Production of valuable ionic liquids by membrane dialysis

Poster

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PRODUCTION OF VALUABLE IONIC LIQUIDS BY MEMBRANE DIALYSIS

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AIM OF THE WORK:

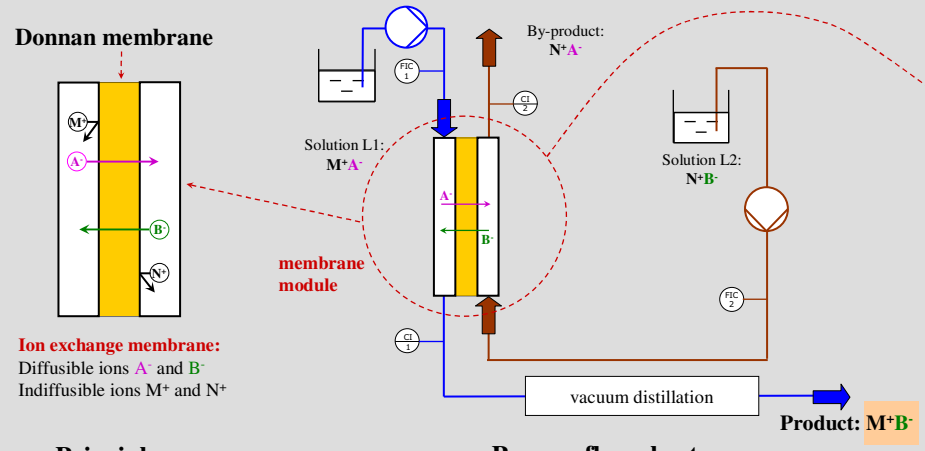
Development of an alternative feasible method for the production of highly valuable IONIC LIQUIDS (ILs) from low-cost educts.

THEORETICAL

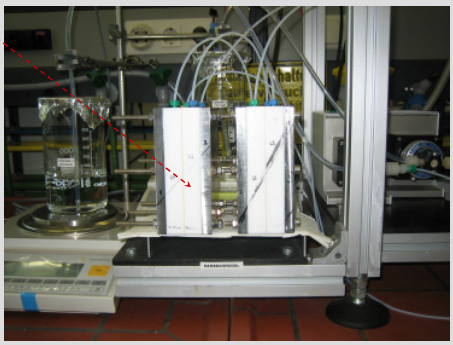
Basis of the production method is the metathesis reaction by means of Donnan diffusion through selective ion exchange polymeric membranes.

Reaction: MA + NB → MB + NA

EXPERIMENTAL



Principle | Process flow sheet



Membrane module system

RESULTS AND DISCUSSION

- EMIMAc and EMIMFo produced as pure ILs at similar rates in countercurrent mode.
- Flexibility of the process: more products are available by simply changing the educt.

EMIMCl + NaFo → EMIMFo + NaCl

EMIMCl + NaAc → EMIMAc + NaCl

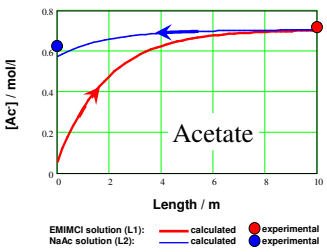
Product (IL)	Purity [%]	Volume flow [ml/min] Solution 1 (L1)	Volume flow [ml/min] Solution 2 (L2)	Flow ratio $F_{L1} : F_{L2}$	K^* [mol/m²-s]	Productivity [kg/m²-h]
1-ethyl 3-methyl imidazolium acetate (EMIMAc)	**99**	**0,1**	**0,5**	**0,2**	**$1{,}2 \times 10^{-3}$**	**0,05**
1-ethyl 3-methyl imidazolium formate (EMIMFo)	**94**	**0,1**	**0,5**	**0,2**	**$1{,}1 \times 10^{-3}$**	**0,05**

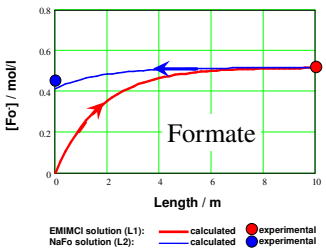
Optimization of Ion Exchange

For the mass (mol) transfer of a compound ***i*** from solution ***L1*** to solution ***L2*** through a membrane:

$$\frac{d^2 n_i}{dt \cdot dz} = K^* \cdot \frac{dA_{DIFF}}{dz} \cdot (c_{iL1(z_j)} - c_{iL2(z_j)})$$

n_i = moles of compound i
A_{DIFF} = diffusion area = 0,01 m²
K^* = mass transfer coefficient of compound i through a membrane (membrane coefficient)
L = total length of diffusion = 10 m
z_j = length at position j (z_j = 0..L)





- Further investigated systems: EMIMCl/NaOH; EMIM-Ethylsulfate/NaOH; BMIMCl/NaAcetate.
- Model systems : NaCl/NaAc; NaCl/NaOH; NaAc/NaOH; $CuSO_4$-NaFo/NaOH.
- See Poster P4.

CONCLUSION:

- An efficient production of EMIMAc, EMIMFo and additional valuable ILs is achieved.
- The process, followed by a step of vacuum distillation and final crystallization, results in a purified IL.
- The ion exchange process is calculated and optimized based on the applied fitting model.

LITERATURE

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