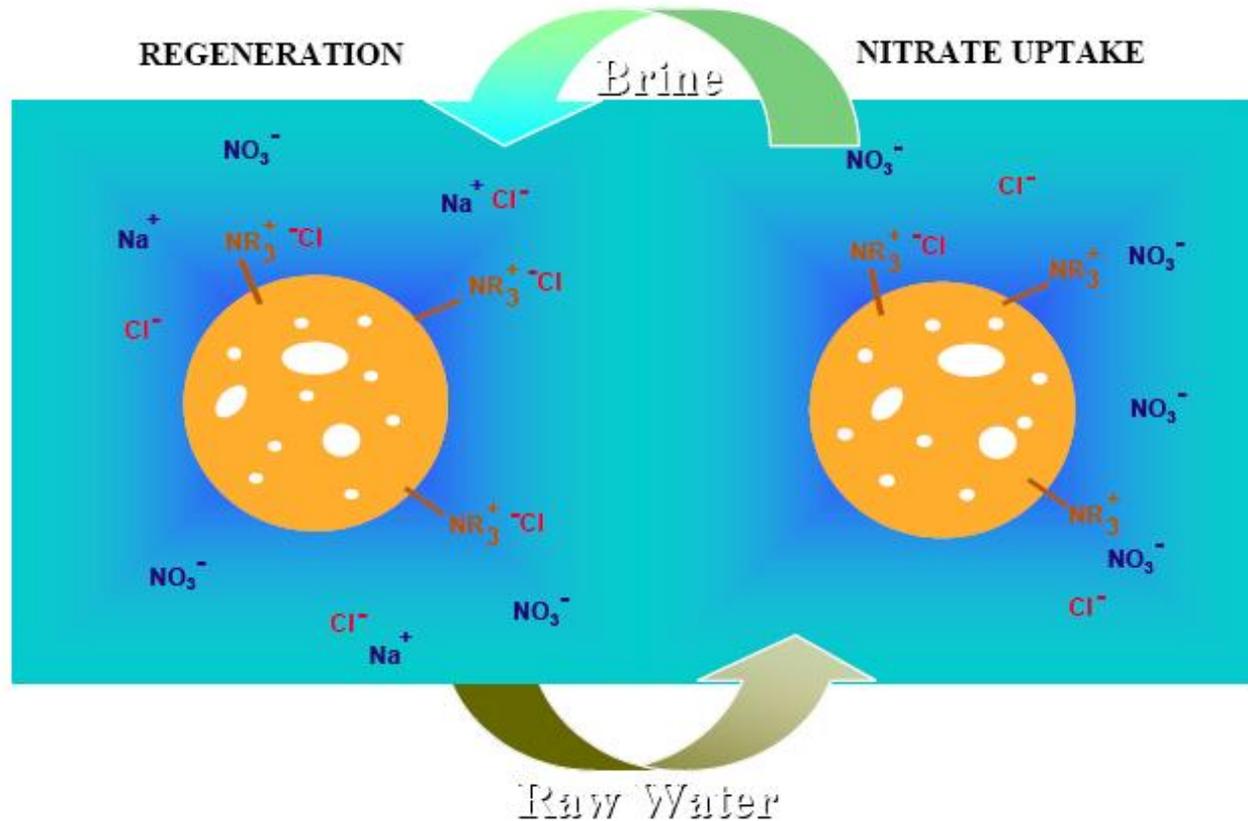


# The MIEX<sup>®</sup> Technology

Summary of MIEX<sup>®</sup> Technology Commercialization – August 2012

Capacity (MLD)	Installed
• 55 MIEX <sup>®</sup> Plants Total	849 MLD
• 44 MIEX <sup>®</sup> Plants in Operation	618 MLD
• 11 MIEX <sup>®</sup> Plants Contracted	231 MLD
• 35 MIEX <sup>®</sup> Plants in US & Canada	441 MLD
• 7 MIEX <sup>®</sup> Plants in UK & Europe	170 MLD
• 9 MIEX <sup>®</sup> Plants in Australia & New Zealand	147 MLD
• 4 MIEX <sup>®</sup> Plants in China	91.5 MLD
• + 2 Nitrate EcoRegen <sup>®</sup> Plants in US	5 MLD

# Nitrate Removal by Ion Exchange



# MIEX<sup>®</sup> Resin = Magnetic Ion EXchange

NSF Standard  
61 certified



Magnetic IX bead  
(~180 micron size)



# MIEX<sup>®</sup> DW 1401 Resin Selectivity

DOC (most preferred ion to remove)

