





Membrane Humidifiers

fumasep® High Performance Membrane Humidifiers for Fuel Cells

A member of
BWT – For You and Planet Blue.


fumatech
Functional Membranes for Fuel Cells and Batteries


Humidifier Modules for Fuel Cells

FUMATECH – the company for functional membranes and plant technology – is one of the leading manufacturers of ion exchange membranes for fuel cell application.

The Ecomate® membrane humidifier modules are highly permeable to water vapour. Modules are available with different sizes ranging from 0.7 kW to 110 kW. The modules have a low pressure drop and high heat recovery. Furthermore they are easy in assembling, handling and operation.

The state-of-the-art technologies for humidification of PEM fuel cells are mainly related to the direct injection of water into the gas stream or to the humidification of a gas stream by flowing of the air along a wetted membrane.

The performance of the PEM fuel cell is decisively dependent on the humidity of the electrolyte membrane and the humidifier plays an important role in moisturizing the electrolyte membrane.

The Ecomate® membrane humidifiers are capable of improving the humidification efficiency while lowering the pressure loss and are adaptable as passive type to be power free and to be volumetrically optimized.

Instead of the expensive fluorinated materials the Ecomate® membrane humidifier concept relies on non-fluorinated membranes with excellent heat and moisture exchange rates.

Make Your System Reliable and Efficient!

- Economical & Optimized Solution for PEMFC System
- Automotive, Forklift, Back-up, Industrial, mCHP Applications
- Operation Type: Gas-to-Gas and Liquid-to-Gas
- Available at Low to High Pressure Operation
- Excellent Heat and Moisture Transfer Efficiency
- Low Pressure Drop & High Thermal Durability
- Customizable with regard to Membrane & Module
- World Wide Technical Support
- Mass & High Speed Production

The fuel cell system cathode air humidity control is critical for maintaining a proper water balance system and an effective fuel cell performance. We have developed a line of water to gas and gas to gas humidifiers that address the most imperative design demands of fuel cell systems: cost, reliability and zero-power-consumption.

The design of the humidifier employs two different shapes, a cylindrical form for H7 and H02 size and cubic form for H05, H10, H20, H50 and H100 size.

The Ecomate® membrane humidifier modules are especially developed for application in fuel cell systems. These modules are designed as water to gas and gas to gas humidifiers. For the gas to gas humidifier, dry and pre-heated gas flows

through the hollow fiber bundles and gets humidified by adsorbing the water of the moisture interface of the hollow fiber membrane. Both flow configurations – co-current and counter-current – can be operated with these modules

The humidifiers show long operating live time with no power consumption. Our humidifiers are specifically designed to achieve effective water transfer through a series of micro-porous hollow fibres at a wide range of flow rates and temperatures.

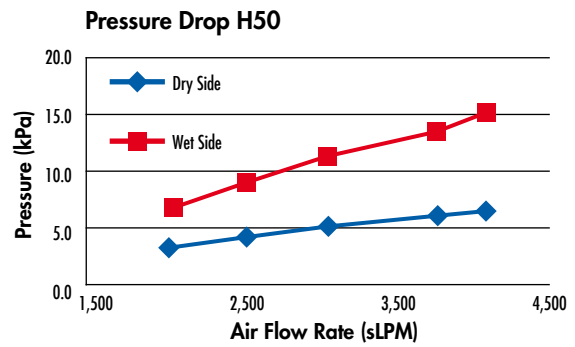
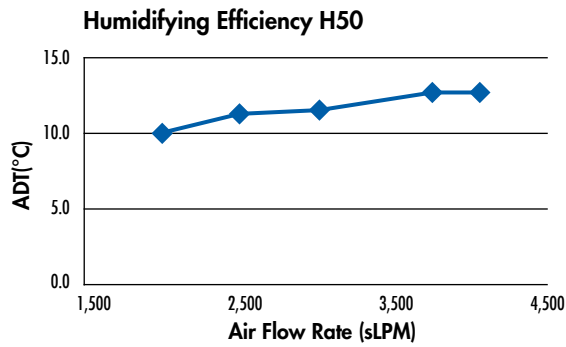
The lightweight, compact humidifier provides high humidification effectiveness irrespective of flow rates. The durability and reliability of our competitively priced product will make it attractive to fuel cell manufacturers that are seeking to improve the performance of their fuel cell systems.



