Design and development of bioreactor design.

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Introduction

A bioreactor is a device within which biochemical transformations are caused by the action of enzymes or living cells. The simple method of shaking cells in a flask to enhance oxygenation through the liquid surface and to aid mass transfer of nutrients without cell damage has to be scaled up for industrial processing. The use of biotechnology in the manufacture of pharmaceuticals is of increasing interest. Consequently, these techniques require attention in the planning of unit processes [1].

A bioreactor refers to any manufactured device or system that supports a biologically active environment. In one case, a bioreactor is a vessel in which a chemical process is carried out which involves organisms or biochemically active substances derived from such organisms. This process can either be aerobic or anaerobic. These bioreactors are commonly cylindrical, ranging in size from litres to cubic meters, and are often made of stainless steel.[citation needed] It may also refer to a device or system designed to grow cells or tissues in the context of cell culture. These devices are being developed for use in tissue engineering or biochemical/bioprocess engineering [2].

Bioprocessing can be considered in terms of small-scale bioreactors, or fermenters, and the translation of such processes into large-scale economically viable production operations. Bioprocessing is by no means a new field. The topicality of this subject is due to the increasing interest in the use of isolated cells and microorganisms as manufacturing tools. It might well be argued that the technology was developed millennia ago for the purposes of wine and beer production. More recently, the use of attenuated microorganisms or isolated antigenic materials for vaccination resulted in fur-ther developments. In the last decade, interest in genetic engineering and manipulation of the genetic code of certain microorganisms has produced a revolution in pharmaceutical manufacturing [3].

Mixing

Concentration and temperature are influenced by mixing in bioreactors. Total homogeneity within a system is rarely, if ever, achieved and local variations in mixing within vessels may affect growth, metabolism, or other molecular expression phenomena. Operating conditions influence terminal mixing time to reach designated variability associated with complete mixing and mean circulation time to circulate through specific region once. Characterization of mixing times and the influence of geometric features of reactors under different operating conditions and scales of operation bench, pilot, and full scale are important if efficiency time and cost is to be optimized

Heat transfer

Heat is dissipated mainly by convection across the walls of the jacket or coils. In aerated systems, metabolic heat production is correlated with oxygen uptake rate. The maximum metabolic load should be considered in design calculations as in gas-liquid oxygen transfer. Handbook values are available for heat transfer on the jacket side, vessel side, and in tubes. In general, heat transfer becomes a problem only in very large scale operations and in dense microbial populations, which are frequent with recombinant cells. In other cases, gas-liquid mass transfer and mixing are the major concerns.

Shear

Agitation is required to maintain suspensions of the cells. Agitated bioreactors are designed to maintain complete suspension no cell mass at the bottom of the reactor or a homogeneous suspension. These terms imply stable flocculation aggregates in suspension or homogeneous cell distribution throughout the suspension. The mechanism of shear damage to the cells is not clear. Mycelia or protozoan cells exhibit shear rate–limited growth, and cell damage has been monitored by analyzing the concentration of low-molecular-weight nucleotides in the culture broth [4,5].

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