Chromate

Phosphate

Perchlorate

Sulfate

Carbonate

Bromide

Iodide

Arsenate

**Nitrate**

Chlorate

Hydroxide

Bromate

Nitrite

**Chloride**

Bicarbonate

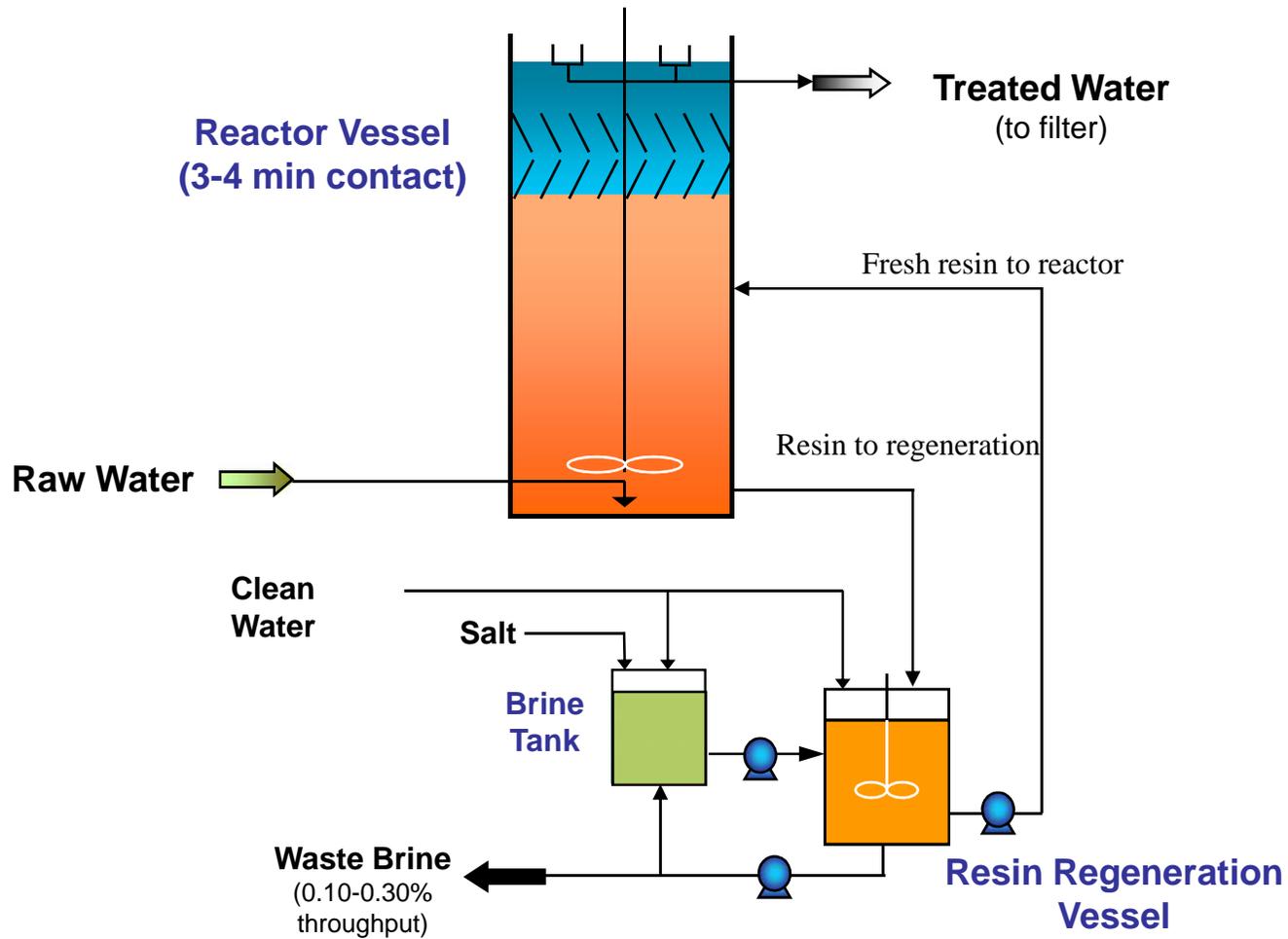
Fluoride



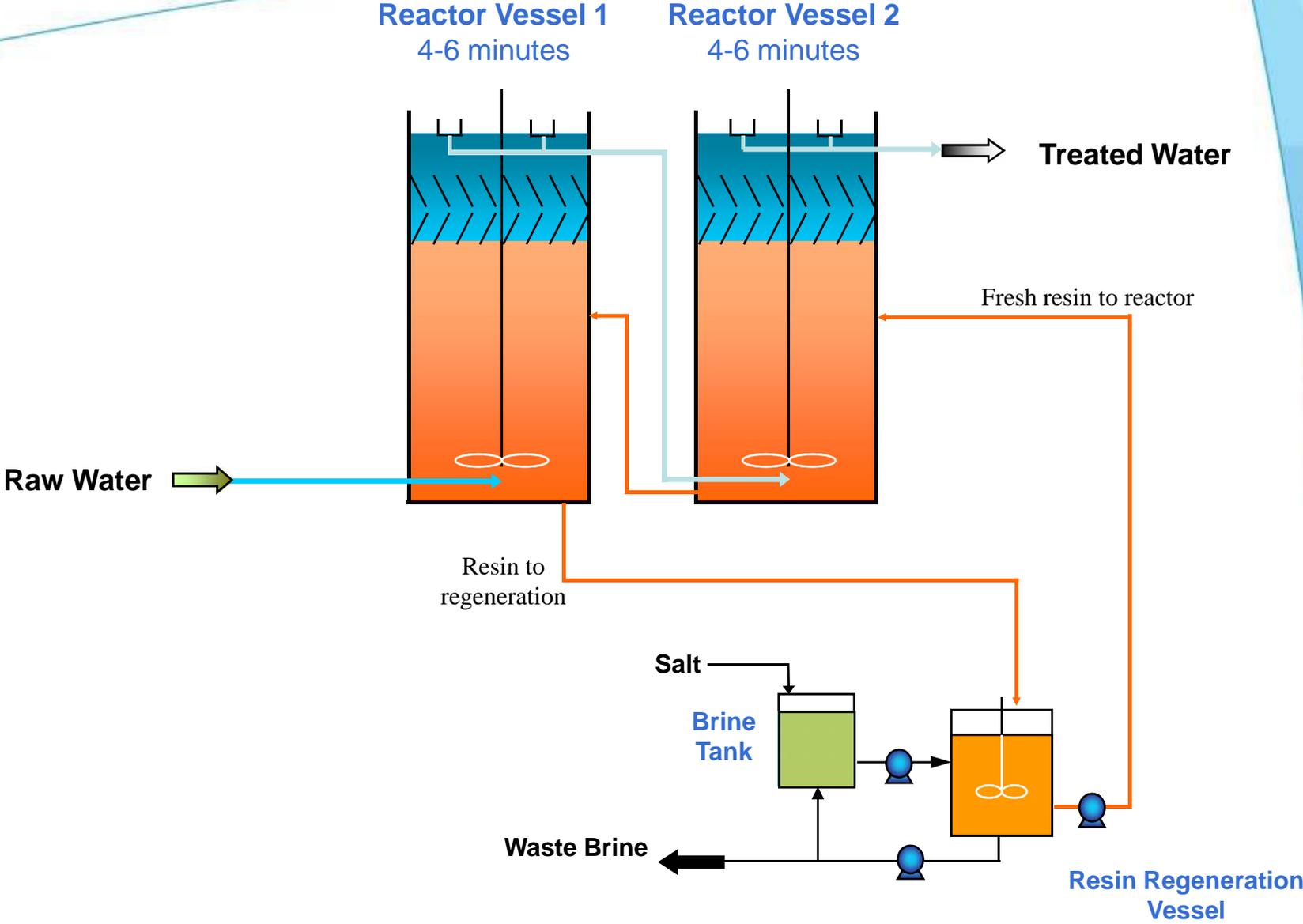
Decreasing  
Selectivity



## MIEX<sup>®</sup> High Rate Process Description



# Counter Current MIEX<sup>®</sup> Process



# High Rate MAGNAPAK® System - Newport, ME

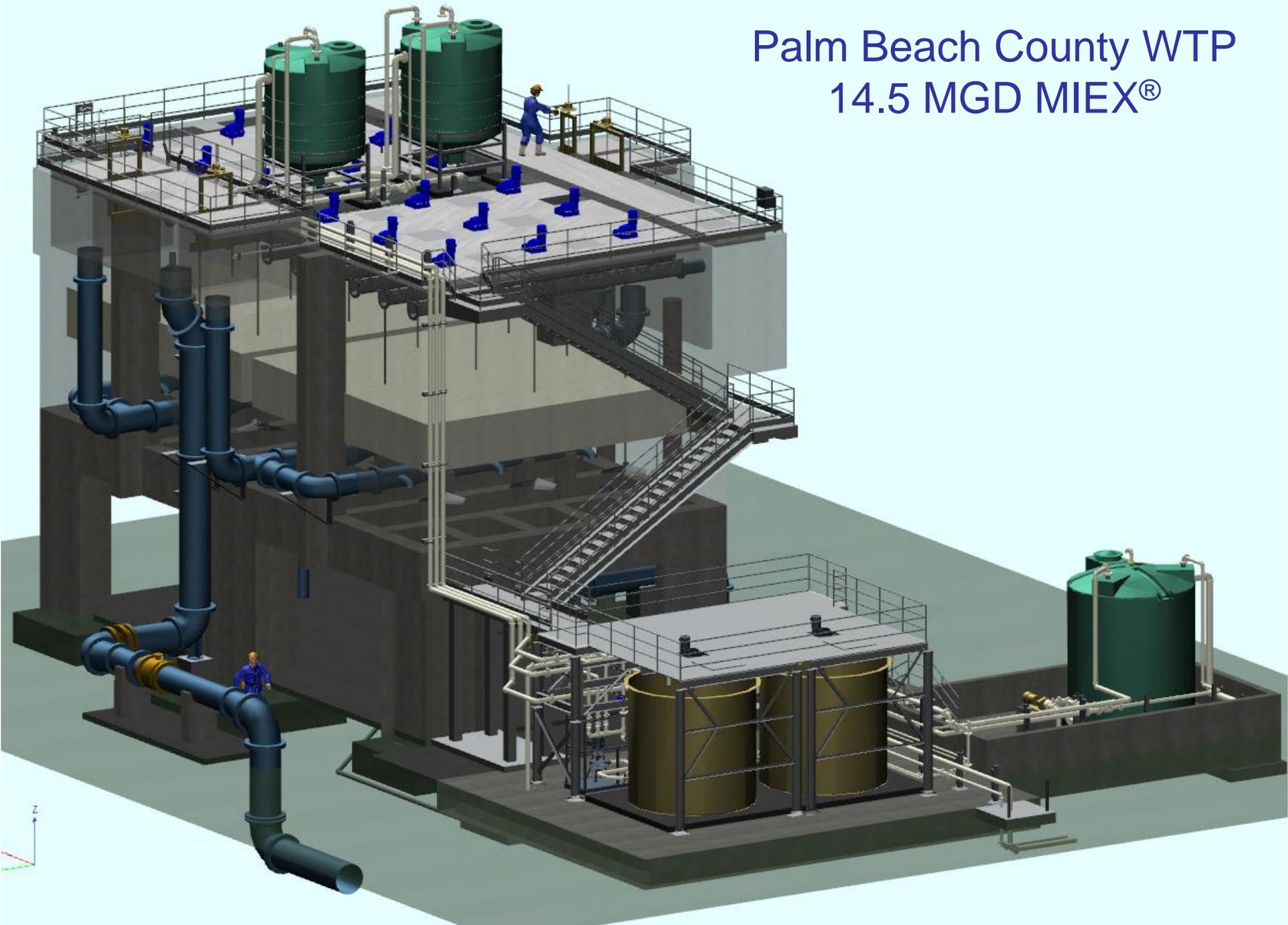
