CLEANTEQ WATER

Continuous Ion Exchange Enabling Chemical Free High Recovery RO for Non-Potable Reuse

Willem Vriesendorp
Chief Executive Officer

Business Units

Water Technology Solutions

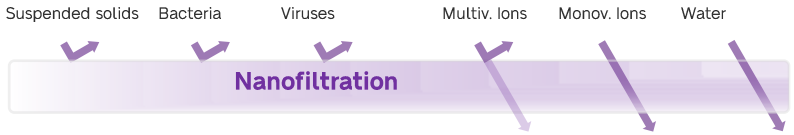
BIOCLENS™ CIF® BIONEX™ PHOSPHIX™

HIROX® DESALX® EVAPX™

Water Technology solutions providing semi-customed advanced water treatment solutions and related consumables

Graphene Oxide Membranes

NEMATIQ



NematiQ produces Graphene membranes as a consumable and modules directly to end-users and various partners

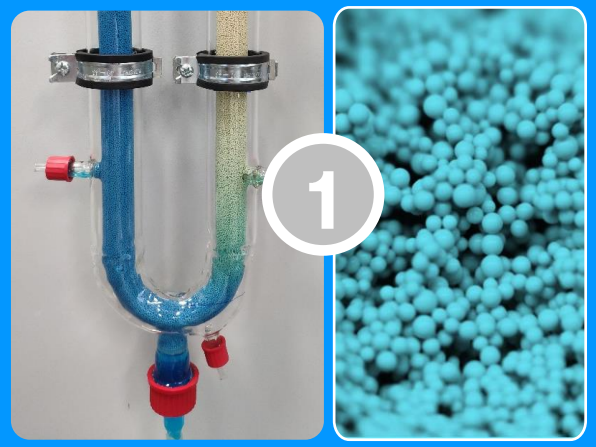
Metal Recovery / Green Mining

Metal recovery solutions to recover valuable metals, remove metal pollutants and minimize waste

Three Technology Platforms

3 core technologies * Multiple unique solutions * >10 patents * Innovation Awards

Water Technology solutions



Unique Resin technology for Selective pollutant removal

Encapsulated Bacteria for intensified nutrient reduction

HIROX® EVAPX™ CIF® PHOSPHIX™ DESALX® BIONEX™ BIOCLENS™

Graphene membranes

Graphene membranes for minimal energy use and minimal secondary waste

NEMATIQ

Unique Technology Solutions

Encapsulated Bacteria Lenses

BIOCLENS™

Intensification of nitrification and denitrification to achieve lower footprint and operate under harsh conditions of high salinity and toxicity

Continuous Ionic Filtration

CIF®

Moving resin beds in counterflow to water to improve treatment efficiency, reduce chemical use, produce smaller volume brines and filter solids

Complete Nutrient Removal

BIONEX™

Resins to remove TN from main effluent irrespective of temperature and composition with BIOCLENS used to remove TN from concentrated brine

Chemical Free Ultra High Recovery RO

HIROX®

CIF removes hardness to maximize recovery and membrane life, while produced brine is used to regenerate the resins without need for additional chemicals

Membrane Free Desalination

DESALX®

Chemical removal of divalent ions resulting in ultra-high recovery of complex waste water at low cost without producing saline brines

