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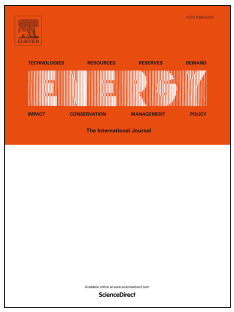

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Design and Operation of Extractive Distillation Systems Using Different class of Entrainers for the Production of Fuel Grade *tert*-Butyl Alcohol: A Techno-Economic Assessment

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Abstract

The 21st century beholds interest in biofuels, leading to a key challenge being the production of fuel grade '*tert* butyl alcohol' (TBA) with reduced economics. As a consequent step in the investigation with a different class of entrainers for TBA dehydration (*Aniya et al. 2015, 2016*) through extractive distillation (ED), the present study explores the utilization of ionic liquid [emim][Cl] and inorganic salt [$MgCl_2$] as a potent entrainer. A comprehensive approach is proposed with phase-equilibrium measurements, thermodynamic modeling, design and process optimization using Aspen Plus. A techno-economic assessment of all the investigated processes (conventional solvents: CSED, solvent + salt: SEED, designer solvents or ionic liquids: DEED and ionic liquid + salt: DSEED) concluded SEED process to be the most promising with 6%, 18% and 37% savings in TAC and 9%, 23% and 41% savings in SEC as compared to the DSEED, DEED and CSED processes respectively. Further, retrofits (heat integration and thermally coupled schemes) demonstrated 13% and 6% reduction in specific energy consumption respectively thus improving the energy efficiency of ED systems. Heat integration brought in 12% savings in TAC over SEED process. However, thermally coupled schemes resulted in marginal benefit (2% savings) in terms of TAC over SEED process.

Keywords: *Extractive distillation, Ionic liquid-salt Extractive distillation, Optimization, Total annual cost, Thermally coupled, Energy efficiency*

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