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Efficient Removal of Phenolic Compounds from Model Oil Using Benzyl Imidazolium-Based Ionic Liquids

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Abstract

Three benzyl imidazolium-based room temperature ionic liquids (RTILs) with various substituents namely allyl, benzyl, and vinyl were synthesized and used as solvents in liquid-liquid extraction for the removal of phenolic compounds from hexane as the model oil. The RTILs were characterized using ¹H NMR, ¹³C NMR, FT-IR, and CHN elemental analyses. Their density and viscosity were also measured. Five main parameters were evaluated through the removal process; the effect of IL substituent, the phase volume ratio of IL and model oil, phase contact time, and temperature. IL containing allylic substituent showed outstanding performance with approximately 95% efficiency under selected optimized conditions. To ensure that the RTIL can be used as a solvent for the removal of phenol, various other types of model oil apart from hexane such as petroleum ether, heptane, and cyclohexane were also used. The RTIL exhibited good recyclability and negligible loss of mass even after six cycles. Further mechanistic interactions between RTIL and phenol were studied by ¹H NMR and FT-IR.

Keywords: Room temperature ionic liquid, Benzyl imidazolium, Phenol, Liquid-liquid extraction, Model oil

1. Introduction

Phenol is a major industrial chemical usually produced from a multi-step process with benzene as the feedstock [1]. Other major sources of phenolic compounds are coal liquefaction oil, coal tar, petroleum, and biomass via pyrolysis [2-4]. Phenol is separated from coal via pyrolysis of low-rank coals, carbonization, hydrolysis, and liquefaction. It is used industrially for the production of phenolic resins, bisphenol A, caprolactam, and other phenolic compounds. In addition, they have been widely employed in many industrial processes as synthesis intermediates or as raw materials in the manufacturing of herbicides, pesticides, insecticides, pharmaceuticals, and dyes [5].

Coal tar has a relatively high concentration of phenolic compounds. Thus, it is desirable to separate phenolic compounds from the oil mixture before further refining for economic

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