Low Energy Evaporation/ Crystallization

EVAPX™

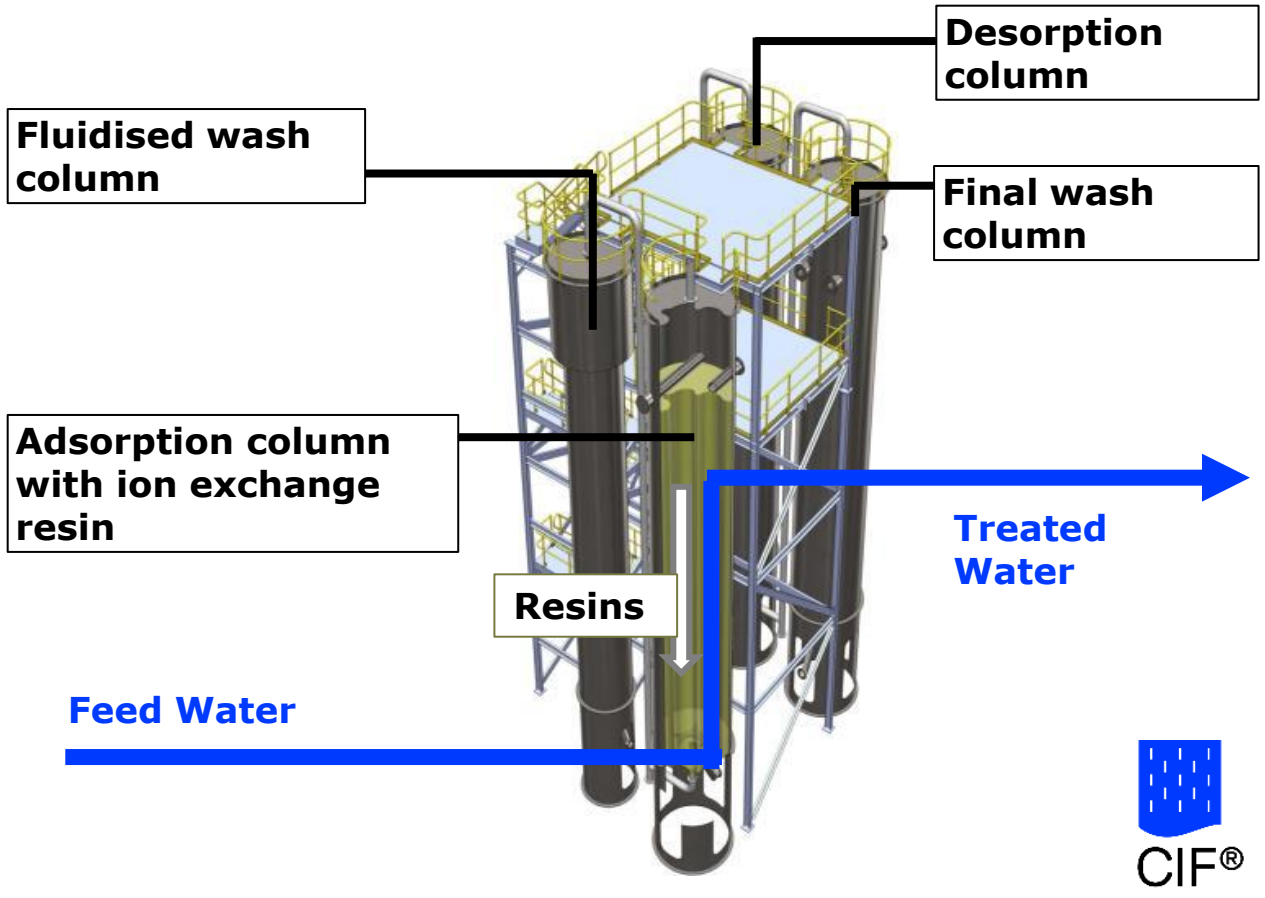
Low temperature normal pressure evaporation to minimize energy use, reduce scaling and fouling risks and enable the re-use of waste heat

Phosphorous removal and recovery

PHOSPHIX™

Selective removal of phosphate from water creating a solid phosphorus product that can be recycled using low-cost chemicals making recycling attractive even at lower Phosphate concentrations

