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Separation of toluene from gas phase using supported imidazolium ionic liquid membrane

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Abstract

Investigation on utilization of supported ionic liquids membranes for hydrocarbon separation from the gas phase was performed. Properties of membrane phase, wettability of supports, swelling effects and solubility of toluene were taken into account. Toluene permeation rates were significantly higher than those of pure nitrogen, the selectivity in a range of 17-341 was satisfying for separation. Despite the increase of viscosity resulting from increasing alkyl chain length of imidazolium bis(trifluoromethylsulfonyl)imide [Tf₂N] ionic liquids, permeation of toluene increases due to the higher hydrophobicity and therefore separation is solubility-controlled. However, imidazolium trifluoromethanesulfone [TfO] ionic liquids did not follow the same path. Nevertheless, toluene was successfully separated from N₂/toluene gas stream using ionic liquid membranes based on both [Tf₂N] and [TfO] yet, in the light of the obtained results and literature data these systems are highly recommended for VOCs separation from gas phase.

Key words: ionic liquid, supported ionic liquid membrane, toluene, separation, selectivity

1. Introduction

Supported liquid membrane (SLM) is a two phase system of a porous support and liquid phase held in the membrane pores by capillary forces [1]. Several disadvantages can be observed when using traditional volatile organic solvents as a membrane phase, such as secondary stream pollution or loss of membrane phase caused by vaporization, polymer support degradation or displacement of liquid from the pores due to transmembrane pressure [2]. Many efforts have been made to improve the lifetime of SLMs and to prevent instability mechanisms, one of them is replacing volatile solvent with ionic liquid [3,4]. The key aspect in obtaining satisfying effectiveness and long membrane lifetime is the proper choice of system components: ionic liquid and polymeric or ceramic support that are compatible with each other. Properties of both are crucial in forming useful supported ionic liquid membrane.

Ionic liquids are composed of an asymmetric organic cation and organic or inorganic anion [5]. They seem to be an excellent media for separation processes and a substitute for toxic and volatile organic compounds. The main property of ionic liquids that makes them promising media in separation

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