

德国 FuMATech 公司

FuMATech (FUMATECHBWTGmbH) 公司位于德国，是一家主要从事燃料电池技术和膜分离技术领域，特别是水溶液处理的高科技公司。FuMATech 公司的 DynamicTeam 受益于其高素质人员，在聚合物化学、膜生产和膜分离技术方面拥有 25 年以上经验。

FuMA-Tech公司离子交换膜使用领域包括：低温质子交换膜燃料电池 (LT-PEMFC)、高温质子交换膜燃料电池 (HT-PEMFC)、直接甲醇燃料电池 (DMFC)、碱性燃料电池 (AFC)、氧还原液流电池、电解槽和电渗析等。



FuMA-Tech 公司的产品丰富，包含有：阴离子交换膜 (AEM)、阳离子交换膜 (CEM/PEM) 双极膜 (BPM); 包含多个系列产品, 其中 Fumion 系列为离聚体树脂, 主要作为分散剂和粘合剂; Fumasep 系列主要用于电渗析和液流电池; Fumapem 主要用于燃料电池, 包括 AFC、PEMFC、DMFC 等, Fumea 系列主要是水电解用催化剂涂层膜。

1. Fumasep 电解用氟化膜

Fumasep-F型离子膜是基于全氟磺酸/PTFE的阳离子交换膜，具有优异的化学稳定性和离子电导性，主要用于电解。这些膜有和没有加强，均具有很高的机械强度和化学稳定性。进一步的应用是生产次氯酸钠和次氯酸进行水消毒，目前主要有 Fumasep-FS-830、Fumasep-FS-930、Fumasep-FS-950、Fumasep-FS-990-PK、Fumasep-F-930-RFD、Fumasep-F-1850、Fumasep-F-10120、Fumasep-F-10120-PK 八种型号。

1.1 Fumasep-FS-830 阳离子膜

fumasep®		FS-830
membrane type		cation exchange membrane
appearance / colour		transparent
backing foil		PET
reinforcement		none
counter ion		H ⁺ form
delivery form		Dry
thickness (dry)	µm	26 - 32
weight per unit area	g cm ⁻²	5,8 – 7,0
area resistance in 0.5 M H ₂ SO ₄ ^{a)}	Ω cm ²	< 0,11
area resistance in 0.25 M VOSO ₄ ^{a)}	Ω cm ²	< 0,26
area resistance in 0.25 M (VO) ₂ SO ₄ ^{a)}	Ω cm ²	< 0,15
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	> 98
uptake in 2 M H ₂ SO ₄ at T = 25 °C ^{c)}	wt %	< 12
dimensional swelling in 2 M H ₂ SO ₄ at T = 25 °C ^{d)}	%	< 15
uptake in vanadyl sulfate at T = 25 °C ^{c)}	wt %	< 5
dimensional swelling in vanadyl sulfate at T = 25 °C ^{d)}	%	< 4
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	260 – 320
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	19 – 27
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	38 – 50
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	90 – 150
bubble point test in water at T = 25 °C	bar	> 3
proton transfer rate ^{f)}	µmol min ⁻¹ cm ⁻²	> 10.000

a) measured in two-electrode cell (through-plane), T = 25 °C.

b) determined from membrane potential measurement in a concentration cell.

c) reference membrane dried over P₂O₅ *in vacuo*.

d) reference membrane as received

e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1.

f) determined from pH potential measurement in a concentration cell 0.5 M HCl / 0.5 M NaCl @ T = 25 °C.

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1.2 Fumasep-FS-930阳离子膜

fumasep®	unit	FS-930
membrane type		cation exchange membrane
appearance / color		transparent
backing foil		PET
reinforcement		none
counter ion		H ⁺ form
delivery form		dry
thickness (dry)	µm	26 – 34
weight per unit area	mg cm ⁻²	5.6 – 7.3
area resistance in 0.5 M H ₂ SO ₄ ^{a)}	Ω cm ²	< 0.1
conductivity in 0.5 M H ₂ SO ₄ ^{a)}	mS cm ⁻¹	> 33
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	> 99
uptake in 2 M H ₂ SO ₄ at T = 25 °C ^{c)}	wt %	< 18
dimensional swelling in 2 M H ₂ SO ₄ at T = 25 °C ^{d)}	%	< 11
uptake in vanadyl sulfate at T = 25 °C ^{e)}	wt %	< 6
dimensional swelling in vanadyl sulfate at T = 25 °C ^{d)}	%	< 6
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	> 200
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	> 10
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	> 25
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	> 140
proton transfer rate ^{f)}	nmol min ⁻¹ cm ⁻²	> 28000
Version ^{g)}	2.1	Valid from August 20 th 2020

- a) in 0.5 M H₂SO₄ solution @ T = 25 °C, measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement
- b) determined from membrane potential measurement in a concentration cell, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement
- c) reference membrane dried over P₂O₅ *in vacuo*
- d) reference membrane as received, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement
- e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement
- f) determined from pH potential measurement in a concentration cell 0.5 M HCl / 0.5 M NaCl @ T = 25 °C
- g) Changes without prior notices may apply.

