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TRANSPORT PHENOMENA & FLUID MECHANICS

相似理论在分子蒸馏过程数学模型中的应用
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Scaling Analysis of Molecular Distillation Mathematical Model
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摘要 分子蒸馏过程中液体流动状况是影响分离效果的关键因素之一。目前国内外尚未有关于分子蒸馏过程流动状况的研究报道。本文对分子蒸馏过程流动状况进行了相似分析，并建立了分子蒸馏过程流动状况的数学模型。

关键词 分子蒸馏；流动；相似理论；数学模型；

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The Analysis of Distillation Tray Column Efficiency by Fluid Dynamics and Mass Transfer Computation

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Abstract: The flow pattern of the liquid phase on distillation trays is of great importance on distillation process performance. But until now, there was very few published work on quantitative investigation of this subject. By combining the computational fluid dynamics (CFD) with the mass transfer equation, a theoretical model is proposed for predicting the details of velocity and concentration distributions as well as the tray efficiency of distillation tray column. Using the proposed model, four different cases corresponding to different assumptions of liquid and vapor flowing condition for a distillation tray column were investigated. In Case I, the distributions of velocity and concentration of the incoming liquid from the downcomer and the spraying vapor from the underneath tray spacing are uniform. In Case II, the distribution of the incoming liquid is uniform but the spraying vapor is uniform. In Case III, the distribution of the incoming liquid is uniform but the spraying vapor is non-uniform. In Case IV, the distributions of both the incoming liquid and the spraying vapor are non-uniform. The details of velocity and concentration distributions on a multiple sieve tray distillation column in four different cases were simulated using the proposed model. It is found that the shape of the simulated concentration profiles of vapor and the liquid is quite different from case to case. The computed results also show that the tray efficiency is highly reduced by the maldistribution of velocity and concentration of the incoming liquid and upcrising vapor. The tray efficiency for Case I is higher than Case II or Case III, and that for Case II is higher than Case III. The present study demonstrates that the use of computational method to predict the mass transfer efficiency for the tray column, especially for the large one, is feasible.

Key words: Keywords: molecular distillation; mass transfer;

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