CIF®: Continuous Ionic Filtration

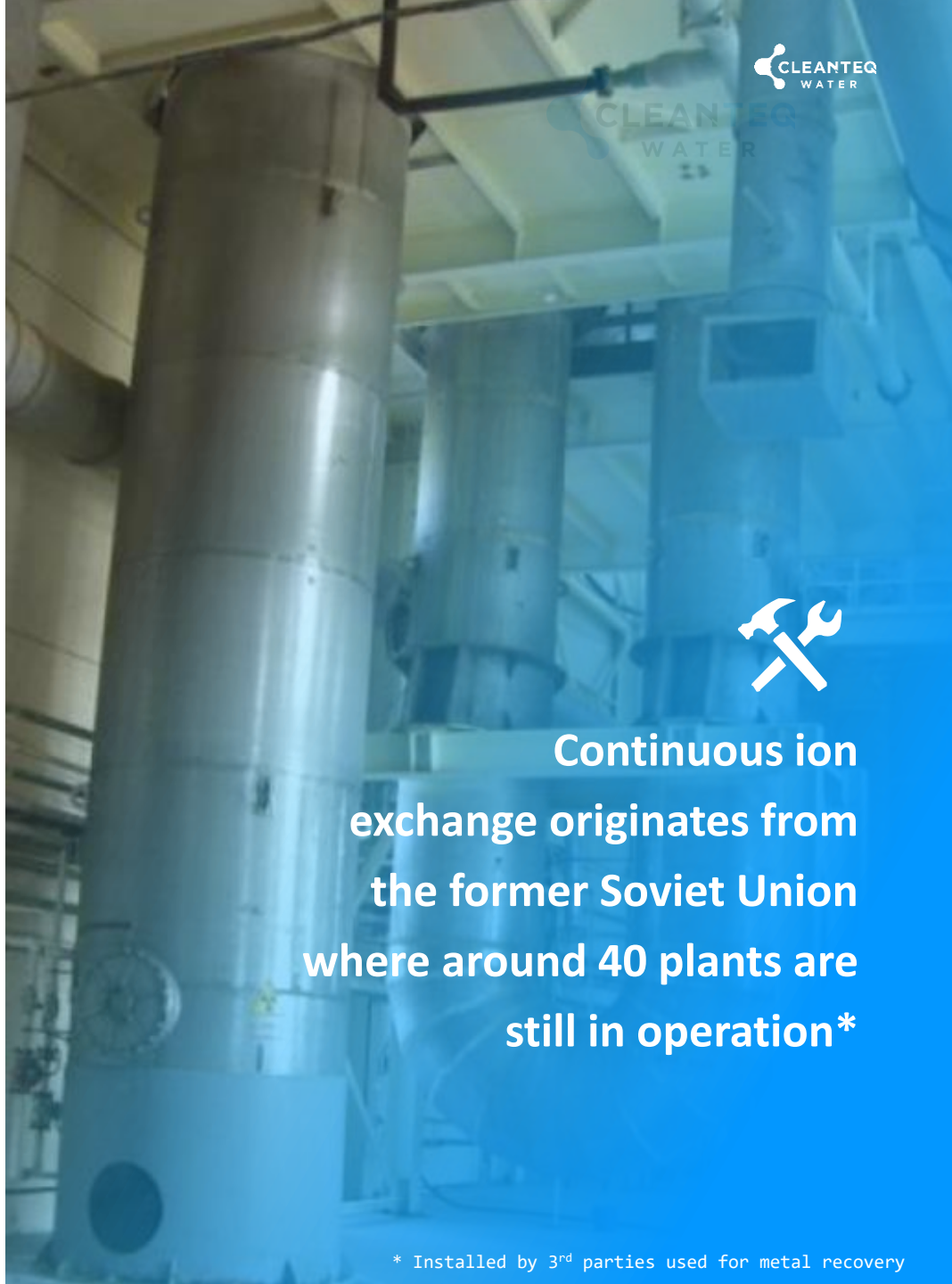


Features

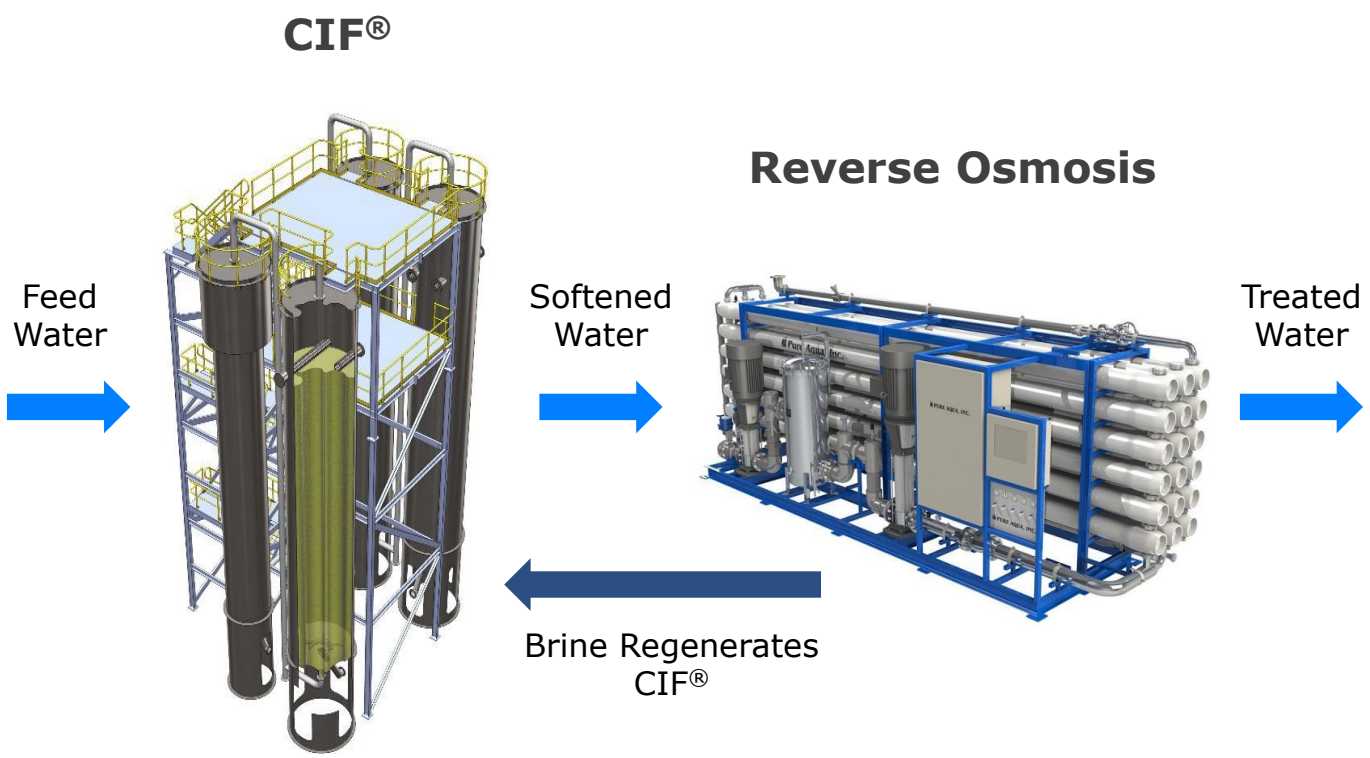
- Moving packed bed of resins
- Selective removal of desired pollutants using ion exchange
- Tolerates up to 150 mg/L of suspended solids and performs physical filtration like a sand filter
- High fouling resistance since resin is periodically moved
- Alternative fluidized bed and Resin-in-Pulp designs to allow for sludges

Resin Technology Background

- **Continuous ion exchange has been specifically adapted by Clean TeQ Water for water treatment applications**
- **Clean TeQ holds over 10 patents and extensive know-how**