400 gpm

Regeneration  
Skid

Reactor  
Vessel



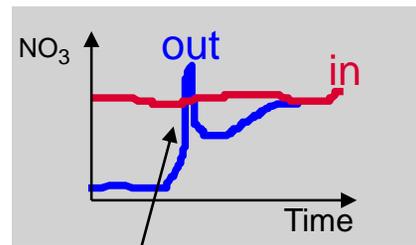
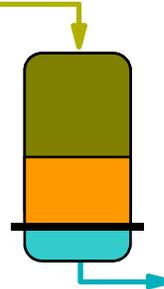
Palm Beach County WTP  
14.5 MGD MIEX®



# Fluidized Bed Ion Exchange

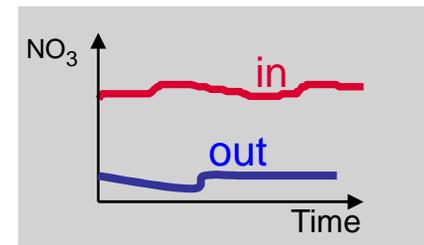
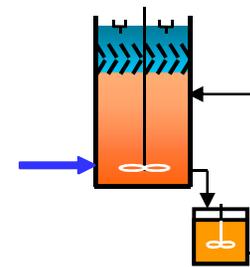
- No blending
- Resin regenerated to meet target effluent WQ
