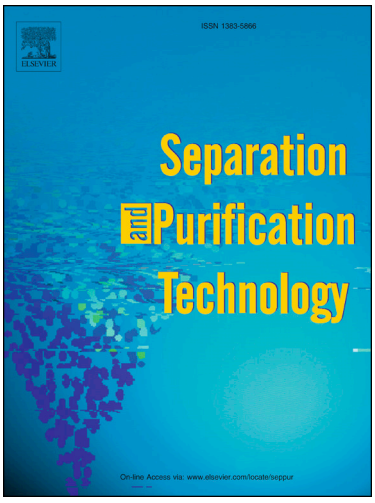

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Control of extractive distillation process for separating heterogenerous ternary azeotropic mixture via adjusting the solvent content

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Abstract

The existence of heterogeneous azeotrope of toluene-water and homogenous azeotrope of toluene-methanol makes it difficult to separate the toluene-methanol-water mixture. Two methods of three column extractive distillation and two column extractive distillation using decanter were explored to separate the ternary azeotrope. Diethylene glycol and N-methyl-2-pyrrolidone were used as heavy solvent in the two processes, respectively. The UNIQUAC physical model was used in both simulations. Based on the minimum total annual cost, variables of the two processes were optimized and the results indicated the two column extractive distillation using decanter can save 51.4 % of total annual cost than three column extractive distillation. The dynamics of two column extractive distillation using decanter was studied due to its superiority of economics. Several common control schemes were used to investigate the controllability of two column extractive distillation using decanter and all schemes showed poor controllability on feed composition disturbances. An improved control structure was designed to achieve better control of the process. In the improved control scheme, the temperature controller of column C1 was replaced by a proportional controller, and a certain amount of solvent flow rate was increased. The integral squared error was calculated to compare the dynamic performances of the improved control structure with different solvent flow rate, and a suitable amount of solvent was found in view of the controllability and economy.

Keywords: Ternary azeotrope; Extractive Distillation; Controllability; Process evaluation

1. Introduction

Toluene and methanol are both widely used as solvents and raw materials in chemical industry.