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Industrial Fermentation Procedures

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Batch Fermentation

Batch process, all the ingredients are combined and therefore the reactions proceed with none further input. Batch fermentation has been used for millennia to form bread and alcoholic beverages, and it's still a standard method, especially when the method isn't well understood. However, it is often expensive because the fermenter must be sterilized using high steam between batches. There's often addition of small quantities of chemicals to regulate the pH or suppress foaming. Batch fermentation goes through a series of phases. There's a lag introduce which cells suits their environment; then exponential growth is observed. Once most of the nutrients are consumed by the cells, the growth of cells slows and becomes non-exponential, but production of secondary metabolites (including commercially important antibiotics and enzymes) accelerates. This continues through a stationary phase after most of the nutrients are consumed, then the cells die.

Fed-batch fermentation

Fed-batch fermentation may be a variation of batch fermentation where a number of the ingredients are added during the fermentation. This enables greater control over the stages of the method. Especially, production of secondary metabolites is often increased by adding a limited quantity of nutrients during the non-exponential growth phase. Fed-batch operations are often sandwiched between batch operations.

Continuous fermentation

In continuous fermentation, substrates are added and final products removed continuously. There are three varieties: chemo stats, which hold nutrient levels constant; turbid stats, which keep cell mass constant; and plug flow reactors during which the medium flows steadily through a tube while the cells are recycled from the outlet to the inlet. If the method works well, there's a gentle flow of feed and effluent and therefore the costs of repeatedly fixing a batch are avoided. Also, it can prolong the exponential growth phase and avoid byproducts that inhibit the reactions by continuously removing them. However, it's difficult to take care of a gentle state and avoid contamination, and therefore the design tends to be complex. Typically the fermenter must run over 500 hours to be more economical than batch processors.

Open fermentation

The high cost of sterilizing the fermenter between batches is often avoided using various open fermentation approaches that are ready to resist contamination of the cultures. One is to use a naturally evolved mixed culture. This is often particularly favored in wastewater treatment, since mixed populations can adapt to a good sort of wastes. Thermophilic bacteria can produce carboxylic acid at temperatures of around 50°Celsius, sufficient to discourage microbial contamination; and ethanol has been produced at a temperature of 70 °C. This is often slightly below its boiling point (78°C), making it easy to extract. Halophilic bacteria can produce bio plastics in hyper saline conditions. Solid-state fermentation adds a little amount of water to a solid substrate; it's widely utilized in the food industry to supply flavors, enzymes and organic acids.

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