CHLORINSITU® - ELECTROLYSIS FOR ON-SITE CHLORINE GENERATION

Bjorn Korthouwer

Managing Director

VDH Water Technology Ltd

VDH WATER TECHNOLOGY LTD

- Manufacturer of Electrolysis Systems for Chlorine Generation
- Sister company of ProMinent GmbH (Germany)
- HQ in The Netherlands (70 employees)

  Founded 1978 ➔ Aquatics (>2,000 systems installed worldwide)
- North American Production in Vancouver, BC (12 employees)

  Founded 2016 ➔ Horticulture/ Cooling Towers (>300 systems installed NA)
- Manufacturer of Open-Cell systems (CHLORINSITU® IIa)
- Manufacturer of Membrane cell systems (DULCO®Lyse)

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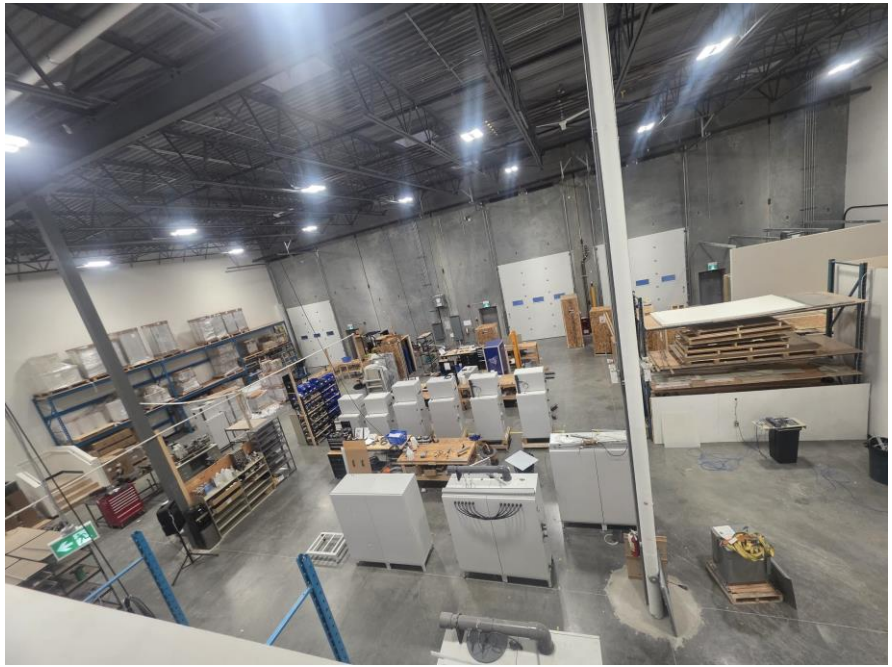
VDH WATER TECHNOLOGY LTD

- December 1, 2025 ➔ Moved to new Location: 12,000 sqft



300-44200 Progress Way
Chilliwack, BC Canada

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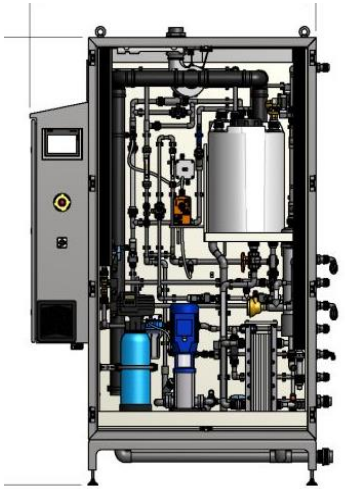
VDH WATER TECHNOLOGY LTD

CHLORINSITU IIa 60-300
COOLING TOWERS
PROCESS WATER
F&B - DAIRY
MUNICIPAL

CSA/UL LISTED
NSF61 CERTIFIED
EPA LISTED

CHLORINSITU IIa 625 – 2,500
COMMERCIAL POOLS
PROCESS WATER
MUNICIPAL

CSA/UL LISTED
NSF50 PENDING
EPA LISTED
PMRA CERTIFIED AS OF 02/27/2026



DULCOLYSE 100-300
FOOD & BEVERAGE

CSA/UL LISTED
NSF61 CERTIFIED
EPA LISTED

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WHY SALT ELECTROLYSIS SYSTEMS??

- No transport or storage of large volumes of harsh chemicals (NaOCl and H_2SO_4)
- No risk of accidents due to undesired blending of chemicals

- Fresh production of chlorine products and less deterioration of NaOCl → higher reactivity
- Direct, rapid, accurate and controlled production of fresh chlorine product

- Reduction of chloride (Cl^-) levels compared to other systems
- Lower chlorate (ClO_3^-) levels in product and application water

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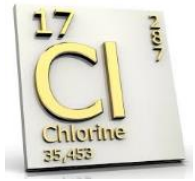
BASIC FUNCTION

- Chemistry



$$2NaCl + 2H_2O \xrightarrow{2e^+} Cl_2\uparrow + 2NaOH + H_2\uparrow$$

salt + water $\xrightarrow{2e^+}$ chlorine + caustic + hydrogen

- Theoretical minimum consumptions @100% efficiency:
  - Chemicals: 1 lbs Cl_2 requires 1.65 lbs salt
  - Electricity : 1 lbs Cl_2 requires 2 kWh

