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Concentrating super base ionic liquid from aqueous solution by membrane filtration

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PURPOSE OF THE ABSTRACT

Regenerated cellulose fibers are obtained by dissolving cellulose from wood pulp or vegetable fibers. As the length of wood pulp fibers is too short for textile use, they need to be processed using continuous spinning and regeneration technology. Cellulose structure is transformed in different ways depending on the type of solvent and treatment conditions.

Currently, the most used industrial methods for dissolving cellulose pulp are Viscose, Lyocell and more recently the ionic liquids (IL) are pointed with a sustainable alternative solvent to produce these fibers [1]. Of the several ILs identified as capable of dissolving cellulose, only a small fraction has the characteristics suitable to produce regenerated cellulose fibers. Preliminary fiber-spinning has identified [DBNH][OAc] as a key structure that allows the production of high-performance fibers through the IONCELL-F process. More recently, [mTBDH][OAc] and [mTBNH][OAc] has also been identified as promising solvent to produce high-performance fibers [2].

However, after fiber regeneration, the centrifugation bath contains IL, water, and mono- and oligosaccharides from unregenerated cellulose and, in the case of unstable IL, some degradation products. The recovery of IL and its purification is crucial from both an environmental and a financial point of view. The recovery of IL can be accomplished simply by evaporating the water, but this process predisposes the solvent to adverse conditions and requires high energy for vaporization [3].

Membrane separation technology may be an alternative as it is a well-defined and commercially available technology. Membrane separation has been widely applied in several processes, such as water and sewage treatment, pharmaceutical processes, food processing, and among others, due to a series of performance and cost advantages over competitive technologies.

Thus, in this work, the recycling and purification of hydrophilic, water-miscible super base ionic liquid employing membrane separation technologies were studied. The filtration behavior of [mTBDH][OAc] and [mTBNH][OAc] in aqueous solutions by the two membranes, DL (nanofiltration) and BW30LE (reverse osmosis) were investigated.

The results show that the permeate flux increased linearly with the pressure applied (10 ? 50 bar) at a constant IL concentration (1 %wt) (Figure 1) and decreased with the IL concentration at constant pressure (Figure 2). Compared to the DL membrane, BW30LE showed higher retention because of its smaller pore size. Under the optimal experimental conditions determined in this study, [mTBNH][OAc] in the [mTBNH][OAc]/H2O solution could be concentrated to 9.9 wt% from its initial content of 5.0 wt% using the BW30LE membrane, and rejection around 80% was achieved at 40 bars. Therefore, the membrane process can be used as an IL preconcentration step, and the combination of different separation techniques seems to be the most promising way to recycle ILs.

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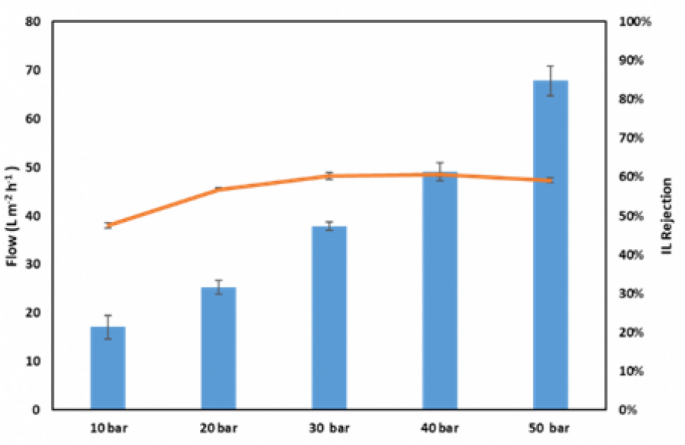
FIGURES



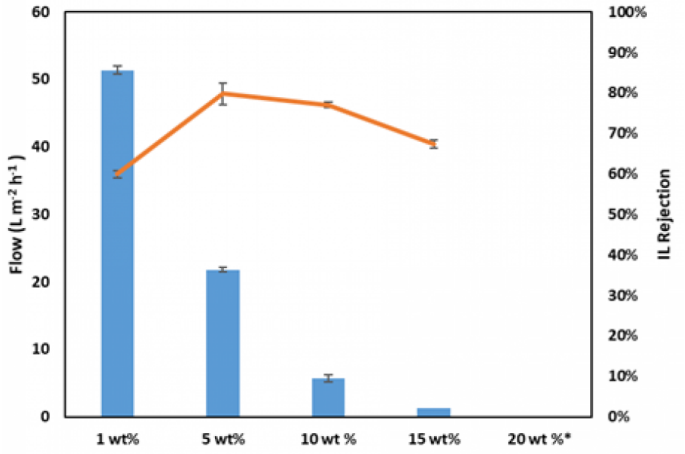


FIGURE 1

Figure 1

Figure 1. Variation of flow and rejection of [mTBNH][OAc] (1 %wt) as a function of pressure for BW30LE membrane.

FIGURE 2

Figure 2

Figure 2. Variation of flow and rejection of [mTBNH][OAc] as a function of [mTBDH][OAc] concentration for BW30LE membrane at 40 bars. At 20 wt% no flow was observed under the tested conditions.

KEYWORDS

Ionic Liquids | Recovery | nanofiltration | reverse osmosis

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