Economics and controllability of hybrid extraction and distillation process for the recovery of propylene glycol methyl ether for industrial wastewater

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Abstract

An industrial ternary mixture of acetone/isopropyl ether/water forms two binary azeotropes and a ternary azeotrope at atmospheric pressure and conventional distillation processes cannot achieve efficient separation. A hybrid azeotropic-extractive distillation (HAED) process is proposed for the separation of acetone/isopropyl ether/water. In this process, isopropyl ether is chosen as a light entrainer aimed to form a binary azeotrope with acetone, so that water can be separated from the bottom of azeotropic distillation column (ADC) at 0.3 atm. Then extractive distillation for the separation of binary azeotrope of acetone/isopropyl ether is investigated with ethylene glycol (EG) as an entrainer. On the basis of minimum total annual cost (TAC), a sequential iterative optimization procedure is performed to optimize the economy of two processes with two different feeding ways of light entrainer. The results demonstrate that both processes can make three products purities achieve 99.5 wt% with three columns. Additionally, compared with the process in which light entrainer is blend with the fresh feed, the process in which the light entrainer is added in the upper of the ADC can reduce the TAC and energy consumption by 9.3% and 9.21%, respectively.