MPure™

Innovative Electrodeionization by MEGA a.s.

Czech Republic

MPure™ ELECTRODEIONIZATION

MEGA a.s. and MemBrain s.r.o.

Manufacturer of :

- ion-exchange membranes and spacers
- membrane stacks (ED, EDR)
- electromembrane systems

MemBrain

R&D institute with focus on:

- electromembrane processes
- hybrid membrane processes
- bipolar membranes
- gas separation

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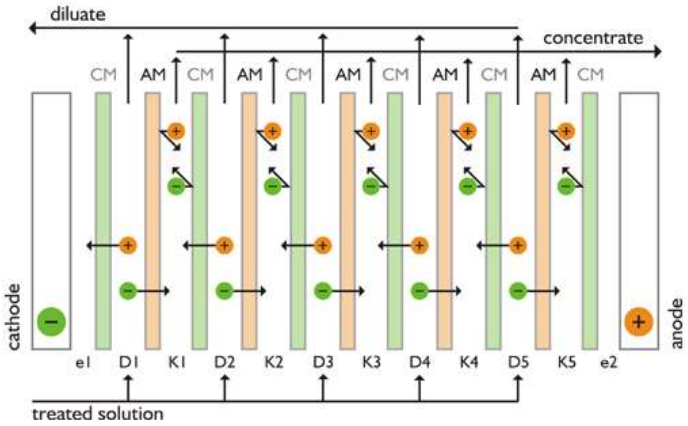
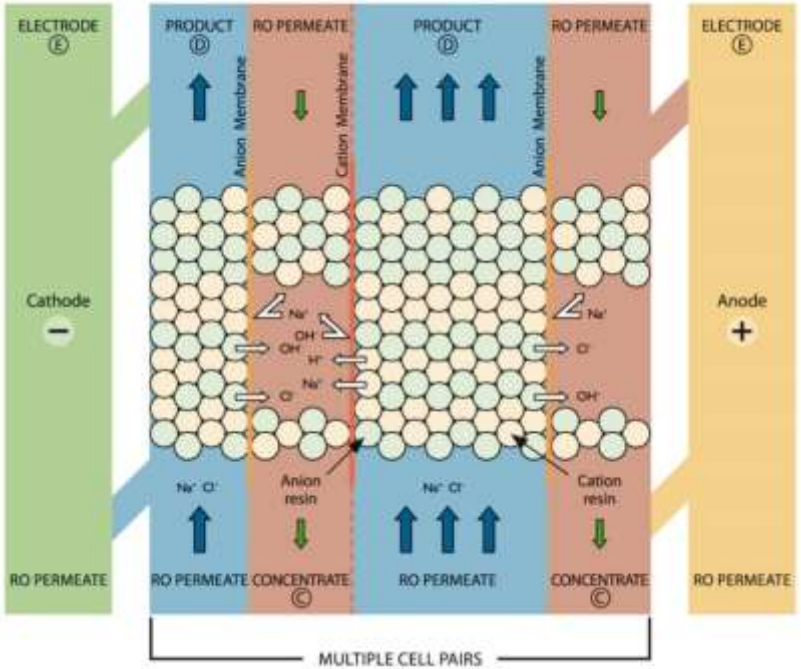
All E-Separation started with Electrodialysis



Electrodialysis (ED) is used to transport salt ions from one solution through ion-exchange membranes to another solution under the influence of an applied electric potential difference.

How EDI works



- Ion exchange of ions with resin beads
- Ions in the resin migrate toward the electrodes, through IX membranes and into C-chambers
- Water splitting produces H^+ and OH^- ions resulting in continuous regeneration
- Impurity ions trapped in C-chambers by membranes, H^+ and OH^- recombine to give H_2O

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EDI main markets

- **Power** (boiler feed water and injection in turbines) , Oil and Gas (boiler feed water)

- **Semiconductor** (rinse water incl. LCD & photovoltaic production)

- **Pharma (highly purified water)**

Total installed EDI capacity:

- More than 150 000 m^3/h (2013)
- More than 3 000 installations (capacity >5 m^3/h)

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Water quality requirements - POWER

Boiler Feed Water Quality

Table 1: ASME Suggested Water Chemistry Limits[1]