- No nitrate dumping
- 8 gpm/ft<sup>2</sup>
- Surface water applications

Trad. IEX



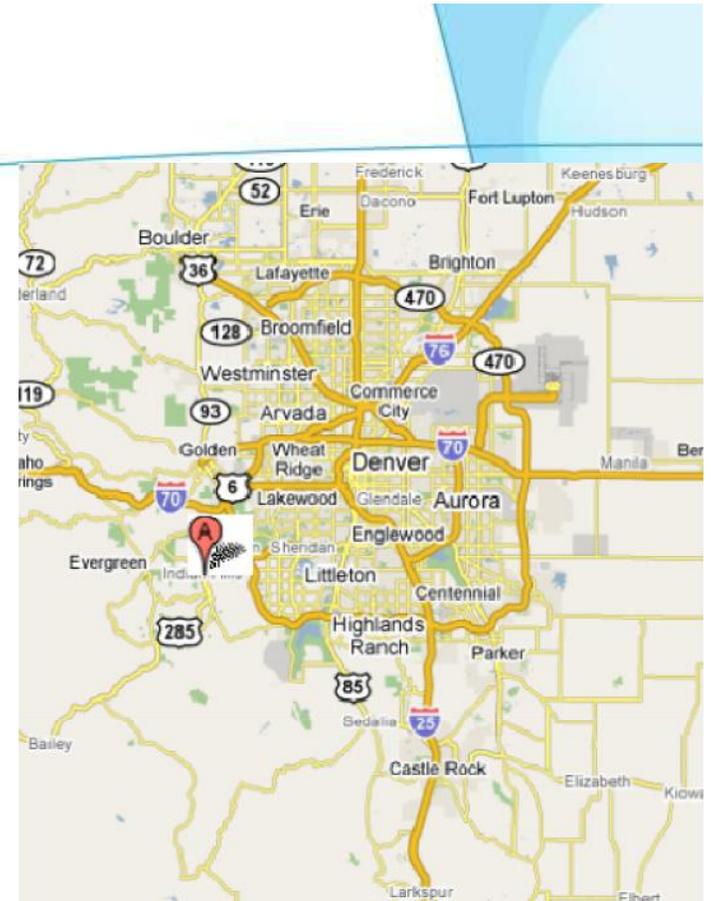
Chromatographic Peaking

MIEX® Process



## Indian Hills Water District

- Distribution
  - Serves population of 1100
  - Average 45,000 gallons/day
- Water treatment plant
  - Surface water
  - Supplemented by wells
  - Nitrate concentration in wells has increased to >10 mg/L



