



Ion Exchange Membranes

High-performance fumasep[®] ion exchange membranes for Electro Membrane Processes

A member of
BWT – For You and Planet Blue.



fumatech
Functional Membranes for Fuel Cells and Batteries

 **BWT GROUP**

The company

Focussing on water as the basis of all forms of life, and energy as the basis for a higher quality of life, FUMATECH “Functional Membranes and Plant Technology” combines the important tasks of providing energy and water. The company is engaged in the field of fuel cell technology and membrane separation technology, particularly for the treatment of aqueous solutions.



FUMATECH draws its particular strengths as a leading producer of ion-exchange membranes from its membership in the BWT Best Water Technology Group.

FUMATECH is committed to develop new products that will accelerate progress in polymer electrolyte fuel cells.

The company is both competent und competitive as a leading supplier of polymers and membranes for manufacturing of membrane electrode assemblies.

The high performance membranes are the heart of a proton exchange membrane (PEM) fuel cell stack.

FUMATECH produces and develops

- polyelectrolytes (funion® ionomers),
 - proton conductive membranes (fumapem® membranes) and
 - separation membranes (fumasep® membranes)
- based on proprietary technology and designed for high precision mass manufacturing.

- | | |
|----------------|---|
| ■ funion® | ionomer resin as granular polymer, in solution form or in dispersion |
| ■ funion® FF | granular perfluorosulfonyl fluoride resin for extrusion |
| ■ fumapem® F | perfluorosulfonic acid membranes for PEMFC |
| ■ fumapem® AM | polybenzimidazole membranes for high temperature PEMFC |
| ■ fumapem® ST | hydrocarbon membranes for DMFC and PEMFC |
| ■ fumapem® P,E | hydrocarbon membranes for DMFC |
| ■ fumapem® FAA | anion-exchange membrane for alkaline FC |
| ■ fumasep® FAP | anion-exchange membrane for redox flow batteries |
| ■ fumasep® FBM | bipolar membrane |
| ■ fumasep® HF | hollow fibre cartridge for gas humidification |
| ■ fumasep® | ion-exchange membranes for humidifier, electrodialysis and electrolysis |
| ■ fumea® | catalyst coated membranes for water electrolysis |

High-performance fumasep® ion exchange membranes for Electro Membrane Processes

FUMATECH – the company for functional membranes and plant technology – is one of the leading manufacturers of ion exchange membranes for different electrochemical operations.

Our modern coating plant produces porous, non-porous and functional membranes with excellent resistance to acids, bases, solvents and oxidation. With our new membrane coating line in a clean room, our further improved polymer production and a 'state of the art' air purification which will meet all future requirements, we do another important step in the new markets of water treatment technology, the innovative change of energy whilst using fuel cells as well as the energy storage with batteries.

fumasep® membranes are produced according to FUMATECH's proprietary solution casting technology. They are supplied in standard sheet sizes for example of 200 x 300 mm, 520 x 520 mm, 520 x 1050 mm and other sizes on request. The maximum width of 1650 mm could be produced on rolls with thicknesses ranging from 10 µm up to 500 µm.

Standard Grade Membranes

The fumasep® FAS and fumasep® FKS are standard homogeneous anion and cation exchange membranes for electrodialysis and reversed electrodialysis. They are cost saving membrane types with reinforcement as well as non reinforced films. Those membrane types are optimised in view of thickness, conductivity, permselectivity and area resistance, depending on the application. The recommended applications are for example desalination processes, concentration of salts, acids and bases, nitrogen removal from drinking water.

Membranes for Electrodialysis with Bipolar Membranes

Our products fumasep® FAB, FKB and FBM are designed and optimized for electrodialysis with bipolar membranes.

The EDBM is the combination of conventional electrodialysis for salt separation with electrochemical water splitting for the conversion of a salt into its corresponding acid and base.

fumasep® FAB is an anion exchange membrane which is developed for very low proton crossover to receive a high concentration of acid. fumasep® FKB is a cation exchange membrane optimised for high cation transport in combination with high OH⁻ retention. fumasep® FBM is a bipolar membrane, which induce the splitting of water into protons and hydroxide ions.

The bipolar membrane fumasep® FBM combines high selectivity and efficiency as well as high chemical stability within a broad pH range, excellent mechanical stability and low electrical resistance. It is ideally suited for the production of acid and base from the corresponding salts, as well as for innovative concepts such as biological fuel cells.

