Simulation of a hybrid process involving extraction into ionic liquid impregnated microparticles and microfiltration

Marek Blahušiak, Štefan Schlosser*

Institute of Chemical and Environmental Engineering, Slovak University of Technology, Radlinského 9, 81237 Bratislava, Slovakia
Tel. +421918674248; email: stefan.schlosser@stuba.sk

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ABSTRACT

A new hybrid process involving the extraction of butyric acid (BA) into ionic liquid impregnated microparticles and the microfiltration (extraction-microfiltration, EMF) process has been proposed and its feasibility examined by simulation. Diafiltration of the regenerated suspension of the solvent impregnated resin (SIR) with water is important to decrease the amount of BA in the recycled regenerated suspension, BA concentration in the lean fermentation broth, consumption of chemicals and to increase the yield of the BA in concentrates. Improvement of these parameters is significant (decrease of chemicals’ consumption and BA concentration in the lean fermentation broth by over 80% and increase of the BA yield from 56 to 91% for a three stage EMF process) for diafiltration with the volumetric flowrate of washing water being twice the volumetric flowrate of the diafiltered suspension. Above this ratio, the gain in the BA yield and consumption of chemicals is not high. At the same time, concentration factor of the product in the primary concentrate decreases. The introduction of more extraction/MF stages significantly increases the concentration factor and yield of BA due to its higher concentration and the equilibrium capacity of SIR particles in the suspension entering the regeneration up to three stages. However, with the increasing number of stages, the capital and operating costs of the separation increase as well. Applicability of the EMF process in cases requiring a higher yield of the solute is not high. The EMF process can be more competitive in separations with lower requirements on the yield of separated species and higher capacity of SIR at the output concentration of the solute, where only one extraction/MF stage is adequate.

Keywords: Extraction; Solvent impregnated resin; Butyric acid; Microfiltration; Hybrid process; Simulation

*Corresponding author.