

## Supplementary Material

### Recovery of ionic liquids from aqueous solutions using membrane technology aqueous solutions

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#### S1 - Membranes

**Table S1.** Membranes and corresponding ionic liquid rejection reported in literature.

Membrane	Ionic Liquid	IL Rejection	Reference
Desal DVA 032	[BMIM][BF <sub>4</sub> ]	82.0 %	Kröckel et al. [1]
Desal DVA 00		95.0 %	
FilmTec NF90	ChCl:EGLY	20.0 %	Haerens et al [2]
DK		88.0 %	
FilmTec BW30XLE		90.5 %	
FilmTec 102326		91.1 %	
Desal DK	[MMIM][DMP]	86.8 %	Abels et al. [3]
Desal DL		85.7 %	

Starmem 240			85.6 %	
BW30LE-RO	[mTBDH][OAc]	52 %		Sosa et al. [4]
	[mTBNH][OAc]	23.2%		
NF270-NF	[mTBDH][OAc]	48%		
	[mTBNH][OAc]	46.5%		
NF membrane made from polyamide with polysulfone support (FilmTec, DuPont, Minnesota, USA)	[BMIM][Cl]	33.8 %		Jianguo et al. [5]
	[C10MIM][Cl]	94.1%		
NF90	[AMIM][Cl]	92.0%		Wang et al. [6]
	[BMIM][Cl]	94.7%		
	[BMIM][BF4]	89.3%		
NF270	[AMIM][Cl]	69.0 %		
	[BMIM][Cl]	87.3 %		
	[BMIM][BF4]	81.6 %		

[BMIM][BF4] - 1-butyl-3- methylimidazolium tetrafluoroborate

ChCl:EGLY – Choline Chloride : Ethylene glycol

[MMIM][DMP] - 1,3-dimethylimidazolium dimethylphosphate

[mTBDH][OAc] - 7-methyl-1,5,7- triazabicyclo[4.4.0]dec-5-enium acetate

[mTBNH][OAc] - 5- methyl-1,5,7-triaza-bicyclo[4.3.0]non-6-enium acetate

[BMIM][Cl] - 1-butyl-3-methylimidazolium chloride

[C<sub>10</sub>MIM][Cl] - 1-Decyl-3-methylimidazolium chloride

[AMIM][Cl] - 1-allyl-3-methylimidazolium chloride

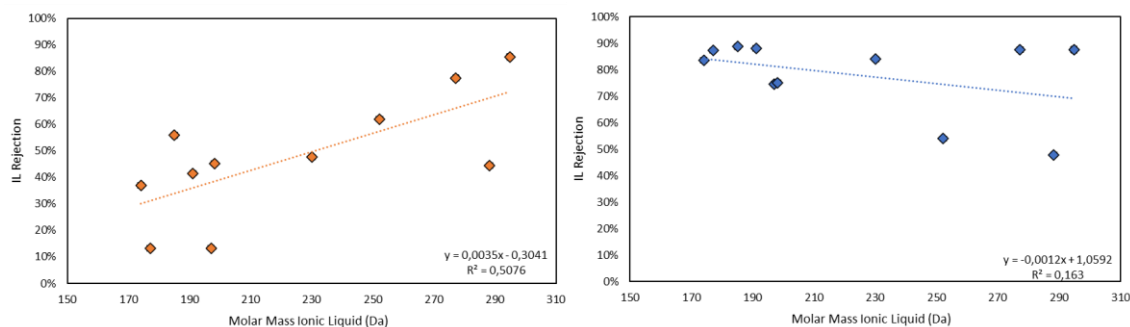
**Table S2.** Specifications of membranes\*.

Membrane	NF270	BW30LE
Manufactures	FilmTec	Dow FilmTec
Material	Polyamide – TFC	Polyamide – TFC
Active Layer	Semi-aromatic polyamide obtained by interfacial polymerization between trimesoyl chloride and piperazine	Full aromatic polyamide obtained by interfacial polymerization between trimesoyl chloride and m-phenylenediamine
Membrane Type	Nanofiltration	Reverse Osmose
Maximum operating temperature (°C)	45	45
Surface charge (pH 7)	Negative	Negative
pH range	2-11	2-11
Molecular Weight cut-off	~ 200 – 400	N/A
Isoelectric Point	5.2 [7]	4.5 [8]

\*Reported by the supplier

The isoelectric point (i.e.p.) of BW30LE and NF270 membranes is around 4.5 and 5.2, respectively. For pH > i.e.p., the zeta potential of both membranes is negative due to deprotonation of the -COOH groups of the polyamide skin layer.

## S2 - IL effect



**Figure S1.** Relationship between IL rejection of (♦) NF270-NF and (♦) BW30LE-RO and IL molar mass. Conditions: solution of 1 wt% of 10 bar, 200 rpm at 298.2 K.

### S3 – Statistical Analysis

**Table S3.** Results for the correlation coefficient ( $r_{\text{pearson}}$ ) obtained between the molecule volume, molar mass, anion volume and IL rejection with NF270-NF and BW30LE-RO membranes.