HIROX® – Ultra High Recovery RO



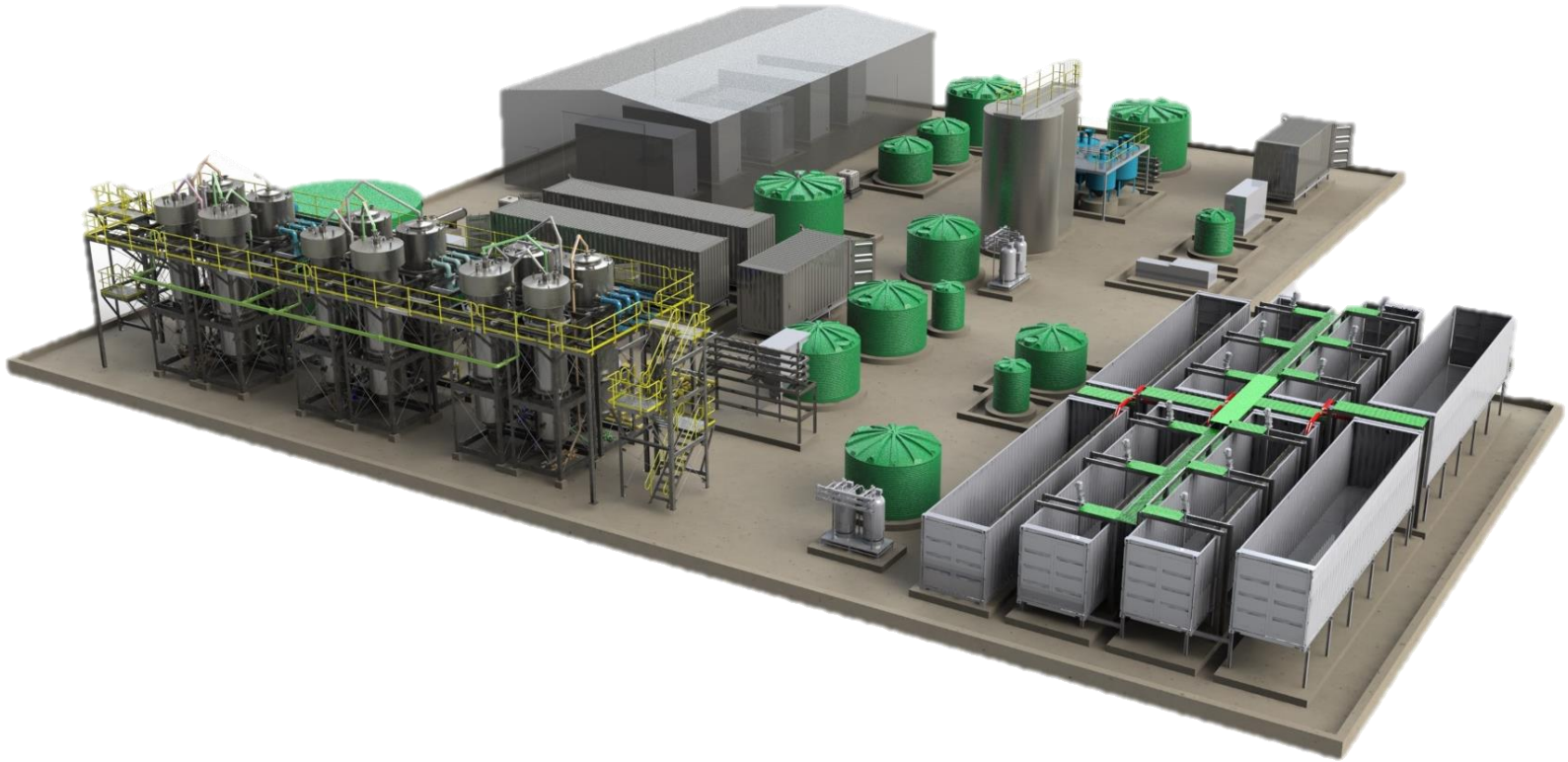
Features

- CIF® removes scale forming di/trivalent cations to low levels before water proceeds to RO
- RO brine used to regenerate ion exchange resin in a chemical free process
- Used for the desalination of brackish & saline feeds
- Very high water recovery (typically 92-98%)
- Longer time between CIP and longer membrane life
- Can retrofit CIF® to existing RO

Municipal Effluent Recycling: MBR Effluent

BIOCLENS™

HIROX®



- Combination of HIROX and BIOCLENS, 98% recovery
- Minimize brine stream, maximize water recovery
- Phosphate and nitrate removed from saline brine stream to minimize CAPEX and meet disposal criteria

MBR Effluent

- CIF® removed calcium to below 1 mg/L before RO
- The RO brine concentrated to approximately 20 g/L TDS (mainly NaCl)
- Concentrated brine contained enough sodium to regenerate the resin without additional chemicals, at a significantly lower concentration than is typically used in batch processes
- RO would not suffer from scaling even without antiscalants