1. 2. 1 Fumasep-FS-950阳离子膜

fumasep®		FS-950
membrane type		cation exchange membrane
appearance / colour		transparent
backing foil		PET
reinforcement		none
counter ion		H ⁺ form
delivery form		Dry
thickness (dry)	µm	45 -55
weight per unit area	g cm ⁻²	8,2 – 9,2
area resistance in 0.5 M H ₂ SO ₄ ^{a)}	Ω cm ²	< 0,1
area resistance in 0.25 M VOSO ₄ ^{a)}	Ω cm ²	< 0,3
area resistance in 0.25 M (VO) ₂ SO ₄ ^{a)}	Ω cm ²	< 0,15
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	> 98
uptake in 2 M H ₂ SO ₄ at T = 25 °C ^{c)}	wt %	< 8
dimensional swelling in 2 M H ₂ SO ₄ at T = 25 °C ^{d)}	%	< 6
uptake in vanadyl sulfate at T =25°C ^{c)}	wt %	< 5
dimensional swelling in vanadyl sulfate at T =25°C ^{d)}	%	< 4
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	270 – 340
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	19 – 28
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	36 – 50
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	90 – 150
bubble point test in water at T = 25 °C	bar	> 3
proton transfer rate ^{f)}	µmol min ⁻¹ cm ⁻²	> 8000

a) measured in two-electrode cell (through-plane), T = 25 °C.

b) determined from membrane potential measurement in a concentration cell.

c) reference membrane dried over P₂O₅ *in vacuo*.

d) reference membrane as received

e) determined by stress-strain measurement at T = 25°C and 50 % r.h., according to DIN EN 527-1.

f) determined from pH potential measurement in a concentration cell 0.5 M HCl / 0.5 M NaCl @ T = 25 °C.

1. 2. 2 Fumasep-FS-990-PK阳离子膜

fumasep®		FS-990-PK
membrane type		cation exchange membrane
appearance ^{a)}		slightly brownish
backing foil		PET
reinforcement		PK
counter ion		H form
delivery form		dry
thickness	µm	85 – 105
weight per unit area	mg cm ⁻²	13 – 17
Dimensional swelling X-Y	%	< 2
IEC	meq.g ⁻¹	1,1 – 1,25
In-plane conductivity @ 25 °C	mS.cm ⁻¹	> 60
Through-plane conductivity @ 25°C	mOhm.cm ²	< 300
Young's modulus at 23 °C / 50 % r.h. ^{b)}	MPa	500 – 1000
tensile strength at 23 °C / 50 % r.h. ^{c)}	MPa	30 – 60
elongation at break at 23 °C / 50 % r.h. ^{c)}	%	> 20
burst test in water at T = 25 °C	bar	> 3

a) the color of the product may vary slightly.

b) and c) determined by stress-strain measurement at T = 25°C and 50 % r.h., according to DIN EN 527-1.

1.2.3 Fumasep-F-930-RFD阳离子膜

fumasep®		F-930-RFD
membrane type		cation exchange membrane
appearance / colour		transparent / slightly opaque
backing foil		PET
reinforcement		yes
counter ion		H ⁺ form
delivery form		Dry
thickness (dry)	µm	28 - 35
weight per unit area	g cm ⁻²	5,9 – 7,7
area resistance in 0.5 M H ₂ SO ₄ ^{a)}	Ω cm ²	< 0,21
area resistance in 0.25 M VOSO ₄ ^{a)}	Ω cm ²	< 0,3
area resistance in 0.25 M (VO) ₂ SO ₄ ^{a)}	Ω cm ²	< 0,6
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	> 97
uptake in 2 M H ₂ SO ₄ at T = 25 °C ^{c)}	wt %	< 8
dimensional swelling in 2 M H ₂ SO ₄ at T = 25 °C ^{d)}	%	< 6
uptake in vanadyl sulfate at T =25°C ^{c)}	wt %	< 6
dimensional swelling in vanadyl sulfate at T =25°C ^{d)}	%	< 4
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	290 – 340
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	-
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	37 – 49
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	80 – 150
bubble point test in water at T = 25 °C	bar	> 3
proton transfer rate ^{f)}	µmol min ⁻¹ cm ⁻²	> 7.500

a) measured in two-electrode cell (through-plane), T = 25 °C.

b) determined from membrane potential measurement in a concentration cell.

c) reference membrane dried over P₂O₅ *in vacuo*.

d) reference membrane as received

e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1.

f) determined from pH potential measurement in a concentration cell 0.5 M HCl / 0.5 M NaCl @ T = 25 °C.