- Power consumption dependent on cell type and construction

- There are two basic types of cells
  - Open Cell (Hypo cell)
  - Membrane Cell

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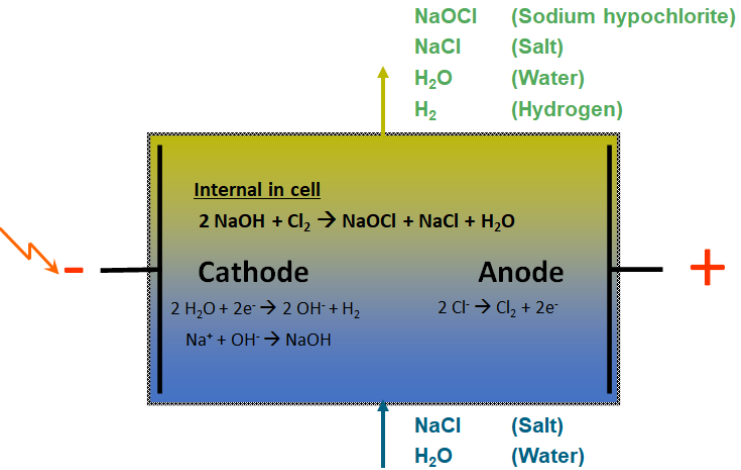
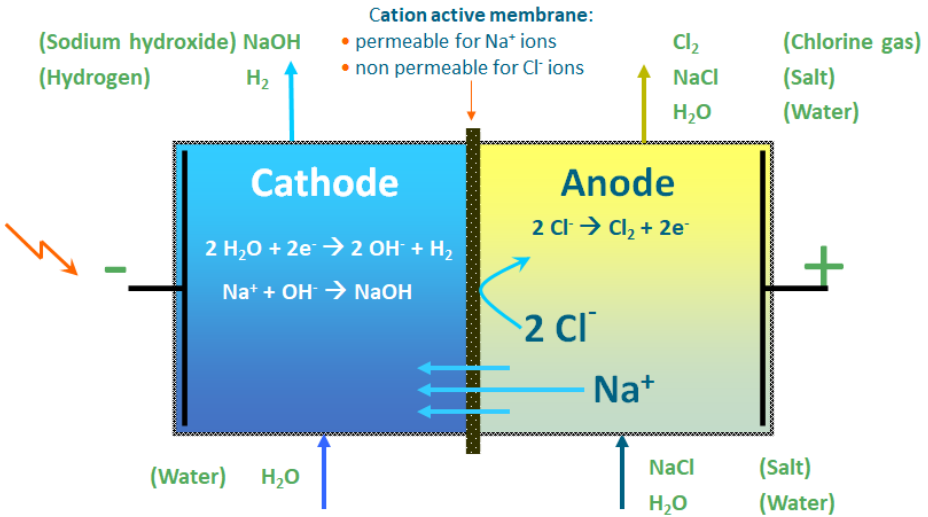
OPEN-CELL VS MEMBRANE CELL TECHNOLOGY



Open cell technology



Membrane cell technology

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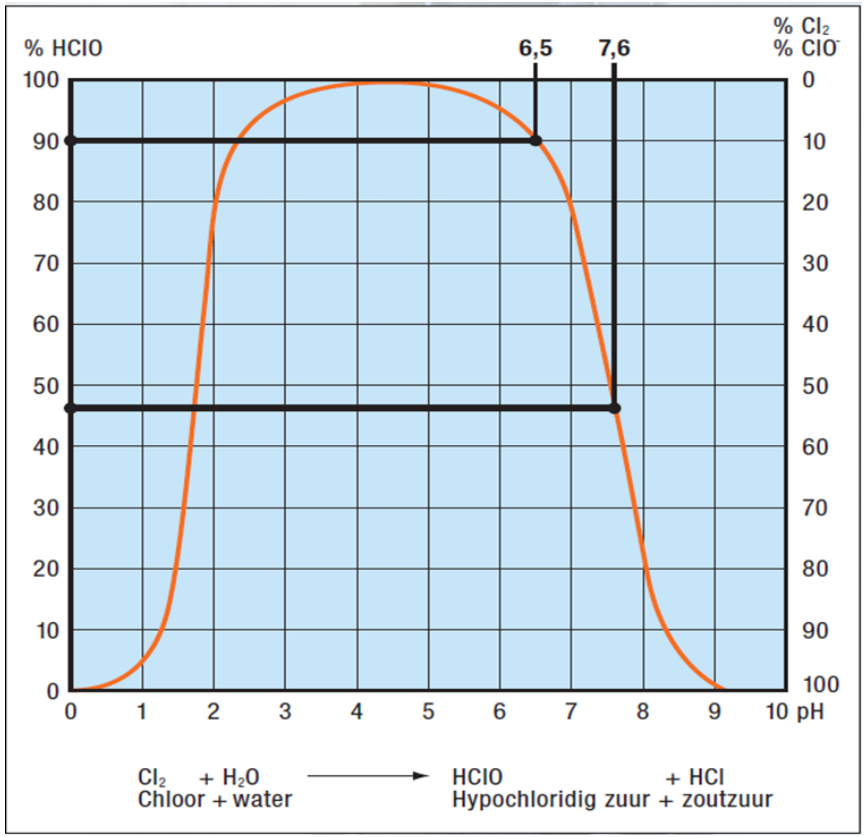
DISINFECTION POWER CHLORINE



Disinfection power (high → low)

1) Cl_2 → HOCl (hypochlorous acid)
DULCO® Lyse

Cl_2	+	H_2O	→	HOCl + HCl

2) 0.8 % Na-hypochlorite
(NaOCl - pH 9)
Chlorinsitu®-IIa

3) Classical Bleach 12.5%
(NaOCl 125-150 g/l - pH 13 - 14)

Cl_2	+	2 NaOH	→	NaOCl + NaCl + H_2O

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DIFFERENT CHLORINSITU® SALT ELECTROLYSIS SYSTEMS

Open- or hypocell technology

- Chlorinsitu® IIa
- 50-65% exhaust of salt
- Average salt consumption
  - **3 – 3.5 lbs salt / lbs FAC**
- Energy consumption
  - **2 – 3 kWh / lbs FAC**
  - **8**,000 ppm (0.8%), pH 9

- Lower initial investment
- Lower maintenance costs
- Higher operational costs

Membrane cell technology

- DULCOLyse (F&B)
- 85% exhaust of salt
- Average salt consumption
  - **~ 2,0 lbs salt / lbs FAC**
- Energy consumption
  - **~ 2 kWh / lbs FAC**
  - 400 ppm, pH 6.5

- Higher initial investment
- Higher maintenance costs
- Lower operational costs

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CHLORINSITU® IIA = OPEN CELL TECHNOLOGY