Less Chemicals

Less brine

High recovery

Longer membrane life-time

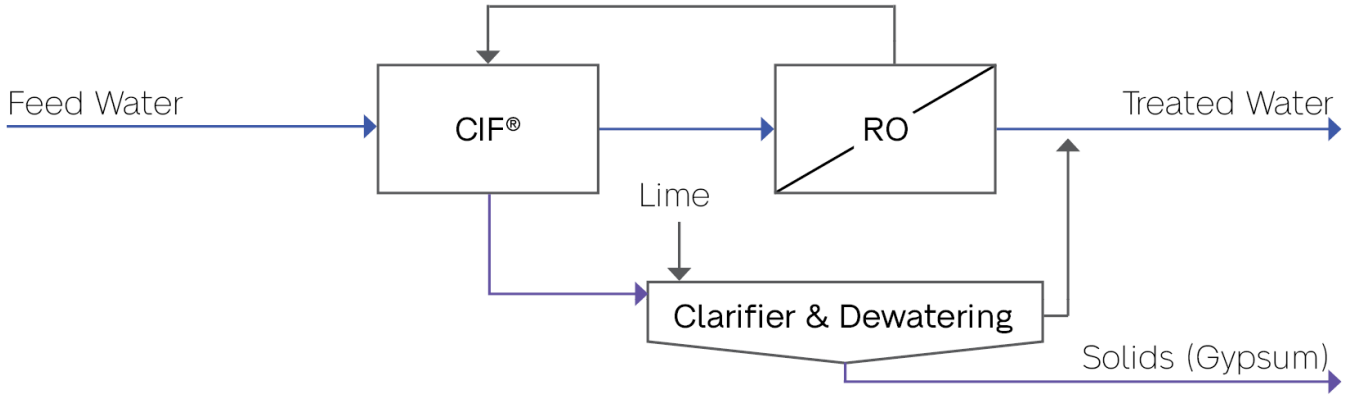
		Average Feed to CIF®				Average CIF® Softened Feed			
Water Type	Resin Ratio	Ca	Mg	Na	Total Hardness	Ca	Mg	Total Hardness	RO Recovery
	BV/BV	mg/L	mg/L	mg/L	mg/L CaCO3	mg/L	mg/L	mg/L CaCO3	
MBR Effluent	100	39	62	519	350	<1	1	<10	92%

Current HIROX® Project – O&G Well Water

- Clean TeQ Water is currently installing a HIROX® plant that will produce 1.2MLD in the Middle East
- The plant is designed to reduce the sulphate content of aquifer water to reduce scaling when used for reinjection
- It will substitute potable water with non-potable water to preserve precious drinking water reserves

Current HIROX® Project – O&G Well Water

- RO recovery of 80% when using HIROX®, compared to 30% when using RO alone
- The sodium in the RO brine fully regenerates CIF®
- A clarifier has been added to recover sodium chloride from the spent brine
- Recovered sodium chloride blended with product water to reach density for well completions, greatly reducing the OPEX
- 90% Overall system recovery



Parameter	Unit	Feed Water	CIF® Softened Water	HIROX® Product Water	After Blending
Ca	mg/L	1,000	50	1	<400
Mg	mg/L	510	485	1	<10
Na	mg/L	5,500	6,500	40	-
Cl	mg/L	9,500	9,500	64	-
SO_4	mg/L	2,900	2,900	2	<440
TDS	mg/L	19,400	19,500	108	10,000 - 15,000

Conclusions

- CIF® softening is sufficient to achieve RO recoveries 95% or higher without suffering from scaling
- The RO brine can be used to regenerate the ion exchange resin without additional chemicals, even at low brine TDS
- Can recover sodium chloride as part of flowsheets reaching ZLD with minimum chemical cost
- Much less chemical use, longer membrane lifetime, less other pre-treatment needs, and lower brine volumes
- Significant application for water treatment in the non-potable reuse space, providing maximum water recovery for hard water

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