	Drum Operating Pressure, psi (MPa)[2]			
	751 – 900 (5.18-6.21)	901 – 1000 (6.22 - 6.89)	1001 – 1500 (6.90 - 10.34)	1501 – 2000 (10.35 - 13.8)
Feedwater				
Dissolved Oxygen, ppm (mg/L) O_2	< 0.007	< 0.007	< 0.007	< 0.007
Total Iron, ppm (mg/L) Fe	= 0.02	= 0.02	= 0.01	= 0.01
Total Copper, ppm (mg/L) Cu	= 0.015	= 0.01	= 0.01	= 0.01
Total Hardness, ppm (mg/L) as $CaCO_3$	= 0.1	= 0.05	ND	ND
pH @ 25°C (77°F)	8.3-10.0	8.8 - 9.6	8.8 - 9.6	8.8 - 9.6
Preboiler System Protection Chemicals, ppm	NS	VAM	VAM	VAM
Nonvolatile TOC, ppm (mg/L) as C	< 0.5	< 0.2	< 0.2	< 0.2
Oily Matter, ppm (mg/L)	< 0.5	< 0.2	< 0.2	< 0.2
Boiler Water				
Silica, ppm (mg/L) SiO_2	= 20	= 8	= 2	= 1
Total Alkalinity, ppm (mg/L) as $CaCO_3$	< 150	< 100	NS	NS
Free OH Alkalinity, ppm (mg/L) as $CaCO_3$	NS	NS	ND	ND
Specific Conductance, mS/cm	1,200-200	1,200-200	= 150	= 80
Steam Purity				
Total Dissolved Solids, ppm (mg/L)	0.5-0.1	0.5-0.1	0.1	0.1

[1] Refer to all applicable notes from ASME associated with this table for important information.

[2] NS = not specified; ND = not detectable; VAM = volatile alkaline materials.

VGB guidelines – R 450 Le (EU)

EPRI guidelines (USA)

ČSN 07 7401

ČSN 07 7403

ČSN EN 12952 - 12

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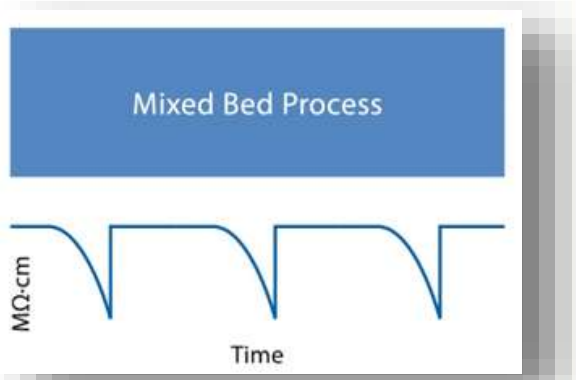
Key EDI Advantages vs. Mixed Bed

- **Eliminates harsh treatment chemicals**
  - Green Technology
  - Bulk chemical storage not required
  - Safety Considerations
- **Eliminates need for regeneration**
  - Continuous operation; improved quality
  - Simple to operate
  - Regeneration system not required
- **Lower operating cost**
- **Modular equipment, scalable**
- **Smaller footprint, could be made mobile**



MPure™ ELECTRODEIONIZATION

MEGA Capabilities

- IX Membrane expertise

- Stack manufacturing expertise

- Systems manufacturing capability

- High quality reputation

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MPure™ Value Proposition

- Equal or better Deionization & Silica performance vs. state-of-the-art EDI
  - Product water quality > 16 MOhm
  - Silica removal typically 96%

