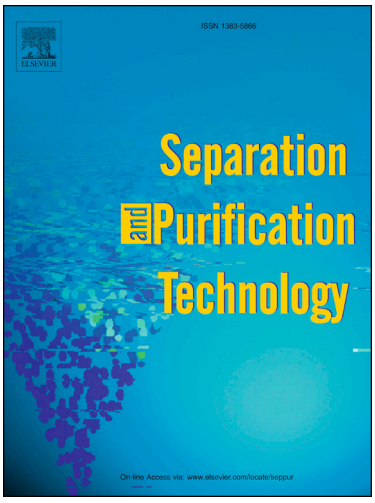

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Cold-model investigation of droplet size distribution of dispersed phase in a novel liquid-liquid cyclone reactor for ionic liquid catalyzed isobutane alkylation

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***Key Words*:** Isobutane alkylation, Liquid-liquid cyclone reactor, Operational parameters, Droplet size distribution, Sauter mean diameter

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1. Introduction

Alkylation of isobutane with light olefins is widely used in the petroleum industry to produce high-quality gasoline. Alkylate is characterized by a high octane number, low vapor pressure, and low contents of sulfur, olefins, and aromatics. Therefore, it is an ideal component of high-octane gasoline. Concentrated sulfuric acid (H_2SO_4) and hydrofluoric acid (HF) are commercial liquid catalysts for isobutane alkylation, but have disadvantages such as severe corrosion, high operation costs, and safety, environmental, and disposal issues. Yoo et al. [1] and Zhang et al. [2] showed that acidic ionic liquids (ILs) are promising substitutes for H_2SO_4 and HF as alkylation catalysts because of their safer operation, low consumption, and strong catalytic performance. A composite ionic liquid developed by the China University of Petroleum (Beijing) shows high selectivity for high octane alkylate and is considered an ideal substitute for traditional alkylation catalysts from safety and environmental points of view [3].

Liquid acid catalyzed isobutane alkylation is a heterogeneous system wherein reactions occur in or near the interface between the catalyst and hydrocarbon phases [4]. The intrinsic reaction rate is extremely fast owing to the highly reactive carbonium intermediate [5]. Too long a residence time of the ionic liquid-hydrocarbon mixture will lead to side reactions, which have detrimental effects on alkylate quality. Thus, it is necessary to study and develop a matched reactor for ionic liquid catalyzed isobutane alkylation (ILA). Liu et al. [6] used a Stratco Reactor and Zhou et al. [7] proposed a novel liquid–solid loop reactor for ILA. However, the ideal time to separate alkylate from the catalyst is unclear, and the reactors suffer from occurrence of side reactions and low product yield.