ProMinent Fluid Controls and VDH

CHLORINSITU IIA – DIFFERENT MODELS

CHLORINSITU® IIa
Small

CHLORINSITU® IIa
Medium

CHLORINSITU® IIa
XLarge

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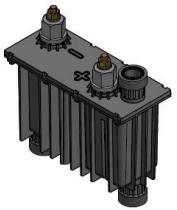
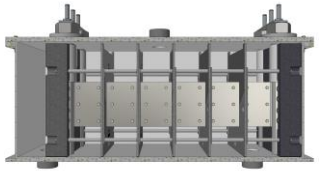
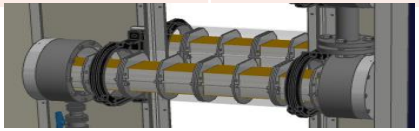
CHLORINSITU IIA

Small		Medium		XL	
60 g/h	3 PPD	625 g/h	33 PPD	5,000 g/h	250 PPD
120 g/h	6 PPD	1,250 g/h	66 PPD	7,500 g/h	375 PPD
180 g/h	9 PPD	2,500 g/h	132 PPD	10,000 g/h	500 PPD
240 g/h	12 PPD			15,000 g/h	750 PPD
300 g/h	15 PPD			20,000 g/h	1,000 PPD
				22,500 g/h	1,125 PPD
				30,000 g/h	2,000 PPD
				45,000 g/h	2,750 PPD







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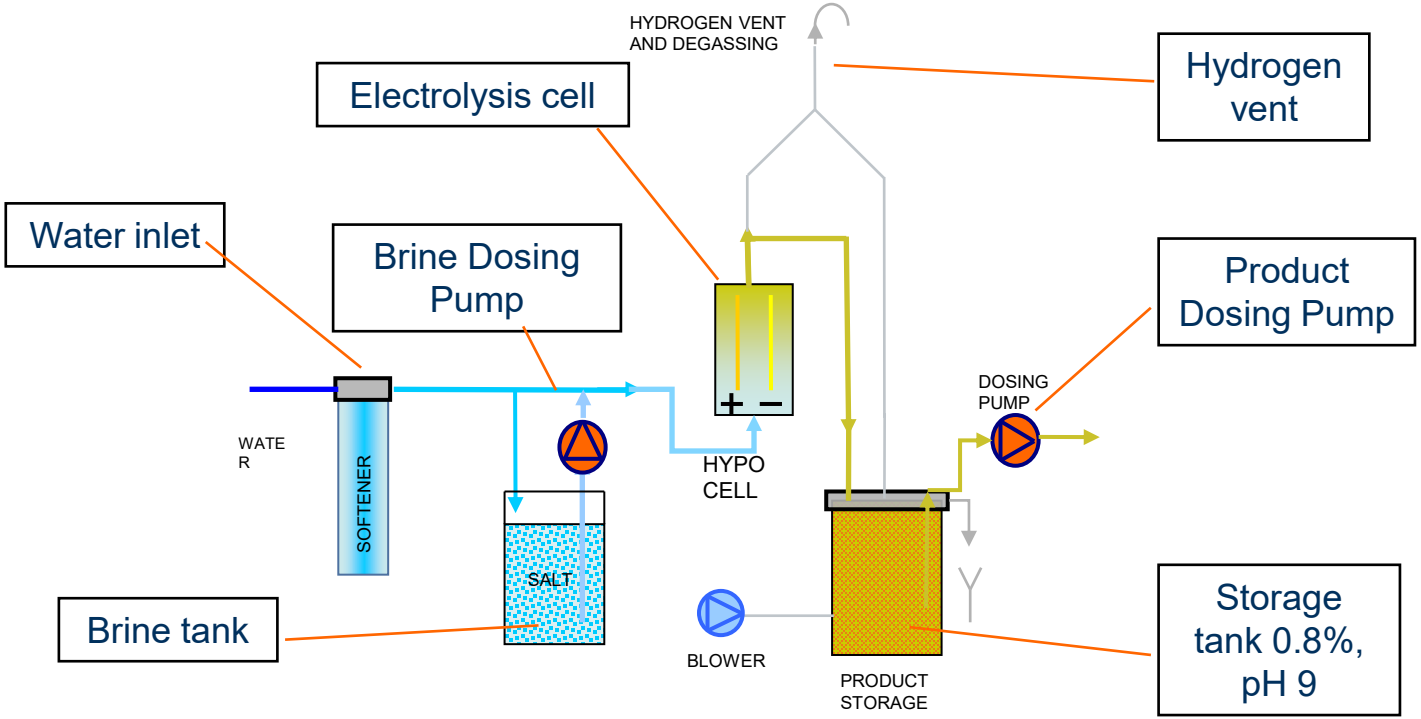
CHLORINSITU® IIA – FUNCTION OPEN CELL TECHNOLOGY



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CHLORINSITU® APPLICATIONS

Model		Capacity (PPD)	Aquatics	Cooling Towers	Breweries	CIP	Dairy	Pulp & Paper	Process water	Municipal
CHLORINSITU® IIa	Small	5 - 15	X	X	X	X	X	X	X	X
CHLORINSITU® IIa	Medium	66 - 132	X	X			X	X	X	X
CHLORINSITU® IIa	XL	250 – 2,750	X					X	X	X
DULCO®Lyse		7 - 15			X	X	X		X	

