Optimization and control of a reactive distillation process for the synthesis of dimethyl carbonate

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Abstract: Dimethyl carbonate is an environmentally benign and biodegradable chemical. Based on integration of reactive distillation and pressure-swing distillation technologies, a novel process for synthesis of dimethyl carbonate through transesterification with propylene carbonate and methanol has been developed by Huang et al. In this work, the optimization of this process was performed by minimizing the total TAC. The results show that the optimal design flowsheet can save energy consuming of 18.6% with the propylene carbonate conversion of 99.9%. Then, an effective plant-wide control structure for the process was developed. Dynamic simulation results demonstrate that the temperature/flow rate cascade control plus with simple temperature control can keep not only product purity but also the conversion of the reactant at their desired values in face of the disturbance in reactant feed flow rate and feed composition.

Keywords: dimethyl carbonate, reactive distillation, transesterification, dynamic simulation

1. Introduction

Dimethyl carbonate (DMC) is an environmentally benign and biodegradable chemical, and it has been widely used in the chemistry industry as a substitute to replace dimethyl sulfate and methyl halides in methylation reactions, or as a carbonylation agent in carbonylation reactions [1]. In addition, DMC also has been used an additive to fuel because of its high oxygen content and octane number [2]. So DMC has