Phase Equilibria for the Extraction of Phenolic Pollutants from Industrial Wastewater using Liquid Membranes Technique

Abstract

Both chemical industry and academia search for alternative solvents to meet the cleaner technology requirements since the most widely used solvents are volatile and harmful. In the present work, the technical feasibilities of room temperature ionic liquids (RTILs) as bulk liquid membranes (BLM) for phenol removal from Industrial Wastewater was investigated. Room temperature ionic liquids (RTILs) used as a membrane mainly due to their properties of low vapor pressure, low volatility and they are often stable. Four ionic liquids with high hydrophobicity were used: 1-butyl-3-methylimidazolium hexafluorophosphate [Bmim] [PF_6], 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl) imide [Bmim][NTf_2], 1-Ethyl-3-methyimidazolium bis(trifluoromethanesulfonyl) imide [Emim][NTf_2] and 1-hexyl-3-methylimidazolium hexafluorophosphate [Hmim][PF_6], in which, phenol Extraction efficiency and stripping efficiency were studied. The effect of different types of anion and hydrophobicity of the ionic liquids on the phenol extraction and stripping efficiencies were investigated. Different operating parameters of feed phase pH, feed concentration, NaOH concentration were studied. In addition to the effect of single ionic liquid (SILs) and binary mixtures ionic liquid (BMILs) on the phenol extraction and stripping efficiencies were also studied. The study shows that highest phenol extraction and stripping efficiencies were [Bmim][NTf_2], [Bmim][NTf_2+PF_6] and [Emim][NTf_2], [Bmim+Emim][NTf_2] respectively. Phase equilibria for the extraction of phenol from industrial wastewater using ionic liquid membranes was determined. The efficiency of ten new solvents as a selective ILs solvent in the extraction of phenol from wastewater was investigated. Data have been estimated experimentally for ten systems containing, phenol + water as a common component liquid and + ten IL solvents. The consistency and accuracy of the tie line data were evaluated using

three correlation namely, Bachman, Hand, and Othmer and Tobias. The Plait Point for each ternary system was estimated. Among the ILs used to extract the phenol from wastewater, [Bmim][NTf_2+PF_6] shows the highest selectivity and distribution coefficient. The liquid-liquid equilibrium data have been predicated using electrolyte non-random-two-liquid (*e*-NRTL) model and extended UNIversal-QUAsi-Chemical (*e*-UNIQUAC) model. The binary interaction parameters have been calculated using Maximum Likelihood Principle technique. The experimental data fitted by the *e*-NRTL model is more accurate than the *e*-UNIQUAC model.