MPure™ Value Proposition

- Improved mechanical construction
- Improved stack robustness

Place for easy mounting lifting eyes

Side plates from AL alloy reinforced by construction ribs

Firm legs for easy mounting to the skid

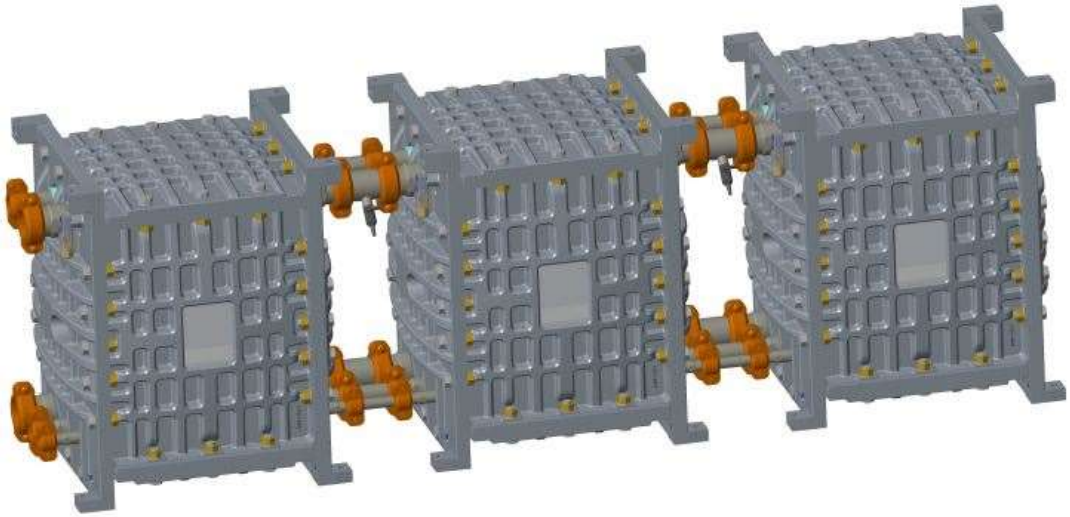
MPure™ Value Proposition

- Reduced system complexity and cost
- Cost competitive also for large flow rates
  - Up to 135 m3/h (594 gpm) – 9 stacks x 15 m3/h
  - Dimensions (mm) up to 4760x1500x2620 mm (LxDxH)

How to reduce EDI system manufacturing costs

- Increase stack flow rate
- Reduce system manifolds
- Reduce number of connections

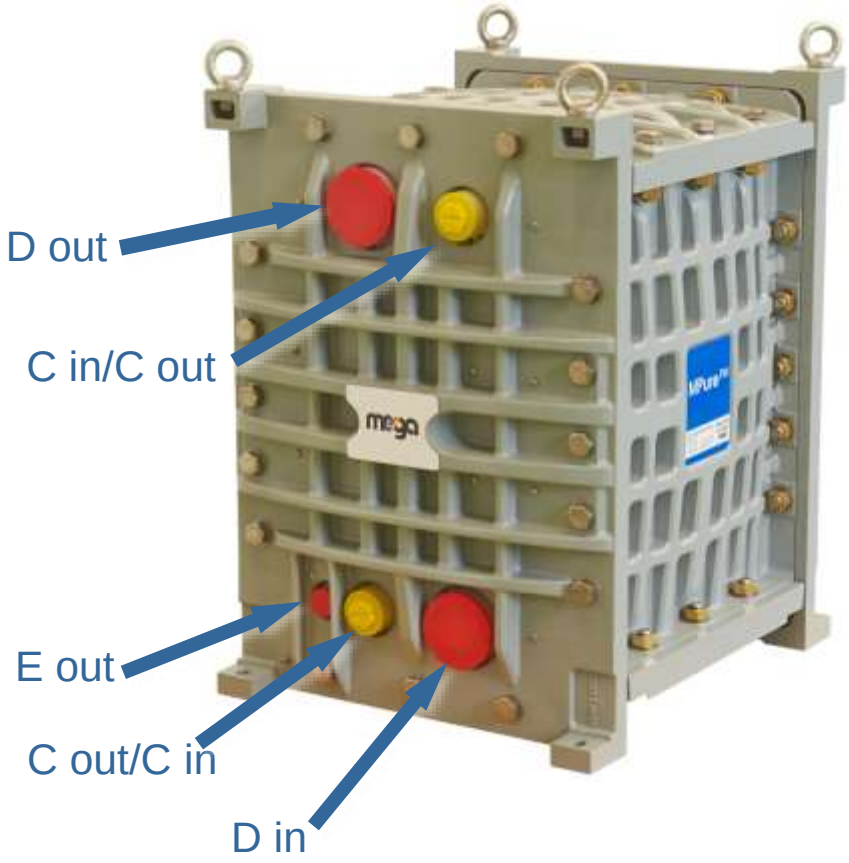
MPure™ Stack Interconnection



MPure™ Product Offering

- Stacks: MPure™ 36
- Systems: RALEX® HPWU units with 1 to 9 stacks and 5 to 135 m^3/h (22 – 594 gpm)
- Rectifiers (one per stack)
- Electrical and Hydraulic Connectors