The patented multilayer membrane consists of a selective anion and cation exchange film. The dissociation of the water into protons and hydroxyl ions takes place in the special interface layer. The water is transferred into this layer by osmotic effects.

3-Compartment-Cell ED-Bipolar

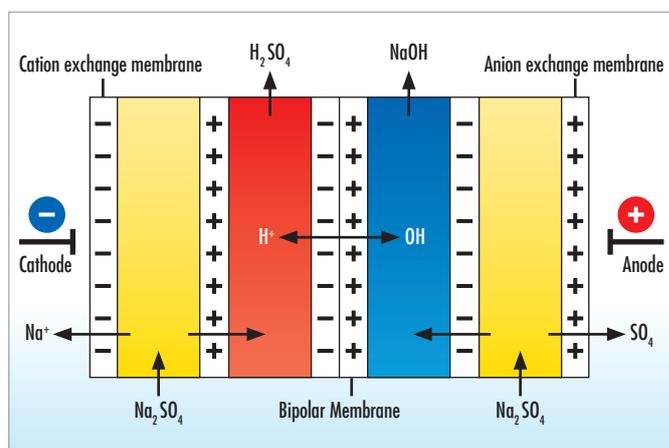


Figure 1: Electrolysis with bipolar membranes in a 3-compartment cell

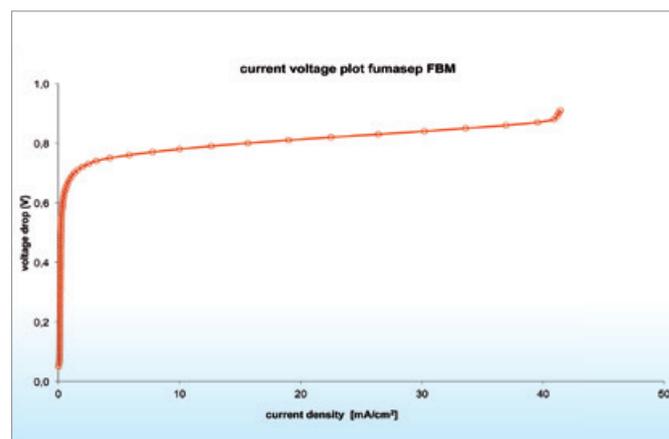
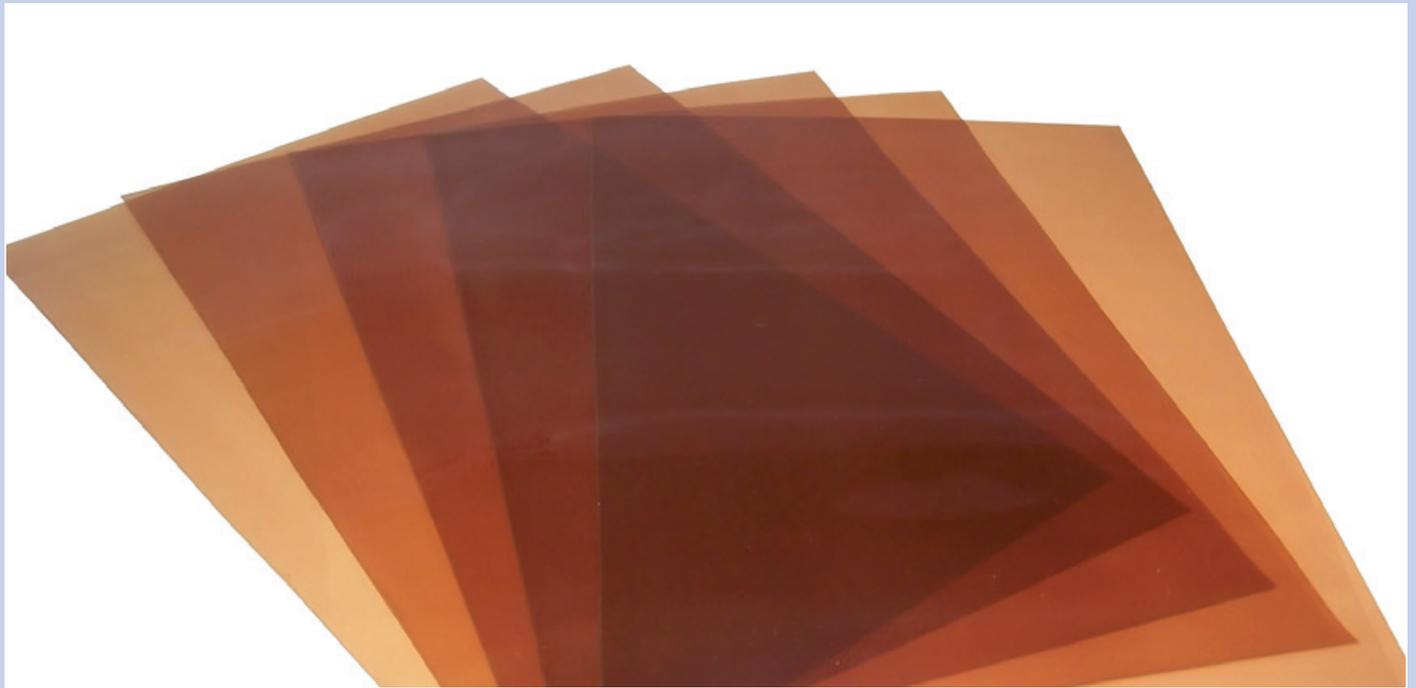