Parameters	NF270-NF			BW30LE-RO		
	$r^2$	$r_{\text{pearson}}$	$p$	$r^2$	$r_{\text{pearson}}$	$p$
Molar Mass	0.5076	0.7125	0.0138	0.1630	-0.4037	0.2182
IL volume	0.6058	*	0.0164	0.0068	*	0.8414
IL anion Volume	0.0087	-0.0935	0.7845	0.9576	-0.9786	<0.0001

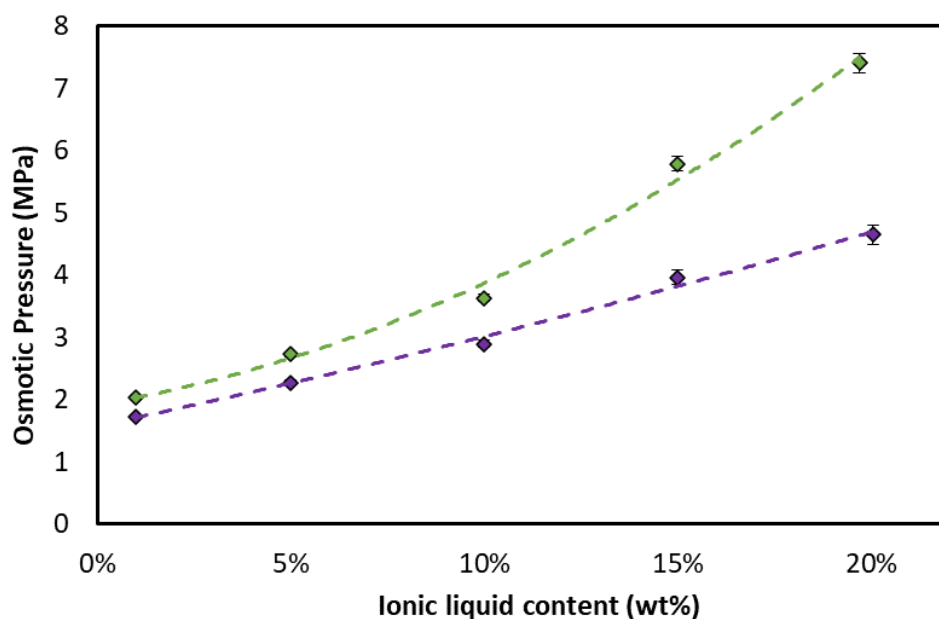
\*The Spearman correlation was performed.

### S4 – Osmotic Pressure

**Table S4.** Measured water activity ( $a_w$ ) and osmotic pressure ( $\pi$ ) of 1 wt% IL aqueous solution at 298.3 K.

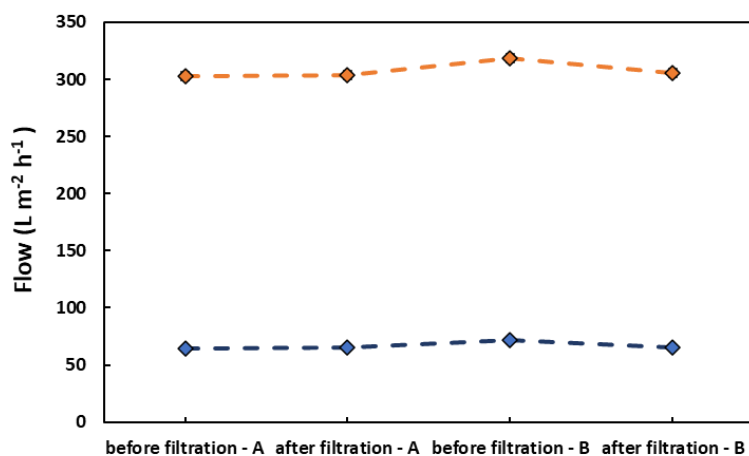
IL	$a_w$	$\pi$ (MPa)

[C <sub>4</sub> MIM][CF <sub>3</sub> SO <sub>3</sub> ]	0.980	2.69
[C <sub>4</sub> MIM][CF <sub>3</sub> CO <sub>2</sub> ]	0.972	3.91
[C <sub>4</sub> MIM][SCN]	0.978	3.06
[C <sub>4</sub> MIM][AOC]	0.981	2.55
[C <sub>4</sub> MIM][Cl]	0.981	2.63
[P <sub>4444</sub> ][Cl]	0.982	2.50
[C <sub>8</sub> MIM][Cl]	0.976	3.29
[N <sub>4444</sub> ][Cl]	0.982	2.52
[C <sub>4</sub> mpip][Cl]	0.982	2.54
[C <sub>4</sub> mpyr][Cl]	0.978	3.09
[C <sub>4-2</sub> mpy][Cl]	0.979	2.91



**Figure S2.** Osmotic pressure of IL solution: (♦) [C<sub>4</sub>MIM][AOc] (♦) [P<sub>4444</sub>][Cl]. Conditions: 1, 5, 10, 15, 20 wt [C<sub>4</sub>MIM][AOc] or [P<sub>4444</sub>][Cl] 298.2 K.

#### S4 – Water permeation flux



**Figure S3.** Water permeation flux of the (♦) NF270-NF and (♦) BW30LE-RO before and after filtration of (A) [C<sub>4</sub>MIM][AOc] and (B) [P<sub>4444</sub>][Cl] at 298.2 K and 10 bar.

#### References

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