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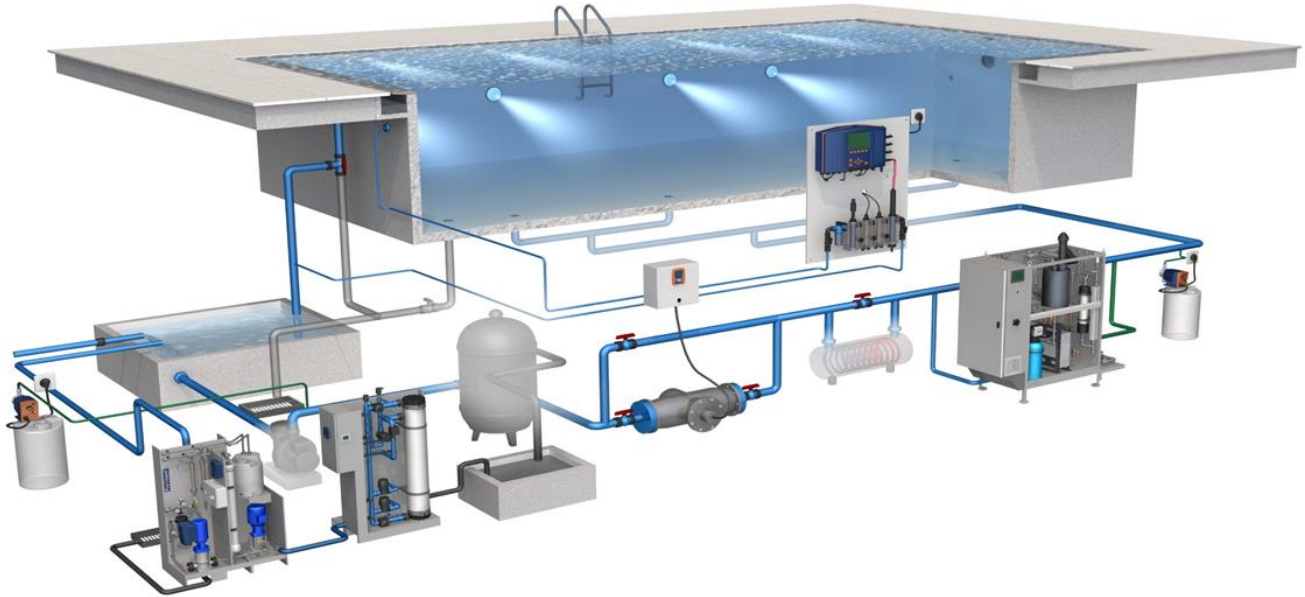
AQUATICS

VDH since 1980 in Aquatics: >800 units in The Netherlands



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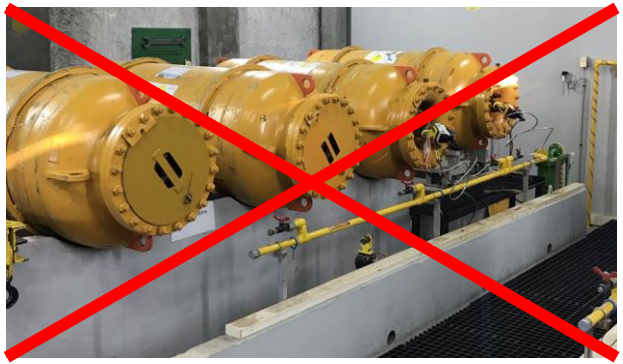
MUNICIPAL/ DRINKING WATER

- Substitution of gas chlorination by ELC



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SUBSTITUTION CHLORINE GAS TRANSPORT

- Chlorine container rupture in Aqaba, Jordan
  (27 June 2022)

- 13 people killed
- > 265 injured

VDH water technology ProMinent®

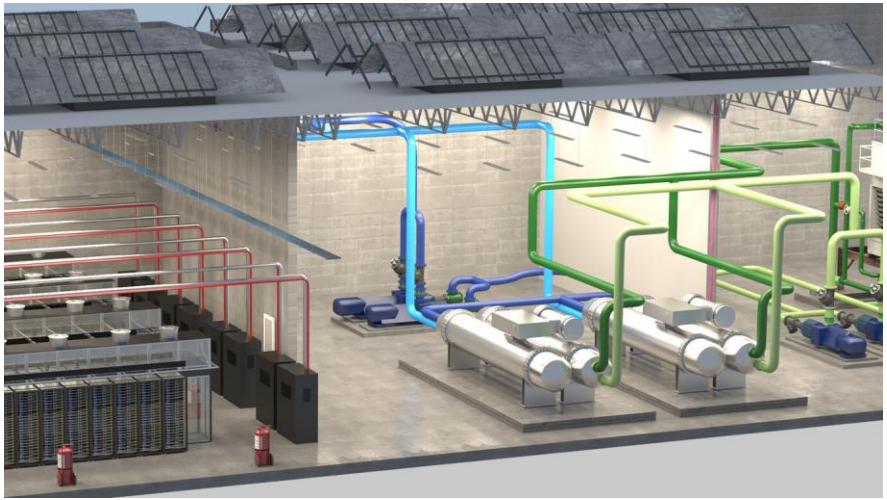
COOLING TOWERS DATA CENTERS

Cooling Water re- use made possible with chlorine injection.

Therefore able to install data centers in remote locations.

No chemical handling
Salt storage only

>50 Unit annually in NA



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HOW TO SIZE A UNIT?

- Chlorine usage = Chlorine demand + Chlorine residual
  Chlorine demand is designed, measured, researched.
  Chlorine residual is regulated for pools, municipal etc.

  Chlorine usage is mg/l = parts per million (ppm)

- Flowrate
  Gallon per minute x 0,012 x ppm = PPD
  1,000 gpm x 0,012 x 3 ppm = **36 PPD**

  - m3/h x ppm = g/h
    400 m3/h x 3 ppm = 1,200 g/h

- Converting from Bleach usage
  Customer is using 50 gallons per day
  1 gallon contains 1.2 lbs of FAC
  50 x 1.2 = **60 PPD**