Figure 2: Current/voltage plot of fumasep® FBM bipolar membrane



Special Grade Membranes

The **fumasep® FAD** anion exchange membrane is a membrane type with excellent properties regarding proton and anion transport as well as high efficiency in view of the metal ions rejection. This characteristic is predestinated for the operation in diffusion dialysis processes for the recovery of free acids from spent treatment bath solutions for example in surface finishing and textile processes.

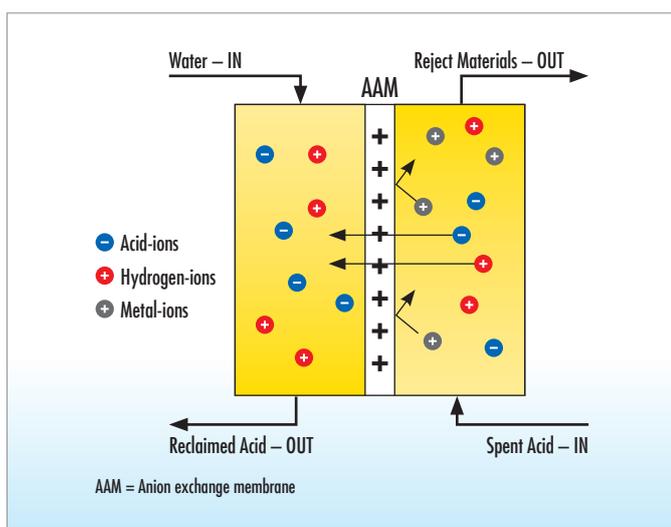


Figure 3: Diffusion dialysis in a 2-compartment cell

For base recovery by diffusion dialysis, the **fumasep® FKD** cation exchange membrane is used likewise.

Depending on the process design, up to 95 % of the free acid and up to 80 % of the base can be recovered in this way and returned to the production process, thus saving chemicals needed for the finishing baths or wastewater treatment.

fumasep® FAP is a chlorine resistant anion-exchange membrane which also allows the transport of protons. This membrane is used for applications that require highly permselective membranes with excellent oxidative stability, low area resistance and high mechanical stability.

fumasep® FAA is an alkaline stable anion-exchange membrane for electro dialysis applications.

fumasep® FKL is a cation-exchange membrane for concentration of bases by electro dialysis.

fumasep® FKE is a thin cation-exchange membrane and proton conductor for electrolysis with high selectivity.

Fluorinated Membranes for Electrolysis

The **fumasep F-types** are cation exchange membranes based on perfluorinated sulfonic acid/PTFE copolymers with excellent chemical stability and superior ionic conductance intended for use in electrolysis. The membranes are produced with and without reinforcement for highest mechanical and chemical stability. Further application is the production of sodium hypochlorite and hypochlorous acid for water disinfection.

