

Recovery and Purification of Products

11.1. STRATEGIES TO RECOVER AND PURIFY PRODUCTS

The recovery and purification of a fermentation product is essential to any commercial process. The difficulty entailed depends heavily on the nature of the product. Products may be the biomass itself, an extracellular component, or an intracellular component. Since the chemical nature of a fermentation broth is quite complex and extremely high purity is required for some products (e.g., some pharmaceuticals), recovery and purification often require many processing steps and in many cases represent a manufacturing cost higher than that involved in producing the product. Since the compounds of interest are often fragile (e.g., heat sensitive) and present in dilute aqueous solution, the traditional separation techniques of the chemical engineer must be augmented with more specialized ones.

Recovery and purification are major expenses in production of most fermentation products; often they comprise more than 50% of the total manufacturing costs, especially for an intracellular product. There is an excellent correlation between the price of a product (on a per-kg basis) and how dilute the product is as it exits the fermentation. For example, citric acid is on the order of 100 g/l when it enters recovery processes and sells for order of 1 to 2 \$/kg, while a therapeutic protein might be at the concentration of 0.00001 g/l and sell for 100,000,000 \$/kg. The efficiency of the production process and the difficulty and cost of the recovery and purification processes are tightly coupled.

The major unit operations used for product recovery and purification and the major principles of separations are summarized in Fig. 11.1. Separation methods vary with the