  - 1 liter of 12.5% bleach ± 135 g/l
    1,000 /135 = 7.4 liter is 1 kg of FAC

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CAPEX/OPEX CALCULATOR

CHLORINSITU IIa	60	120	180	240	300	625	1250	2500	g FAC/h
Production per day	1,3	2,64	3,96	5,28	6,6	15	30	60	kg FAC/day
Production per day	3,0	6	9	12	15	33	66	132	Pounds per day
Average daily usage	80	80	80	80	80	80	80	80	Percent
Maximum per year	385	771	1.156	1.542	1.927	4.380	8.760	17.520	kg FAC/year
Maximum per year	876	1.752	2.628	3.504	4.380	9.636	19.272	38.544	Pounds per year
Specifications CHLORINSITU IIa									
Specific sodium chloride use	3,0								kg/kg FAC
Specific electricity use	4,0								kWh/ kg FAC
Specific w ater use	110,0								l/ kg FAC
CAPEX/ OPEX									
Chlorinsitu IIa									
External storage tank									
Chlorine + pH sensor panel(s)									
Injection skid with dosing pumps									
Spare part pack									
Project specific requirements									
Installation									
Commissioning									
Amortization @ 15years	USD 0	USD 0	USD 0	USD 0	USD 0	USD 0	USD 0	USD 0	USD/ Year
Maintenance 1Year									
Maintenance 3Year									
Labour based on 1 visit per year Excluding travel time & expenses									
Yearly maintenance costs	USD 0	USD 0	USD 0	USD 0	USD 0	USD 0	USD 0	USD 0	USD/ Year
Cell type	Hypocell 60 g/h	Hypocell 60 g/h	Hypocell 60 g/h	Hypocell 60 g/h	Hypocell 60 g/h	Hypocell 625	Hypocell 1250	Hypocell 2500	
Cell costs									
Amount of cells	1	2	3	4	5	1	2	1	
Typical life time expectancy	6	6	6	6	6	6	6	6	Year
Average cell costs @ 15years	USD 0,00	USD 0,00	USD 0,00	USD 0,00	USD 0,00	USD 0,00	USD 0,00	USD 0,00	USD/ Year
Sodium chloride	USD 0,30								USD/ kg
Electricity	USD 0,15								USD/ kWh
Water	USD 0,00								USD/ Liter
Salt, energy costs	USD 348	USD 694	USD 1.041	USD 1.388	USD 1.735	USD 3.943	USD 7.885	USD 15.769	USD/ Year
Total yearly costs with amortiz	USD 348	USD 694	USD 1.041	USD 1.388	USD 1.735	USD 3.943	USD 7.885	USD 15.769	
	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	$/Lbs FAC
Total yearly costs without amo	USD 348	USD 694	USD 1.041	USD 1.388	USD 1.735	USD 3.943	USD 7.885	USD 15.769	
	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	$/Lbs FAC

- Capital investment project
- Spare Parts
- Annual Maintenance
- Renewal Hypocells 5-7 years
- Amortization 15 years

Depending on project:
Approx.
±$1 kg FAC

Bleach depending on location:
±$3-8 kg FAC

ROI = ±2-3 years!!

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OPEN CELL – ADVANTAGES

Advantages over conventional bleach dosing

- Lower concentration*, better controllability
- Lower pH (approx. 9 instead of 14*), less acid required for pH correction
- Lower concentration*, far less deterioration into byproducts when stored and dosed
- Produced on demand, product is fresh
- Radicals are available giving first oxidation/disinfection

- ➢ Better ambient air quality, less stress for personnel
- ➢ Higher disinfection efficiency compared to other open cell manufacturers
- ➢ 25% - 35% lower running costs

* Conventional bleach: approx. 12,5%

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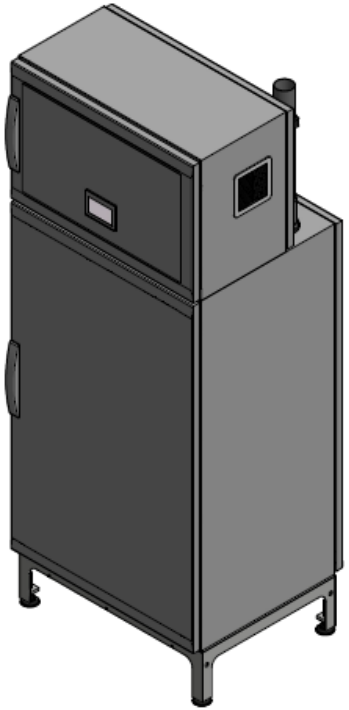
CHLORINSITU® IIA SMALL

- 60 g/h = 3 PPD
- 120 g/h = 6 PPD
- 180 g/h = 9 PPD
- 240 g/h = 12 PPD
- 300 g/h = 15 PPD

Sodium Hypochlorite = 0,8%, pH=9

CSA/UL Listed

NSF61 Listed



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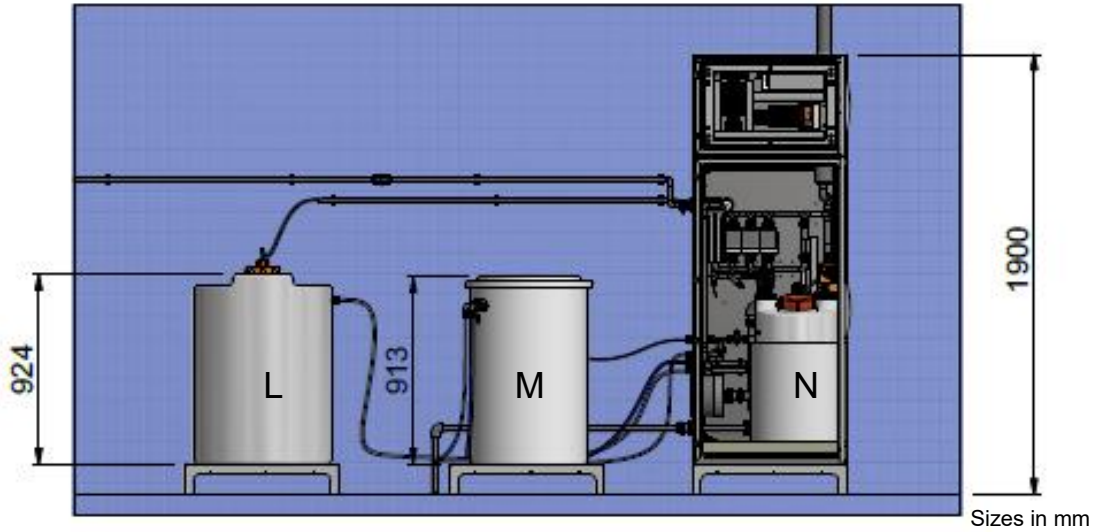
INSTALLATION CHLORINSITU® IIA SMALL



L – External product tank / Storage tank (optional)
M – Salt container
N – CHLORINSITU® IIa

- Internal Softener
- Level control storage tank- level switches/ ultrsonic sensor
- Equipped with modem for remote access.
- Monitored and safe hydrogen ventilation too outside.