MPure™ 36 Stack



MPure™ 36 Stack Specification

Physical Specifications

- Number of cell pairs: 36
- Dimensions (W x H x D): 582 x 802 x 697 mm
- Shipping weight: 330 kg (728 lb)
- Operating weight: 350 kg (772 lb)

		Victaulic
• Hydraulic Connections:	D	2½”
	C	1¼”
	E	¾”

MPure™ 36 Stack Specification

Stack Flow

- Flow nominal: 10 m^3/h (44 gpm)
- Flow maximum: 15 m^3/h (66 gpm)
- Flow minimum: 5 m^3/h (22 gpm)
- Concentrate flow: >0.3 m^3/h (>1.32 gpm)
- Electrode Flow: >0.1 m^3/h (> 0.44 gpm)
- Recovery: <97.5%

MPure™ 36 Stack Specification

Performance:

- Feed pressure: <7 bar (<101.5 psi)
- Pressure drop D @ Nom. Flow: 1.3-2.3 bar (18.9-33.4 psi)
- Pressure difference D>C: >0.3 bar (> 4.3 psi)
- Temperature: 5 – 40 °C (41 – 104 °F)
- Current: <16 A
- Voltage: <300 VDC
- Product water quality*: >16 MΩ.cm
- Silica removal*: >96%

* Please use MPure DESIGN to determine actual performance

MPure™ 36 Stack Specification

Feed water specifications

- TEA and TEC: <25 ppm as $CaCO_3$
- Feed water source: RO permeate or better
- Free Cl_2: <0.01 ppm Cl_2
- Oxidizing agents: N.D.
- Fe, Mn: <0.01 ppm
- Sulfide: <0.01 ppm H_2S
- Oil: N.D.
- Turbidity: <0.1 NTU
- SDI: <1
- pH: 4 – 10
- Total Hardness: <1 ppm as $CaCO_3$
- Total organics: <0.5 ppm TOC
- Silica: < 1.0 ppm SiO_2

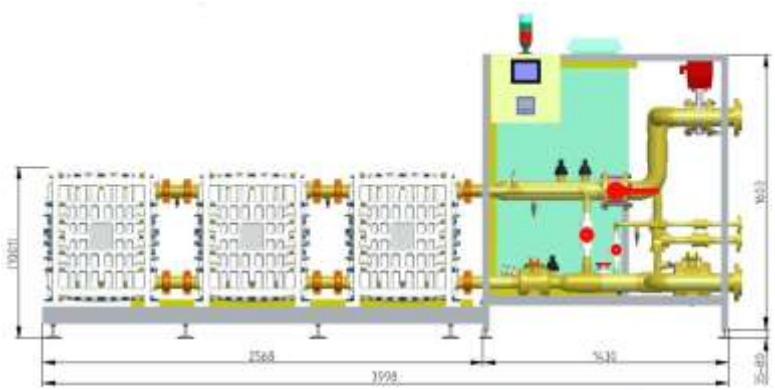
Rectifier solution – MPure™ DC

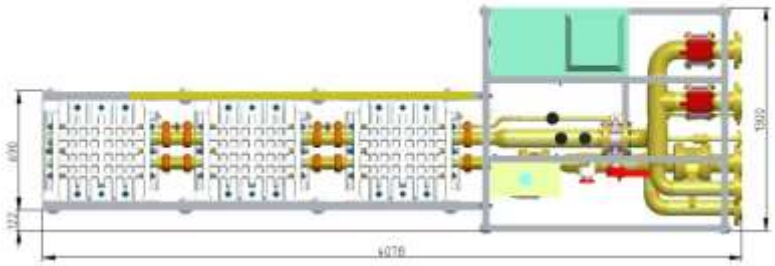
- Switch Mode Power Supply
- One recifier for each stack
- No isolation transformer
- Low ripple, very high effiency
- 4.8 kW: 300VDC/16A
- RS485 and CanOpen communication