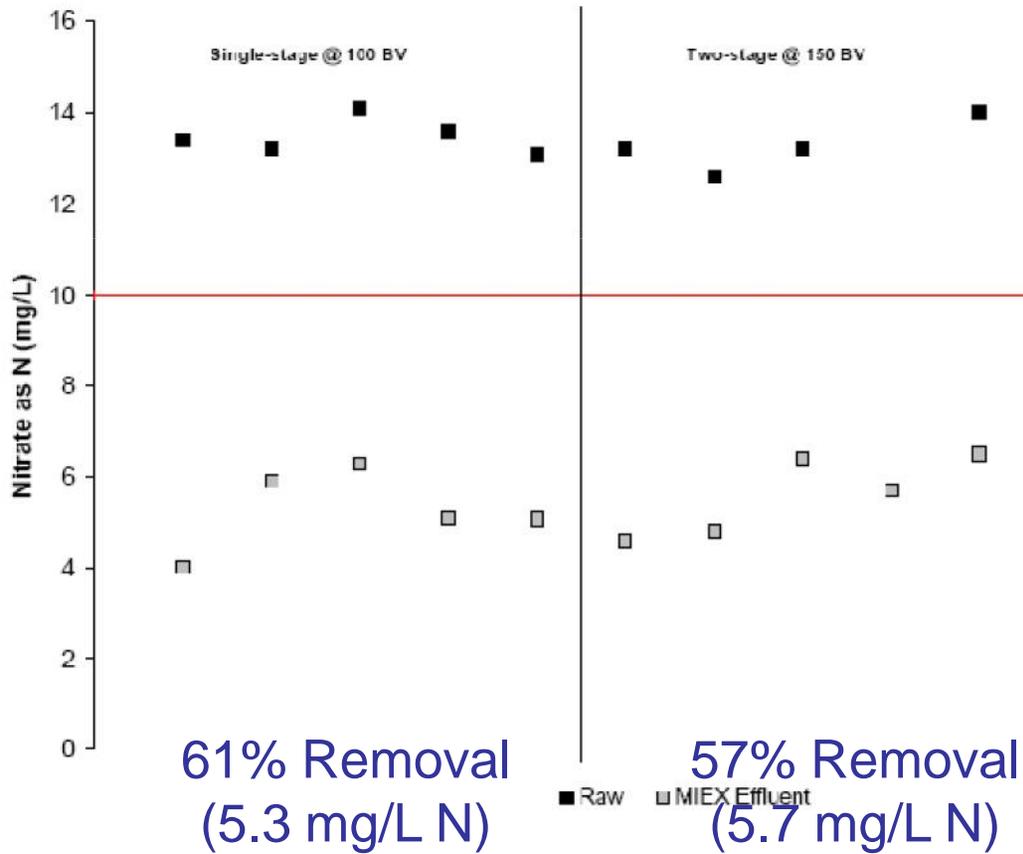
## Indian Hills Water District - Challenges

- 50 gpm flow, reduce nitrates by 50%
- No central wastewater treatment facility
  - Off-site waste disposal
  - Minimize waste to reduce waste handling and costs
- Low waste nitrate removal treatment option
  - Ion exchange

## Treated Water Quality

Contaminant mg/L	Raw Average	Treated Average
Nitrate (as N)	12 - 16	5.4
DOC	3.45	1.25
Sulfate	23	6
Total Hardness	350	350
Calcium Hardness	280	280