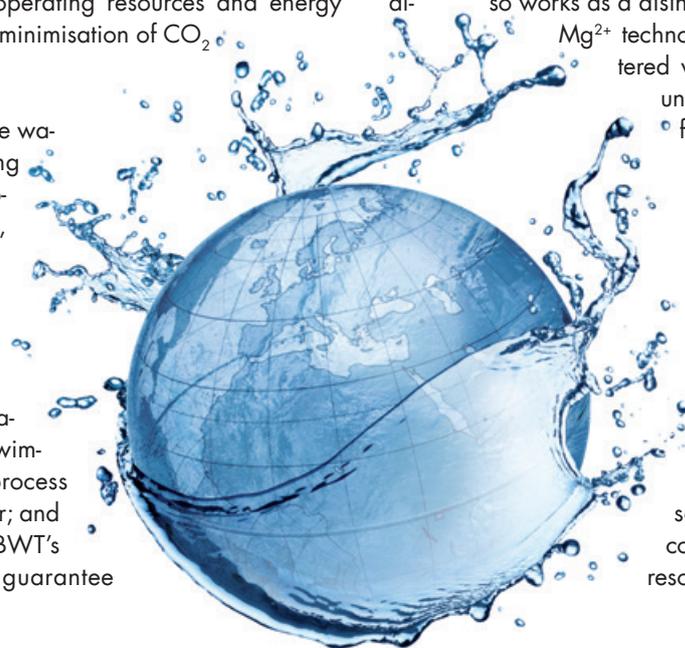
Physical and chemical properties

Type	Reinforcement	Thickness	IEC	Selectivity	Specific area resistance	Stability	
		µm	meq/g	%	Ωcm ²	pH	
Standard Grade Membranes							
FAS	anion	none	10-50	1.6-1.8	94-97	0.4-0.8	1-14
FKS	cation	none	10-50	1.3-1.4	98-99	0.9-1.9	1-14
FKS	cation	polyester	75-130	0.8-1.2	98-99	2.0-4.5	1-9
FAS	anion	polyester	75-130	1.0-1.4	92-97	2.0-3.0	1-9
Membranes for Electrodialysis with Bipolar Membranes							
FAB	anion	PEEK	100-130	1.0-1.1	94-97	4-7	1-14
FKB	cation	PEEK	100-130	1.2-1.3	98-99	4-6	1-14
FBM	bipolar	PEEK	180-200	–	–	–	1-14
Special Grade Membranes							
FAD	anion	polyester	75-90	1.5-1.7	>85	0.4-0.8	1-9
FKD	cation	PEEK	75-90	1.2-1.4	>94	1.0-1.2	1-14
FAP	anion	PEEK/PTFE	130-160	1.1-1.3	>91	1.1-1.3	1-11
FAA-3	anion	PEEK	100-130	1.4-1.6	94-96	1.9-2.5	1-14
FKL	cation	PEEK	100-130	1.0-1.2	98-99	6-10	1-14
FAA-3	anion	none	10-50	1.9-2.1	92-95	0.2-0.7	1-14
FKE	cation	none	10-50	1.4-1.5	98-99	0.3-0.9	1-14
Fluorinated Membranes for Electrolysis							
F-10150	cation	PFA	142-153	1.0	>95	<1.0	1-14
Ultrex™ Membranes							
AMI-7001	anion	polypropylene	500	1.3	>96	25-30	1-10
CMI-7000	cation	polypropylene	450	1.6	>97	25-30	1-10

BWT – The Company

Best Water Technology Group (BWT) is Europe's leading water technology company. Our water partner network comprises the group's 3,300 employees and thousands of plumbers, planners, architects and hygiene experts. Our Research & Development teams, using state-of-the-art methods, work on new processes and materials to create products that are both ecological and economical. Looking ahead, a key development issue is a reduction in the products' use of operating resources and energy consumption and the resulting minimisation of CO₂ emissions.

Whether at the place where the water pipe enters the building ('point of entry') or at the tapping point ('point of use'), BWT's trend-setting 'Made in Europe' products have proved their quality millions of times over in the treatment of: drinking water, mineral water and ultrapure water for the pharmaceutical industry; water for swimming pools; heating and process water; boiler and cooling water; and water for air-conditioning. BWT's wide-ranging innovations guarantee



maximum safety, hygiene and health in the daily use of water – that precious elixir of life. These innovations, among others, include: SEPTRON®, the world's first electrodeionisation module (EDI) with spiral wrap; manganese oxide activation (MDA) – a method for effective manganese removal; AQA total bipolar technology for chemical-free limescale protection; SANISAL – the world's first regeneration salt for softening water systems, which also works as a disinfectant; and the new, revolutionary Mg²⁺ technology that improves the taste of filtered water, coffee and tea. Through its unique, high efficiency membranes for fuel cells and batteries, BWT is creating a cleaner, more sustainable energy supply for the 21st century.

BWT – For You and Planet Blue signifies that our mission is to take ecological, economical and social responsibility, to provide our customers and partners with the best products, systems, technologies and services in all areas of water treatment and, at the same time, to make a valuable contribution to preserving the global resources of our blue planet.



For You and Planet Blue.

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