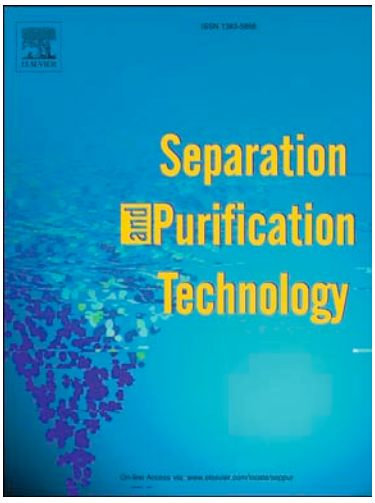

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Optimal hybrid separations for intensified downstream processing of biobutanol

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Keywords: biobutanol, dividing wall column, multi-objective optimization, condition number

Highlights

- Effective downstream processing of biobutanol in the ABE fermentation process
- Alternatives using dividing-wall column for eco-efficient intensified processing
- Multi-objective optimization considering economics, environmental & controllability

Abstract

Current research focuses on new energy alternatives which could compete with the traditional energy sources based on fossil fuels, and eventually diminish the consequences on climate. Recently, butanol produced by ABE fermentation attracted more attention since its energy power is comparable to that of gasoline. But some hurdles are involved in the establishment of this fuel as an immediate substitute of fossil fuels, e.g. lower butanol concentration in the fermentation effluents and the expensive separation steps to purify the effluent.

This work is the first to report the use of hybrid separation based on liquid-liquid extraction (LLX) combined with dividing-wall column (DWC) technology for the purification of the ABE (acetone-butanol-ethanol) mixture. The configurations proposed are the result of multi-objective optimization that aims to find designs that fulfill the tradeoff between those objectives: cost minimization, reduce environmental impact, and increase controllability.

The downstream processing alternatives are designed and optimized by minimizing three objective functions simultaneously: the total annual cost (TAC) as an economical index, the eco-indicator 99 as an environmental function, and the condition number (CN) as control index. Among the four designs, the scheme where only a reboiler is included showed the best economic performances and relatively good values of condition number and eco indicator 99.