# Nitrate Removal (Pilot Results)



## Treatment Rate Optimization According to Nitrate Level

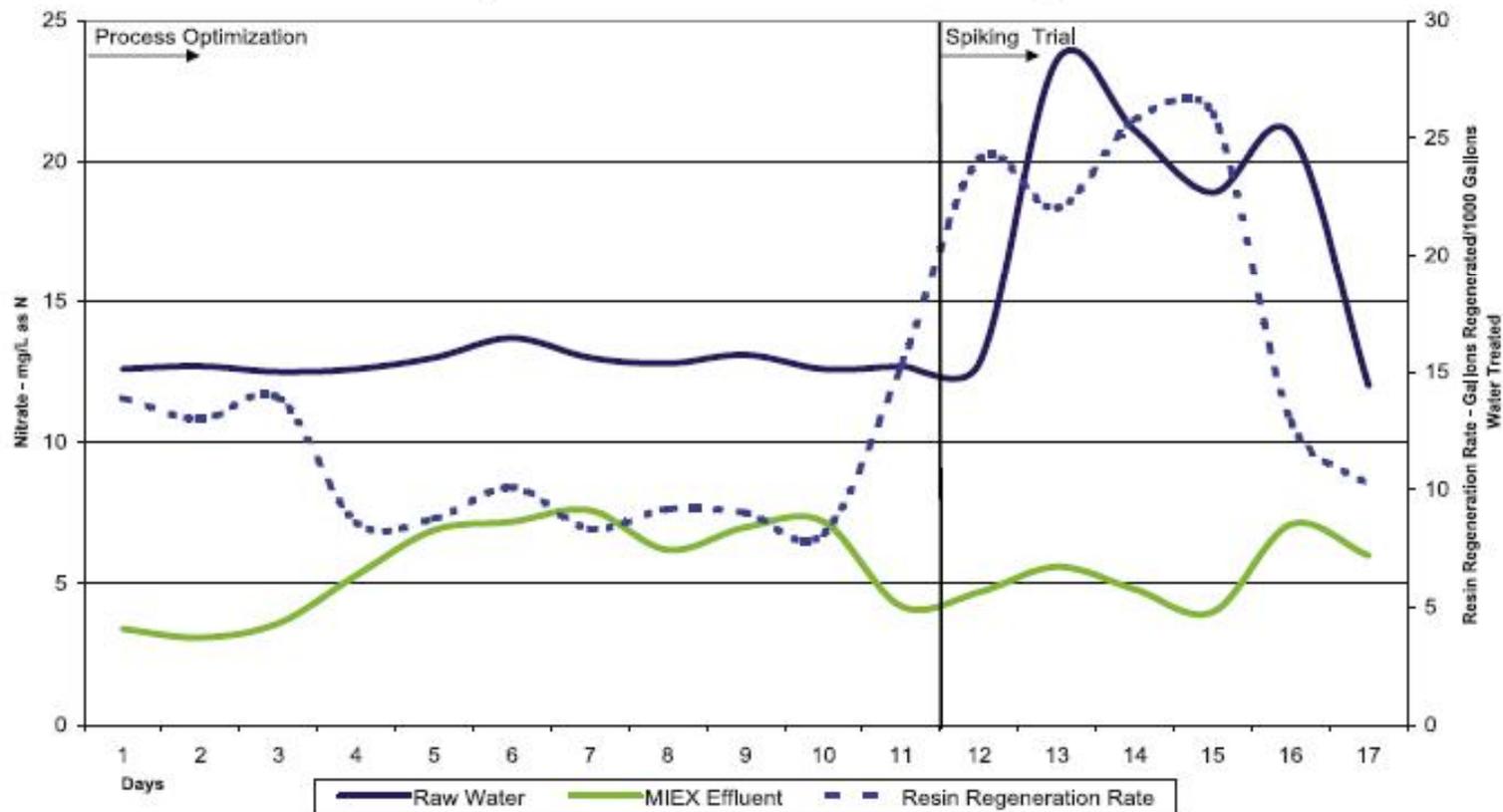


Figure 1: Pilot scale data illustrating the optimized resin regeneration rate used to achieve the client's goals of 6 mg/L N while minimizing the volume of brine waste produced.

## System Operations

- EnviroPak™ Operations
  - Online nitrate analyzer
  - Field colorimeter
  - Salt use – 3000 lb/MG
  - **Waste – 2800 gal/MG gal (0.28%)**
    - 2000 gal storage tank
- 1 µm Bag Filter
- Free Chlorine Injection



## Costs

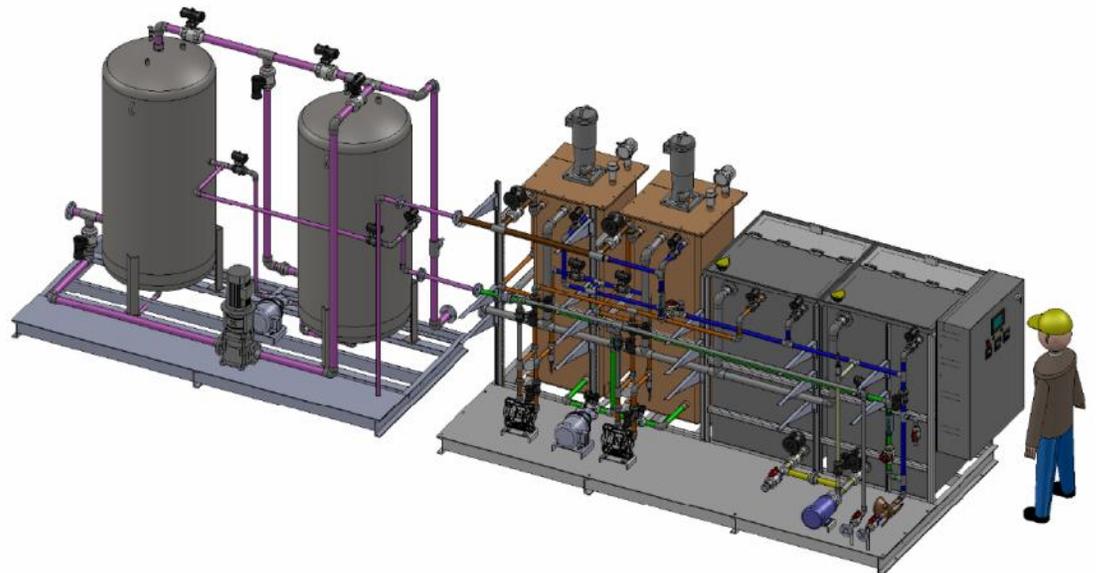
Capital Costs	
Equipment	\$150,000
O&M Costs	
Resin	\$0.08 – 0.15/kgal
Salt (\$100/ton)	\$0.15 – 0.20/kgal
Power	2-3 kw*hr Average

NOTES:

- Basic system
- Painted carbon steel vessels
- FRP / HDPE process tanks
- No online instrumentation
- Redundancy

