Pharmaceutical
BIOPROCESSING

Design of bioreactor

Amine S. Kamen*

Department of Bioengineering, McGill University, Canada

*Author for correspondence:
aminekamen@mcgill.ca

A bioreactor refers to any manufactured device or system that supports a biologically active environment. In one case, a bioreactor may be a vessel during which a chemical change is administered 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 metres, and are often made from chrome steel.[citation needed] it's going to also ask a tool or system designed to grow cells or tissues within the context of cell culture. These devices are being developed to be used in tissue engineering or biochemical/bioprocess engineering.

On the idea of mode of operation, a bioreactor could also be classified as batch, fed batch or continuous (e.g. endless stirred-tank reactor model). An example of endless bioreactor is that the chemostat

Organisms growing in bioreactors could also be submerged in liquid medium or could also be attached to the surface of a solid medium. Submerged cultures could also be suspended or immobilized. Suspension bioreactors can use a wider sort of organisms, since special attachment surfaces aren't needed, and may operate at a way larger scale than immobilized cultures. However, during a continuously operated process the organisms are going to be faraway from the reactor with the effluent. Immobilization may be a general term describing a good sort of methods for cell or particle attachment or entrapment. It are often applied to basically all kinds of biocatalysis including enzymes, cellular organelles, animal and plant cells. Immobilization is beneficial for continuously operated processes, since the organisms won't be removed with the reactor effluent, but is restricted in scale because the microbes are only present on the surfaces of the vessel.

Design

Bioreactor design may be a relatively complex engineering task, which is studied within the discipline of biochemical/bioprocess engineering. Under optimum conditions, the microorganisms or cells are ready to perform their desired function with limited production of impurities. The environmental conditions inside the bioreactor, like temperature, nutrient concentrations, pH, and dissolved gases (especially oxygen for aerobic fermentations) affect the expansion and productivity of the organisms. The temperature of the fermentation medium is maintained by a cooling jacket, coils, or both. Particularly exothermic fermentations may require the utilization of external heat exchangers. Nutrients could also be continuously added to the fermenter, as during a fed-batch system, or could also be charged into the reactor at the start of fermentation. The pH of the medium is measured and adjusted with small amounts of acid or base, depending upon the fermentation. For aerobic (and some anaerobic) fermentations, reactant gases (especially oxygen) must be added to the fermentation. Since oxygen is comparatively insoluble in water (the basis of nearly all fermentation media), air (or purified oxygen) must be added continuously. The action of the rising bubbles helps mix the fermentation medium and also "strips" out waste gases, like CO_2. In practice, bioreactors are often pressurized; this increases the solubility of oxygen in water. In an aerobic process, optimal oxygen transfer is usually the speed limiting step. Oxygen is poorly soluble in water—even less in warm fermentation broths—and is comparatively scarce in air (20.95%). Oxygen transfer is typically helped by agitation, which is additionally needed to combine nutrients and to stay the fermentation homogeneous. Gas dispersing agitators are wont to hack air bubbles and circulate them throughout the vessel.

Fouling can harm the general efficiency of the bioreactor, especially the warmth exchangers. To avoid it, the bioreactor must be easily cleaned. Interior surfaces are typically made from chrome steel for straightforward cleaning and sanitation. Typically bioreactors are cleaned between batches, or are designed to scale back fouling the maximum amount as possible when operated continuously. Heat transfer is a crucial a part of bioreactor design; small vessels are often cooled with a cooling jacket, but larger vessels may require coils or an external device.