Gas to Gas performance of Ecomate® H50

Performance of Ecomate® H50 gas to gas humidifier

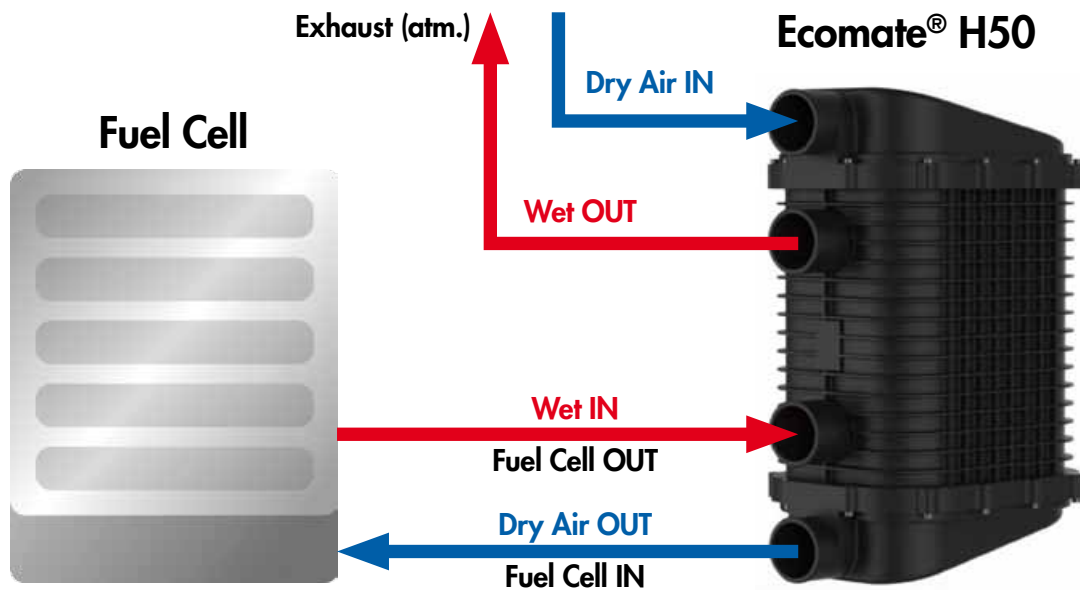
Connection to Fuel Cell



Operation data for Ecomate H50

Gas to Gas	Dry-in Flow rate in sPLM	Approach Dw Temperature in °C	Total Pressure Drop in kPa
	3,000	11	16

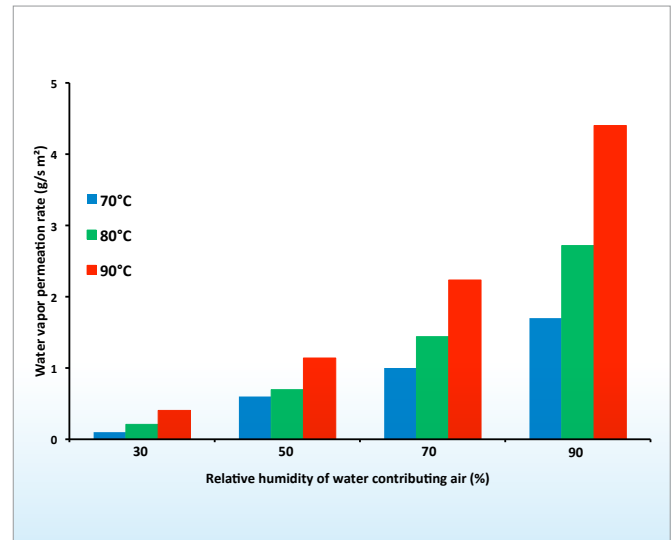
Connection to Fuel Cell



Ecomate®		H7	H02	H05	H10	H20	H50	H100
Design Parameters	Fuel Cell Power (Rated Air Flow)	~0.7 kW (30-70 sLPM)	1~3 kW (50-200 sLPM)	~7 kW (200-400 sLPM)	~10 kW (300-600 sLPM)	~30 kW (1200-2500 sLPM)	~70 kW (2000-4000 sLPM)	~110 kW (3000-6000 sLPM)
	Weight @dry, (kg)	0.4	0.6	3	3	5	6	7
	Volume w/o End-Cap, (Liter)	0.6	1	4	4	7	11	13
	Connecting Method	QFP14	QFP14	QFP22	QFP22 Clamping	Clamping (φ: 1.5 in)	Clamping (φ: 2 in)	Clamping (φ: 2 in)
Performance	ADT (°C, dependent on conditions)	4.5 °C @ 50 sLPM	8.0 °C @ 100 sLPM	8.5 °C @ 300 sLPM	12.7 °C @ 100 sLPM	13 °C @ 1,500 sLPM	11 °C @ 3,000 sLPM	13 °C @ 4,000 sLPM
	Total Pressure Drop (kPa, dependent on system pressure)	2.0 kPa @ 50 sLPM	4.8 kPa @ 100 sLPM	11 kPa @ 300 sLPM	26 kPa @ 600 sLPM	7.5 kPa @ 1,500 sLPM	16 kPa @ 3,000 sLPM	16 kPa @ 4,000 sLPM
Remarks		• Both Gas-to-Gas & Liquid-to-Gas humidification available						