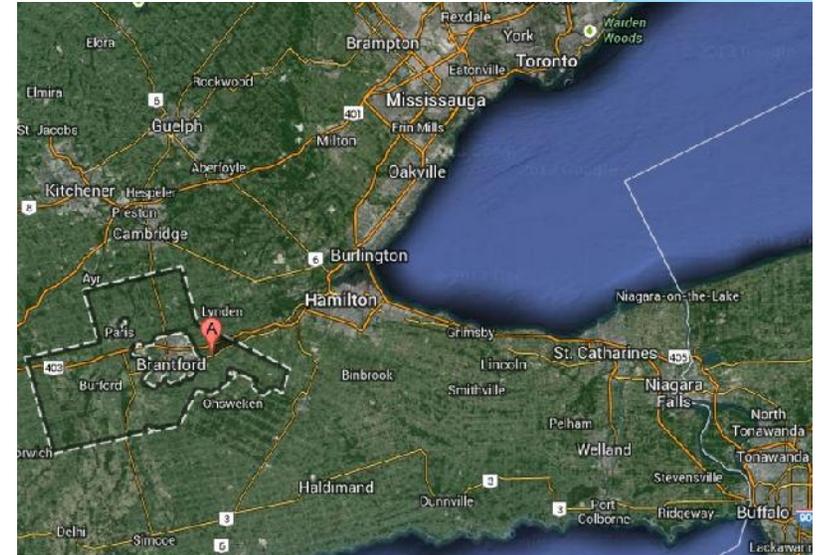
## Reliability

- Countercurrent systems provides 100% redundancy
  - State requirement
  - Can run on single contactor and meet nitrate requirements
  - Dual regeneration vessels



## County of Brant, Ontario

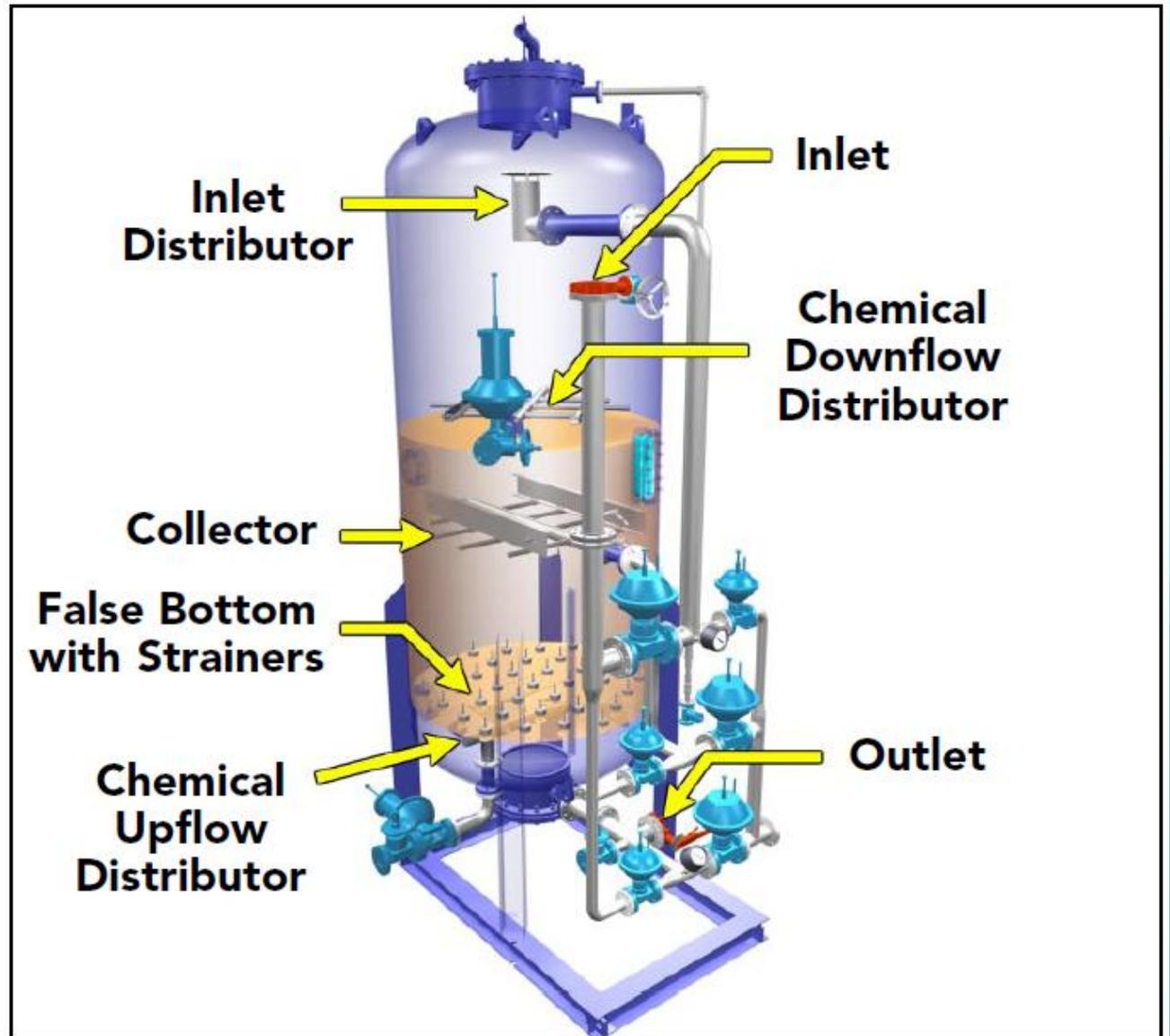
- Distribution
  - 50 Lps (792 gpm)
- Water treatment plant
  - CIX RFP
  - Associated Engineering
  - Ground water
  - Nitrate specific resin
  - Automatic blending, Nitratax analyzers



