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Production of Very-High Purity Succinic Acid from Fermentation Broth using Microfiltration and Nanofiltration-Assisted Crystallization

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Abstract

A combined cross-flow microfiltration (MF) and nanofiltration-assisted crystallization technique was successfully employed as a series of purification steps for the production of very-high purity succinic acid from fermentation broth. The membrane fouling mechanism was firstly investigated for MF system during bacterial cells removal. Resistance-in-series model was applied to evaluate the major factors that caused the decline in permeate flux. Experimental results showed that the membrane performance tended to be significantly affected by the adsorption. Separation performance of nanofiltration (NF) process was subsequently investigated for both synthetic solution, and the MF permeate. For the broth, the NF showed its usefulness for removal of impurities including proteins, macromolecules, and especially multivalent ions. In addition, dia-nanofiltration (DNF) was employed for a complete recovery of the succinic acid in the retentate after concentration mode. The removal rates for protein, and magnesium sulfate were reported at 95.61%, and 97.7%, respectively. Finally, crystallization was conducted as the final step to maximize the purity of the bio-based succinic acid product as all other organic acid by-products were presented in the mother liquor. The final purity of the succinic acid crystal was obtained at 99.18% after simple washing with cold water. In conclusion, very high purity succinic acid can be directly obtained from the realistic fermentation broth by the integration of membrane-based separation processes, and crystallization without the need for any auxiliary component.

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