Rectifiers inside an electrical cabinet

RALEX® HPWU units

Three MPure™ 36 stacks design





- Simple and cost-effective solution
- Small footprint, AISI 304 skid
- PLC with Ethernet interface
- No isolation transformers required
- CIP connections and auto divert valves included

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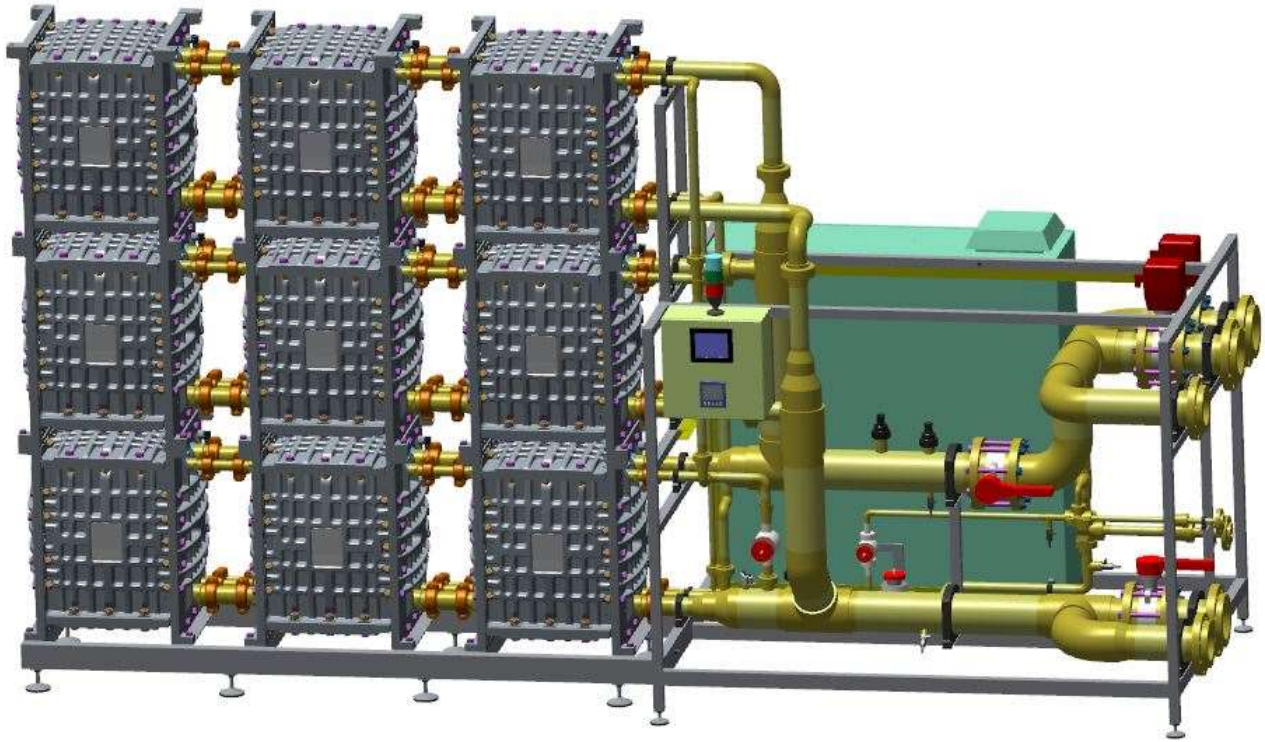
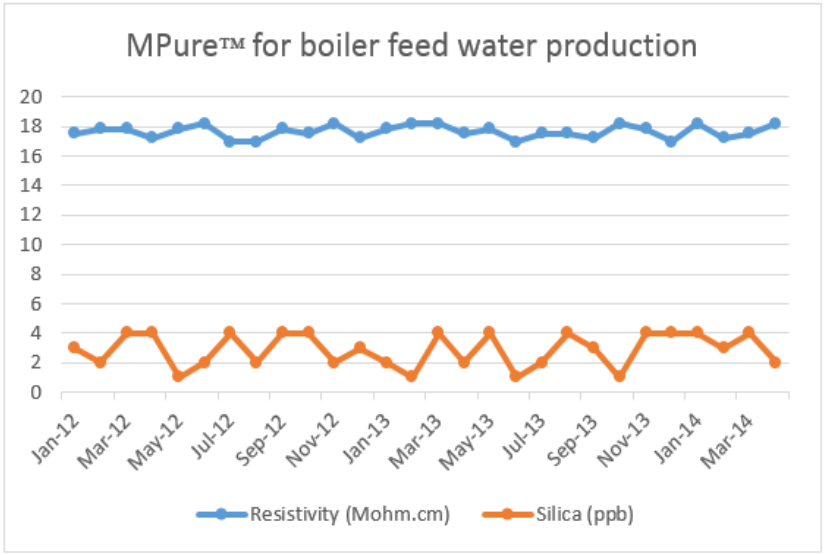
MPure™ System design