General Specifications	
Fuel Cell Power	0.2 ~ 110 kW
Rated Air Flow Rate	30 ~ 6.000 sLPM
Flow Configuration	Counter & Co-Current
Life Time	Stationary > 10.000 hours
Power Requirement	0
Environmental Temperature	-30 °C to 110 °C
Operating Pressure	Moderate to 3 bar
Low Impurities (Cation & Anion Extract in Hot water)	< PPM (not harmful to MEA)
Humidification Efficiency (Approach Dew Temp.)	4 ~ 15 °C (Gas-to-Gas) 2 ~ 5 °C (Liquid-to-Gas)
Total Air Pressure Drop (shell + tube)	< 10 kPa @ Rated Flow Rate (dependent on total pressure)
Linear Dimensional Stability of Membrane	< 1 % to Moisture
Materials of Membrane	Polyimide, Polysulfone
Materials of Housing	PP-GF, PA-GF, PPA-GF (Non-flammable, Low Ion Extraction)

Flat sheet membrane for gas-to-gas humidification – Water transport rates of fumasep F-1020-RF



Humidifier Membranes for Fuel Cells & Enthalpy Recovery Ventilators (ERV)

FUMATECH also produces flat membranes for water transfer applications, made from perfluorinated sulfonic acid or polymers. The polymers are optimised for heat and water transfer rates in applications for fuel cells and house moistening.

The membranes are available in different thicknesses and equivalent weights and can be offered as plain films and with reinforcement.

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

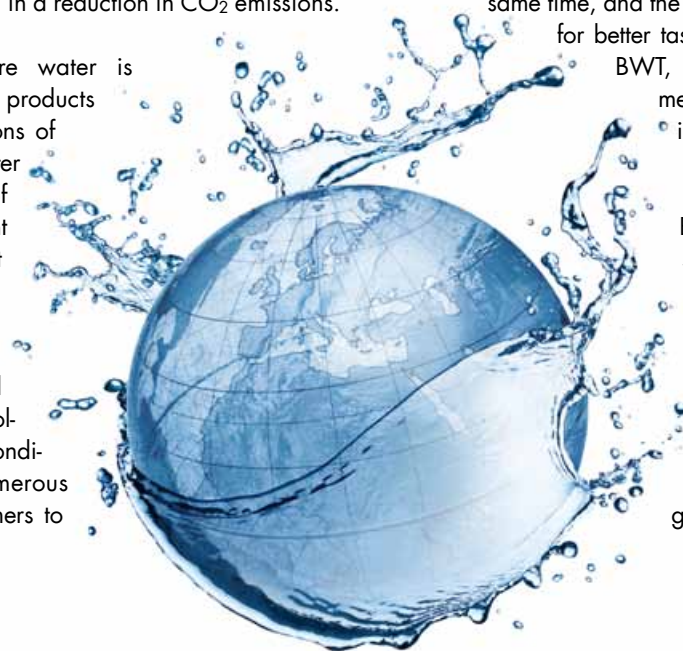
- polyelectrolytes (fumion® ionomers),
 - proton conductive membranes (fumapem® membranes) and
 - separation membranes (fumasep® membranes)
- based on proprietary technology and designed for high precision mass manufacturing.

- | | |
|----------------|---|
| ■ fumion® | ionomer resin as granular polymer, in solution form or in dispersion |
| ■ fumion® 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 |

BWT – The Company

The Best Water Technology Group is Europe's leading water technology company with 3,300 employees and a vast network of partner companies, service staff, installers, planners, architects and hygiene experts. Our R&D teams apply state-of-the-art methods and use the latest processes and materials to create products that are both economical and green. One of the key objectives is to reduce the resource and energy consumption levels of our products, resulting in a reduction in CO₂ emissions.

Practically everywhere where water is involved, BWT's pioneering products have proved their worth millions of times over; where domestic water enters a building ('point of entry') and at its tapping point ('point of use'), for the treatment of seawater, drinking water, mineral water, ultrapure water for pharmaceuticals, water for swimming pools, heating and process water, boiler water, cooling water and water for air-conditioning systems. Our numerous innovations enable our customers to



enjoy the highest levels of safety, hygiene and health in their daily use of water – the precious elixir of life. Among these are: SEPTRON®, the world's first Electrodeionisation module (EDI) with spiral winding, the MDA (manganese oxide activation) method for effective removal of manganese, AQA total bipolar technology for chemical-free limescale protection, SANISAL – the world's first regeneration salt for softening systems that also disinfects at the same time, and the revolutionary new Mg²⁺ technology for better tasting filtered water, coffee and tea.

BWT, with its unique, high-performance membranes for fuel cells and batteries, is setting the 21st century standard for the supply of clean energy.

BWT – For You and Planet Blue signifies our mission to take ecological, economic and social responsibility, and to provide our customers with the best products, systems, technologies and services in all areas of water treatment, while making a valuable contribution to the preservation of our blue planet's global resources.



For You and Planet Blue.

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