Energy requirements and economics of ABE extractive fermentation: a solvent-based comparative assessment

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Abstract

The reindustrialization of Acetone-Butanol-Ethanol (ABE) fermentation is hampered by its significant production cost, linked to high product inhibition and low product yield. ABE fermentation can be significantly enhanced by integrating in situ liquid-liquid extraction. In this study, hybrid simulations using Excel® and ASPEN Plus® based on experimental data were performed to quantify the energy requirements and economic improvement of the overall ABE extractive fermentation process. Four scenarios, based on two different organic solvents (2-butyl-1-octanol, 2B1O, and a vegetable oil, VO) applied in batch or fed-batch operation, were compared with the conventional process. Total energy demand decreased in all extractive configurations and the greatest energy savings (61%) were reached with the VO-based fed-batch operation. However, the highest profit increase was achieved with 2B1O in fed-batch mode, reducing the minimum butanol selling price by 29% over the base case, along with 34% savings in raw materials and 80% wastewater reduction.

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