Safe by Design
CSA/UL Listed
NSF61 Certified
EPA Establishment

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CHLORINSITU® IIA FEATURES

- **Easy operation**
  - Fully automatic operation
  - Only topping up of salt
  - Colour touch HMI with clean menu structure
- **Cabinet Plug & Play concept**
  - Quick and easy installation; no extensive labour time and costs
  - No ATEX problems
  - No room ventilation required for safe operation
  - Internal 50 litre chlorine product tank
  - Internal chlorine dosing pump
  - Level control for optional external chlorine product tank integrated
  - Water softener integrated
  - Modem standard
  - MODBus/BACnet optional
- **State of the art quality chlorine**
  - High chlorine concentration FAC 8 g/l
  - Low chlorate, less than 4% of FAC
  - Low chloride in product due to high salt efficiency

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CHLORINSITU® IIA MEDIUM 625-2,500 G/H

- 625 g/h = 33 PPD
- 1,250 g/h = 66 PPD
- 2,500 g/h = 132 PPD

Sodium Hypochlorite = 0,8%, pH=9

CSA/UL Listed

NSF50/61 Pending

PMRA Aquatics

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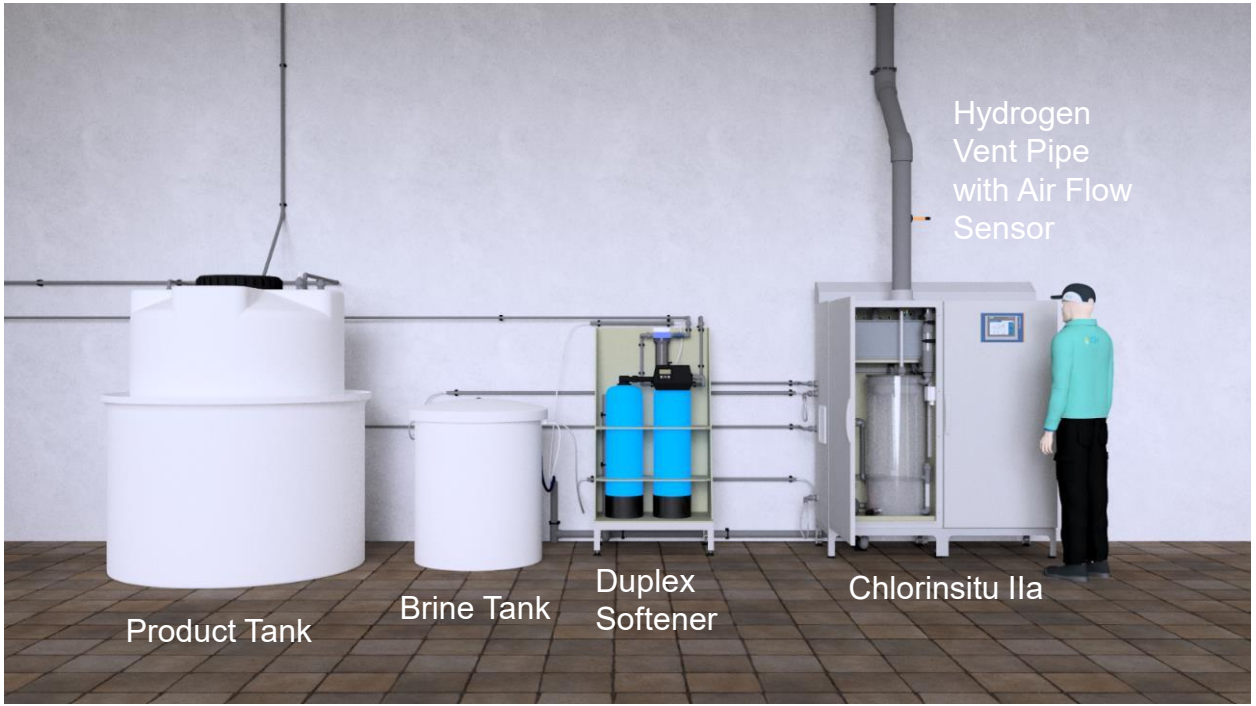
CHLORINSITU IIA 600 – 2.500 G/H INSTALLATION



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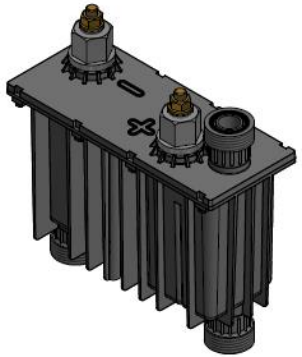
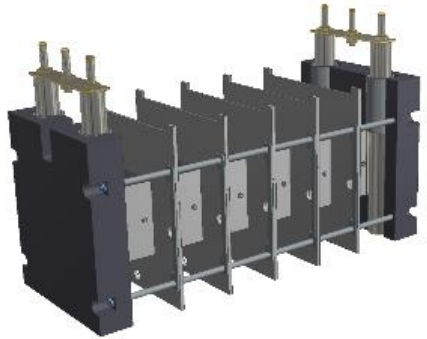
CHLORINSITU IIA SMALL/MEDIUM CELL

- Innovative and unique cartridge design
- New Box-Cells 60 g/h – 625 g/h – 2,500 g/h (equivalent)
- Very efficient flow path of the brine through cell results in outstanding efficiency:
  - **0.8% chlorine @ only 3 kg salt / kg chlorine**
- High safety due to barrage that prevents dry-running of the electrodes
- Can be flushed with acid solution to be cleaned and restore capacity
- Cell housing made from PVC





