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A new process for ternary separations: Semicontinuous distillation without a middle vessel

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Abstract

In this work, a novel semicontinuous process for the separation of ternary mixtures is presented. The new Semicontinuous without Middle Vessel (SwoMV) configuration is a process intensification technique that makes separation of three components to desired purities possible in a single distillation column without the necessity of the middle vessel as opposed to the conventional semicontinuous processes. The elimination of the middle vessel omits the charging and discharging modes of conventional semicontinuous processes, reduces the direct costs of plant and facilitates the retrofit of available distillation columns for purification of new products. Furthermore, SwoMV configuration improves the conventional semicontinuous system by reducing the energy consumption in most cases and expanding the range of system capacities at which it is economically optimal. The separation of benzene, toluene, and *o*-xylene is used as a case study to show the feasibility of the SwoMV configuration. An economic analysis is performed, and conventional continuous distillation, conventional semicontinuous, SwoMV and single side stream column configurations are compared by calculating the total annualized cost of these systems over a range of production rates. The results show the feasibility, applicability and profitability of the novel proposed configuration.

Keywords: Semicontinuous Separation; BTX; Semicontinuous Without Middle Vessel; Ternary Separation; Economic Evaluation

1. Introduction

Distillation is one of the most common unit operations for purification of mixtures into more valuable high-purity components. Since it is a mature and well-studied unit operation, most recent advances in distillation system design have come in the form of advanced process intensification strategies. The semicontinuous distillation configuration proposed by Phimister and Seider (2000a) was one such strategy. For the separation of ternary mixtures to any desired

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