

Supporting Information to: Resistance of ion exchange membranes in aqueous mixtures of monovalent and divalent ions and the effect on reverse electro-dialysis

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1. Composition of the solutions used for testing FKS-50 and FAS-50 as presented in Figure 5.

Source: Gómez-Coma et al. 2019 [1].

Exp	NaCl (M)	MgCl ₂ (M)	CaCl ₂ (M)	Rarea (Ω·cm ²)
1	6·10 ⁻⁴	0	0	1.92
2	0.02	0	0	1.34
3	0.02	1·10 ⁻⁴	0	2.36
4	0.02	1·10 ⁻³	0	4.87
5	0.02	0	1·10 ⁻⁴	2.04
6	0.02	0	1·10 ⁻³	4.40
7	0.02	0	5·10 ⁻³	5.81
8	6·10 ⁻⁴	2.86·10 ⁻⁴	1.19·10 ⁻³	5.47
9	0.02	2.4·10 ⁻³	1.5·10 ⁻³	5.46
10	0.043	1.1·10 ⁻³	2.0·10 ⁻⁴	3.56
11	0.55	0	0	1.05
12	1	0	0	1.11
13	1	0.05	0	2.14
14	1	0.1	0	2.53
15	1	0.2	0	2.72
16	1	0	0.01	1.93
17	1	0	0.02	2.03
18	1	0	0.1	2.91

Table S1. Resistances of FKS-50 measured at 297±1 K

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Exp	NaCl (M)	Na ₂ SO ₄ (M)	R _{area} (Ω·cm ²)
1	6·10 ⁻⁴	0	1.78
2	0.02	0	1.42
3	0.02	1·10 ⁻⁴	1.79
4	0.02	1·10 ⁻³	1.99
5	0.02	5·10 ⁻³	2.04
6	0.55	0	1.11
7	1	0	1.22
8	1	0.01	1.23
9	1	0.06	1.27
10	1	0.1	1.31

Table S2. Resistances of FAS-50 measured at 297±1 K**2. Composition of the solutions used for testing CMX as presented in Figure 6.**

Source: Galama et al. 2014 [2].

Exp	NaCl (M)	R _{area} (Ω·cm ²)	R _{area} (Ω·cm ²)
		DC	AC
1	0.01	119.47	33.78
2	0.1	11.65	5.74
3	0.3	4.35	3.50
4	0.5	3.43	3.13
5	0.7	3.24	3.21
6	0.9	3.47	3.25
7	1.1	3.41	3.04

Table S3. Resistances of CMX measured at 298 K with direct current (DC) and with alternating current (AC).**3. Composition of the solutions used for testing Fuji-CEM-80050 as presented in Figure 7.**

Source: Avci et al. 2016 [3].

Exp	NaCl (M)	MgCl ₂ (M)	R _{area} (Ω·cm ²)
1	1	0	3.284
2	0.9	0.1	8.579
3	0.8	0.2	11.6
4	0.6	0.4	18.5
5	0.4	0.6	22.52
6	0.2	0.8	24.4
7	0	1	26.88

Table S4. Resistances of Fuji-CEM-80050 CMX measured at 298 K.**4. Composition of the solutions used for testing AMX and CMX as presented in Figure 7.**

Source: Kuno et al. 2017 [4].

Exp	NaCl (M)	MgSO ₄ (M)	R _{area} (Ω·cm ²)	R _{area} (Ω·cm ²)
			AMX	CMX
1	0.508	0	2.122	2.175
2	0.4826	0.0254	2.443	3.61
3	0.4572	0.0508	2.499	4.196
4	0.381	0.127	2.613	5.902
5	0.254	0.254	2.891	9.151
6	0	0.508	4.244	14.48

Table S5. Resistances of AMX and CMX. .

5. Specifications of the discussed membranes.

Specs	FAS-50	FKS-50	FAS-PET-75	FKS-PET-75	CMX	AMX	Fuji-CEM-80050
Manufacturer	Fumatec BWT GmbH, Germany				ASTOM Co., Ltd, Japan		Fujifilm B.V. The Netherlands
Type	AEM	CEM	AEM	CEM	AEM	CEM	CEM
Ref.	[5]	[5]	[5]	[5]	[6] [7]	[6] [7]	[4]
Exchange group	~Br ⁻	~H ⁺	~Br ⁻	~H ⁺	~SO ₃ ⁻	~N ⁺ (CH ₃) ₃	~N ⁺ (CH ₃) ₃
Backbone	PET	PET	PET	PET	Styrene + divinylbenzene		polyolifin
Reinforcement	no	no	PET	PET	PVC		Electrospun nanofibers
Thickness (μm)	45 - 55	45 - 55	70-80	74 - 87	164	134	114 ± 2
IEC (meq/g)	1.6 - 2.0	1.2 - 1.4	1.2-1.4	1.0 - 1.25	1.62	1.25	1.1 ± 0.1
R _{area} (Ωcm ²)	0.6 - 1.5	1.8 - 2.5	1.2-2.0	< 2.5	2.91	2.35	3.0
Perm-selectivity (%)	92 - 96	97 - 99	94-97	> 95	99.0	90.7	-
H ₂ O up-take (%)	10 - 25	10 - 20	15-25	-	18	16	-
CD meq/gH ₂ O	14.4	8.0	12.0	-	9.0	7.8	2.4

6. Experimental techniques

Applied	Gómez-Coma et al.	Gómez-Coma et al.	Galama et al.	Kuno et al.	Avci et al.
Ref.	[1]	This paper	[2]	[4]	[3]
Membranes	FAS-50 FKS-50	FAS-PET-75 FKS-PET-75	CEM	AMX CMX	Fuji-CEM-80050
Preconditioning	.	24 h	3 x 24 h	?	3 x 8 h
Temp. (K)	297	297	298	?	298
Compartments in cell	2	2	6	2	2
Work /counter electrodes	Hg Direct contact	Hg Direct contact	.Pt covered Ti	?	Ag/AgCl covered Ag
Reference electrodes	no	no	Ag/AgCl via Haber-Luggin capillaries	no	Ag/AgCl via Haber-Luggin capillaries

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