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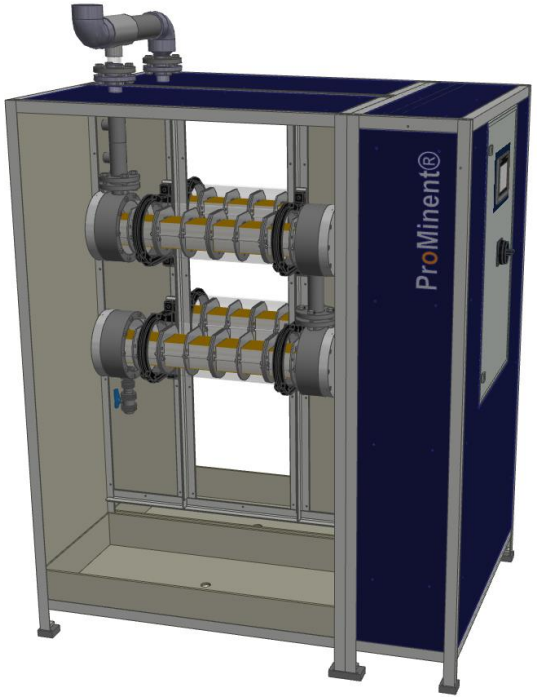
CHLORINSITU®-IIA XL

- 5,000 g/h = 265 PPD
- 7,500 g/h = 398 PPD
- 10,000 g/h = 530 PPD
- 15,000 g/h = 795 PPD
- 20,000 g/h = 1,060 PPD
- 30,000 g/h = 1,590 PPD
- 45,000 g/h = 2,385 PPD



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CHLORINSITU® IIA XL

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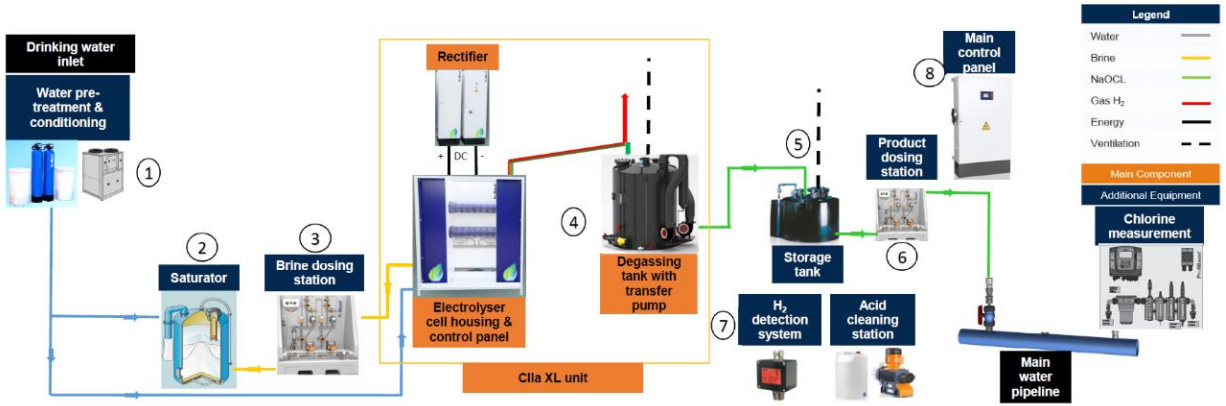
CONFIGURATION CIIA XL



1. Water pre-treatment and conditioning
2. Saturator – Preparation of salt solution
3. Brine dosing station
4. CIIa XL unit with degassing tank
5. NaOCl storage
6. NaOCl dosing stations
7. Accessories
8. Main control panel

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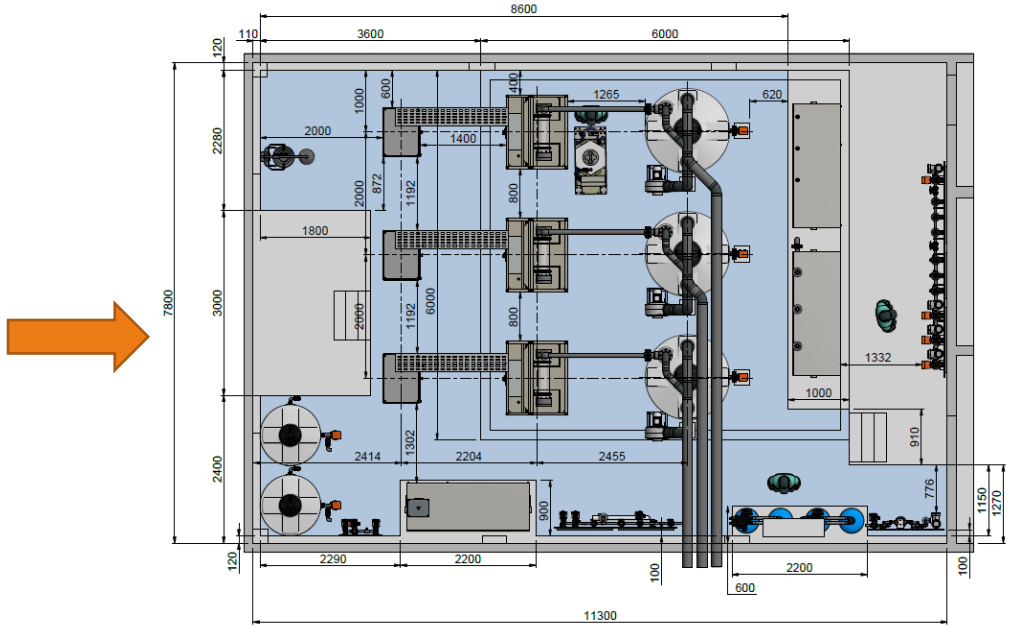
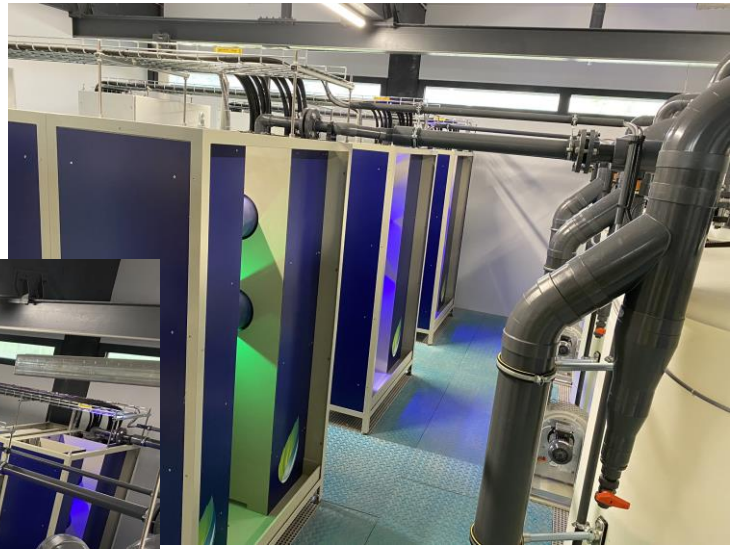
CHLORINSITU IIA XL: MUNICIPAL PARIS