1.2.4 Fumasep-F-1850阳离子膜

fumasep®		F-1850
membrane type		cation exchange membrane
appearance / colour		transparent, colourless
backing foil		PET (white)
reinforcement		none
thickness (dry)	µm	45 – 50
weight per unit area	mg cm ⁻²	9,9 – 10,9
area resistance in 0.5 M H ₂ SO ₄ ^{a)}	Ω cm ²	< 0.3
conductivity in 0.5 M H ₂ SO ₄ ^{a)}	mS cm ⁻¹	17.8
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	>99
uptake in 2 M H ₂ SO ₄ at T = 25 °C ^{c)}	wt %	6
dimensional swelling in 2 M H ₂ SO ₄ at T = 25 °C ^{d)}	%	4
uptake in vanadyl sulfate at T =25°C ^{c)}	wt %	3
dimensional swelling in vanadyl sulfate at T =25°C ^{d)}	%	4
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	> 230
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	8 – 12
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	24 – 30
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	360 – 390

a) in 0.5 M H₂SO₄ solution @ T = 25 °C, measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement.

b) determined from membrane potential measurement in a concentration cell, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement.

c) reference membrane dried over P₂O₅ *in vacuo*.

d) reference membrane activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement.

e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min. before measurement.

1.2.5 Fumasep-F-10120-PK阳离子膜

fumasep®		F-10120-PK
membrane type		cation exchange membrane
appearance / colour		transparent, colourless
backing foil		PET foil
reinforcement		PK
counter ion		H-form
delivery form		dry (non-activated)
Lot No		M28571505
thickness (dry, as received)	µm	120 – 135
weight per unit area	mg cm ⁻²	25
IEC (ion exchange capacity)	meq g ⁻¹	0.79
area resistance in 0.5 M H ₂ SO ₄ ^{a)}	Ω cm ²	0.33
conductivity in 0.5 M H ₂ SO ₄ ^{a)}	mS cm ⁻¹	54.4
area resistance in 0.5 M H ₂ SO ₄ and 0.4 M VOSO ₄ ^{a)}	Ω cm ²	0.98
conductivity in 0.5 M H ₂ SO ₄ and 0.4 M VOSO ₄ ^{a)}	mS cm ⁻¹	18.1
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	95
uptake in 2 M H ₂ SO ₄ at T = 25 °C ^{c)}	wt %	13
dimensional swelling in 2 M H ₂ SO ₄ at T = 25 °C ^{d)}	%	4
uptake in vanadyl sulfate at T = 25°C ^{c)}	wt %	10
dimensional swelling in vanadyl sulfate at T = 25°C ^{d)}	%	2
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	660 – 830
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	–
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	35 – 36
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	38 – 42
bubble point test in water at T = 25 °C	bar	> 3

a) measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
b) determined from membrane potential measurement in a concentration cell sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
c) reference membrane dried over P₂O₅, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
d) reference membrane stored in solution for 24 hrs, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1 measurement.

1.2.6 Fumasep-F-10120阳离子膜

fumasep®		F-10120
membrane type		cation exchange membrane
appearance / colour		transparent, colourless
backing foil		PET foil
reinforcement		none
counter ion		H-form
delivery form		dry
weight per unit area	mg cm ⁻²	2.4
thickness (dry, as received)	µm	114 – 124
IEC (ion exchange capacity)	meq g ⁻¹	0.88 – 0.91
area resistance in 0.5 M NaCl ^{a)}	Ω cm ²	0.79
conductivity in 0.5M NaCl ^{a)}	mS cm ⁻¹	14.3
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	93 – 94
uptake in H ₂ O at T = 25 °C in H-form ^{c)}	wt %	24
dimensional swelling in H ₂ O at T = 25 °C in H-form ^{d)}	%	13 – 14
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	205 – 218
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	9
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	27 – 31
elongation at break at 23 °C / 50 % r.h. ^{e)}	%	235 – 277
proton transfer rate ^{f)}	µmol min ⁻¹ cm ⁻²	6910
bubble point test in water at T = 25 °C	bar	> 3

a) measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
b) determined from membrane potential measurement in a concentration cell, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
c) reference membrane dried over P₂O₅ in vacuo.
d) reference membrane dried, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.
f) determined from pH potential measurement in a concentration cell 0.1 M HCl / 0.5 M NaCl @ T = 25 °C, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min before measurement.