- Up to 135 m3/h (594 gpm) flow rate
- Small footprint

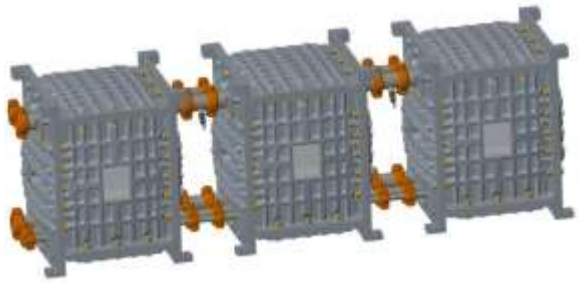


GEAM Demonstration Unit



MPure™ System Features

- Stack interconnection capability for low cost system
- High flow rate blocks, flows up to 45 m^3/h (200 gpm) per block
- High efficiency rectifiers
- CIP connections
- Automatic divert valves



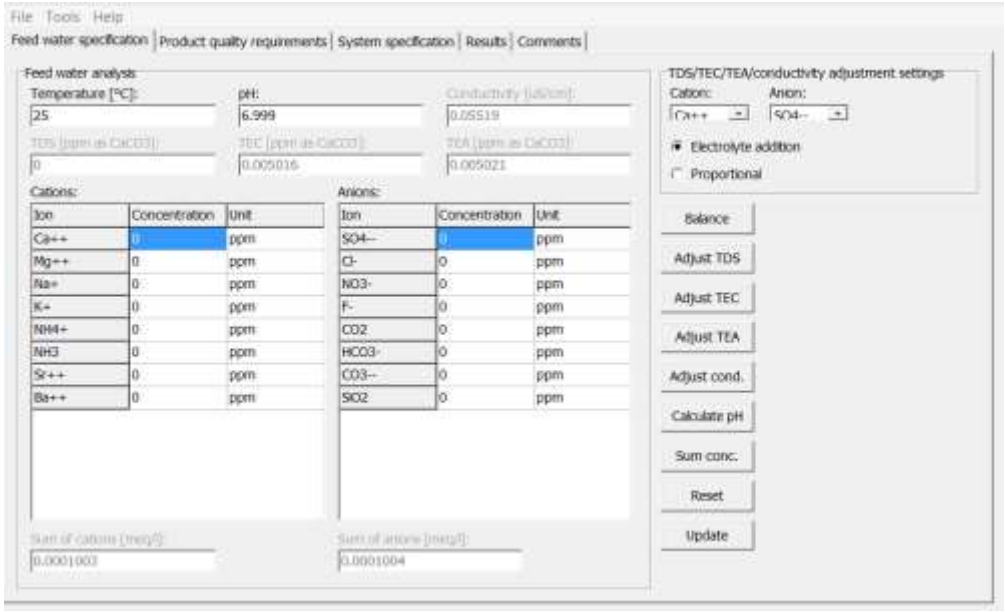
- Systems with flow rates from 5 to 135 m^3/h (22 - 600 gpm)
- High deionization with recovery up to 98.8%
- Robust design: No internal or external leaks
- Small footprint: ideal for operation inside containers

MPure™ information for OEM's

Download and Secure OEM section on www.ralex.eu with all EDI related materials

MPure™ Design Tools

- Engineering Manuals
- Design Software: **MPure™ DESIGN**
- Cost Calculation tool



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Key advantages of MEGA MPure™

- 25 year of experience in electro-separation
- Comparable or better performance versus main competitors
- Cost effective solution
- Flexible design up to 9 stacks for one unit
- Warranty for up to 2 years, estimated life-time 5-10 years
- European producer
- Excellent customer support
- Prompt delivery

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