Abstract

Process Economics Program Report 188B
BIOTECHNOLOGY SEPARATION PROCESSES
(June 2002)

The chemical industry has a renewed interest in developing processes for producing industrial chemicals from bio-based or renewable feedstocks. Important trends that are driving this interest include the concern over global warming caused by petrochemicals and also the concept of sustainability through the use of renewable resources. Recent technology developments have also provided a better means for utilizing bio-based feedstocks. Genetic engineering has enabled fermentation processing to be a more efficient means of production. Currently, the most important industrial products made using fermentation are ethanol, carboxylic acids, amino acids and enzymes.

Fermentation processes used for making industrial biotech products such as lactic acid present unique separation and purification challenges. Product recovery from fermentation broth typically involves the separation of one low concentration component from a large quantity of water and other impurities. This report reviews recent technical advances made in downstream unit operations unique to biotechnology processes such as cell harvesting, biomass removal, extraction, adsorption (chromatography), and electrodialysis. It is an update of the same topic that was reviewed in PEP Report 188A issued in 1988.

The conventional fermentation process for making lactic acid is difficult to scale-up due to the large quantity of salt wastes that are generated. Several new separation developments are underway that promise to allow large scale lactic acid production at more efficient process economics by avoiding the generation of salt waste. Extraction is one of the most promising of these technologies. This PEP Report provides a detailed technical and economic evaluation of newly developed extraction separation processes for making lactic acid.

A major technology shift in amino acid recovery has occurred with the adoption of continuous ion-exchange technology and the abandonment of large, batch ion-exchange resin beds formerly used. In 1990 the first industrial scale continuous ion exchange unit for lysine purification was installed. It is estimated that 75% of all installed lysine capacity uses the new technology. Advantages claimed by the manufacturer of one system are reduced resin requirements through improved resin productivity, reduced wash water use, higher recovery, and reduced waste generation. We evaluate the process economics for making lysine by continuous ion exchange in this PEP Report.

For those in the chemical industry, this report will be useful for understanding the unique challenges associated with separating and recovering fermentation products on an industrial scale. In many cases, the cost of separating fermentation products can amount to over half of the total capital and production costs. The report provides a number of examples from prior PEP Reports to present insights into why this is true. Separation technology trends are reviewed with the analysis of over 50 recent patents in the field.
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