## County of Brant – Challenges

- Wastewater treatment facility
  - Sewer disposal
- 50 Lps to distribution
  - 3 x 20 Lps Contactors, 10 Lps Bypass
  - 24 hour / 20 mg/L as N vessel load capacity
  - Blend to an effluent nitrate of 3.0 as N
  - Not to exceed 3.5 as N
- Low waste nitrate removal treatment bid
  - Split flow counter-current

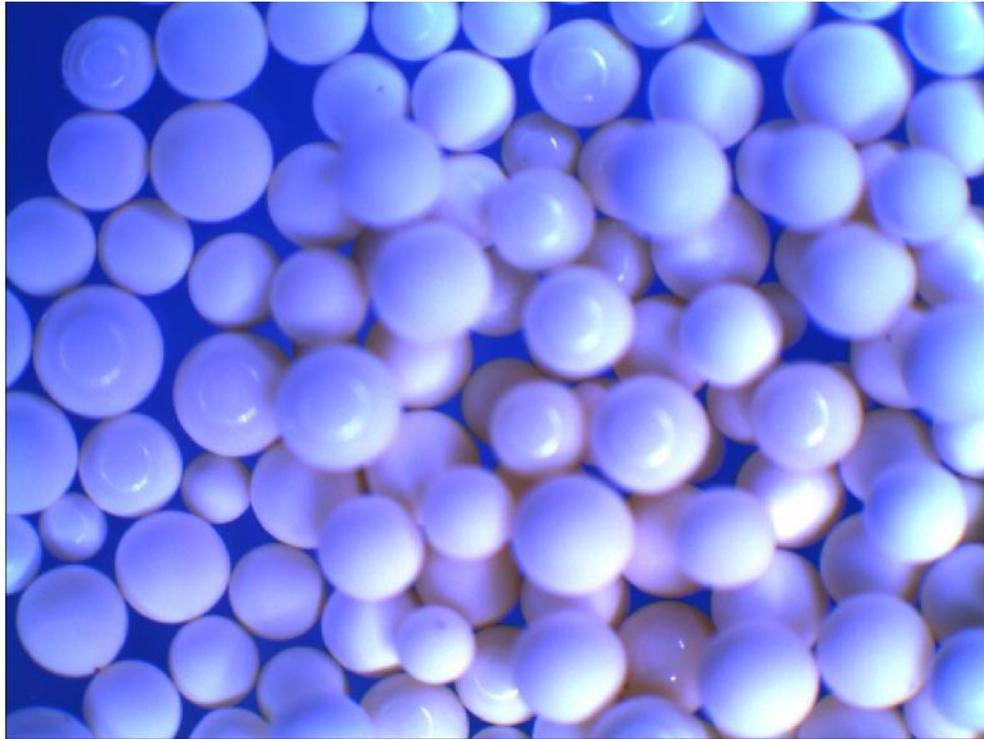
# Split Flow Counter- Current Ion Exchange Vessel



## SBA (Type II) Resin Selectivity

Decreasing  
Selectivity  
↓

Iodide  
Phenate  
**Sulfate**  
Perchlorate  
**Nitrate**  
Bromide  
Cyanide  
Bromate  
Nitrite  
**Chloride**  
Hydroxide  
Bicarbonate  
Phosphate  
Fluoride



NOTE: Nitrate-specific resin may differ from this typical SBA Type II selectivity profile.

## Treated Water Quality

Contaminant mg/L	Raw Average	Treated / Blend Average
Nitrate (as N)	11	0.2 / 3.0
DOC	1.5	-
Sulfate	34	-
Total Hardness	450	-
Silica	13	-



## System Operations

- EnviroPak™ Operations
  - (5) Online HACH Nitratax analyzers
  - Nitrate specific resin
  - **Salt use – 900 lb/MG**
  - **Waste – 3200 gal/MG gal (0.32%)**
    - *0.14% high conductivity waste*
    - *0.18% low conductivity waste*
- Resin Trap
- Free Chlorine Injection

## Costs

Capital Costs	
Equipment	\$1,000,000
Resin	\$250,000
O&M Costs	
Resin	7-15 Year Lifespan
Salt (\$225/ton)	\$0.10/kgal
Power	1-2 kW*hr

**NOTES:**

- Typical equipment costs are ~\$1,000/gpm (250 – 700 gpm through IX)
- Pricing extras include:
  - SS face piping
  - Nitrate specific resin
  - Valve and instrumentation upgrades
  - Remote area increases local salt price

## Reliability

- 3 x 50% systems provides redundancy
  - SCADA alarms
  - Automatic blending
  - Performance warranty
  - Duty / Standby pumps
  - Remote monitoring





# QUESTIONS?

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MISCO Water

**MIEX**<sup>®</sup>