- PM France/VDH supplies 3 x CHLORINSITU IIa XL 10 kg/h
- Replaced chlorine gas cylinders



DRINKING WATER TREATMENT PLANT PARIS

Morsang sur Seine



Chlorinsitu®-IIa XL
3x 10Kg

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DRINKING WATER TREATMENT PLANT PARIS

Salt storage

Brine tanks

Water supply

Brine dosing station

ProMinent®

Water works PM China

- Two Waterworks Fujian Province
- Avg. Flow: 70.000 m³/d
- Serving ~200.000 people
- CIIa XL 10kg & 15kg
- Chlorine Demand:
  - Pre-dosing: 2 mg/l
  - Post-dosing: 3 mg/l

MAINTENANCE AND SERVICE

ProMinent Fluid Controls and VDH

MAINTENANCE

- Maintenance highly recommended: Small Chemical Factory
- After Sales Opportunities:
  - 1- year Maintenance Pack
  - 3- year Maintenance Pack
  - Spare Part Packs
  - Updates/ Modifications
  - Training
  - Service contracts

Schedule a Maintenance visit every year with customer to avoid unexpected long down time.

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MAINTENANCE

- Maintenance Pack
  - BOM List
  - Check List
  - Maintenance Manual

BILL OF MATERIAL Maintenance Pack 1- Year DULCOLyse 100 g/h
Part number: 17400002

Description	Part number	Quantity
Water Filter Cardridge	27210102	1
Flat washer Ø30x20x2 FPM	14825692	2
Flat washer Ø24x14x2 FPM	14825697	4
O- ring 1-1/4" FPM	40000245	2
pH- Electrode PHES-112-SE	27210147	1
Solenoid valve S12 DN8	27210065	2
Spare part set 1601 PVT	27210129	1
O- ring Ø20,22x3,53 FPM	14825272	1
O- ring Ø28.17x3.5 FPM	14825412	4
O- ring Ø15,55x2,62 FPM	14825074	4
O- ring 1/2" FPM Hayward ball valve	40002604	4
Solenoid valve Gemu Type 102	27210066	1
O- ring 1/2" FPM	40000242	2
O- ring 3/4" FPM	40000244	3
Filter IP55 (Small, thick)	4000015906	1
Carton box 12"x10"x8"	39000026	1

MAINTENANCE SCHEDULE
DulcoflLyse 100 g/h
1 year

Costumer:	Date:		Capacity	
Ordernumber:	Name:		Number of cells	
Item	Action	Setpoint	P&I	Order number
1. Inspection				
1.1	Pressure parameters			
1.2	pH product	Analyze		
1.3	Cooling control cabinet	Check		
1.4	Amperage	Check		
1.5	Voltage	Cell 1	5.5 - 5.5 V DC	
		Cell 2	5.5 - 5.5 V DC	
		Cell 3	5.5 - 5.5 V DC	
1.6	Water hardness	Regenerate and check		
1.7	Production stop			
2. Softener				
2.1-3	Special pack	Dressing		
2.3	Watertiter	Replace	dP70	27210102
3. Brine tank				
3.1	Level switch	Check	ALAL10	
3.2	Strainer Suction side	Check and clean	dP210	
4. Process Water System				
4.1	Booster Pump Filter Insert	Clean	dP700	
4.2	Process Water Flow Meter	Clean	dP73	
4.3	Flat washers on the Water Jet Pump 40mm	Replace	dE40	2 x 14825697
4.4	Water Jet Pump Nozzle	Clean	dE40	
4.5	O-rings on the Vacuum Control Valve	Replace	dPHC44	40003604
4.6	O-rings on the Static Mixer	Replace	dM45	2 x 40000245
4.7	pH Sensor	Replace	dQAN45	27210147
4.8	Protect Valve	Replace	dSV45	27210065
4.9	Outlet Valve	Replace	dSV37	27210066
5. Caustic storage tank				
5.7	Caustic dosing pump revision set	Replace	dM45	27210129
5.8	Rinse	Clean	dP23	
6. Membrane cell				
6.2	O-rings on the Anode Side	Replace	dM50	14825272 + 14825412
6.3	O-rings on the Solenoid Brine valve	Replace	dSV25	2 x 14825074
6.4	O-rings on the Brine Valve	Replace	dHV32	40003604
7. Anode refresh tube				
7.1	PVDF Float for anode tube	Clean	dP54	
7.2	Bottom Grip Rod	Clean	dP54	
7.3	Refresh Valve	Replace	dSV38	27210066
7.4	O-rings on the Refresh ball valve	Replace	dHV38	40003604
7.5	O-rings on the caustic solenoid valve	Replace	dSV41	14825074
7.6	Flat Washers on the Water Jet Pump 25mm	Replace	dP28	14825697 + 2 x 14825692
7.7	Water Jet Pump Nozzle	Clean	dE42	
7.8	O-rings on the Anode Pipe	Replace	dP54	3 x 40003344 + 2 x 14825412
7.9	O-ring vacuumtransmitter	Replace		40000242
7.10	O-rings on the Aeration Valve	Replace		2 x 14825074

VDH water technology

MAINTENANCE MANUAL

CHLORINSITU® IIa 625-2,500 g/h

Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.

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THANK YOU FOR YOUR ATTENTION
Questions?