

Al-Farabi Kazakh National University

Design of Fermenters

Lecture 7

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Fermenters

The main function of a fermenter is to provide a suitable environment in which an organism can efficiently produce a target product.

Most of them are designed to maintain high biomass concentrations, which are essential for many fermentation processes.

Fermenter design, quality of construction, mode of operation and the level of sophistication largely depend upon the production organism, the optimal operating conditions required for target product formation, product value and the scale of production.

The performance of any fermenter depends on many factors, but the key physical and chemical parameters that must be controlled are agitation rate, oxygen transfer, pH, and temperature and foam production.

Basic Design of a Fermenter

- The materials used for construction of fermenter withstand repeated steam sterilization and are non-toxic.
- The reaction vessel is designed to withstand vacuum or else it may collapse while cooling.
- The internal surface is smooth and corrosion resistant.
- Either stainless steel or glass is used for construction.

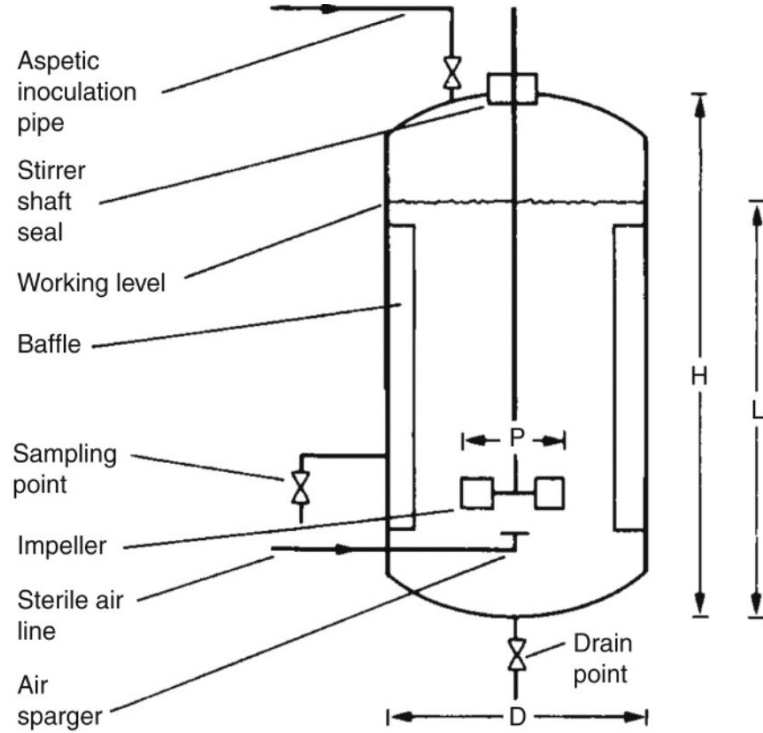


FIGURE 7.1 Diagram of a Fermenter With One Multibladed Impeller

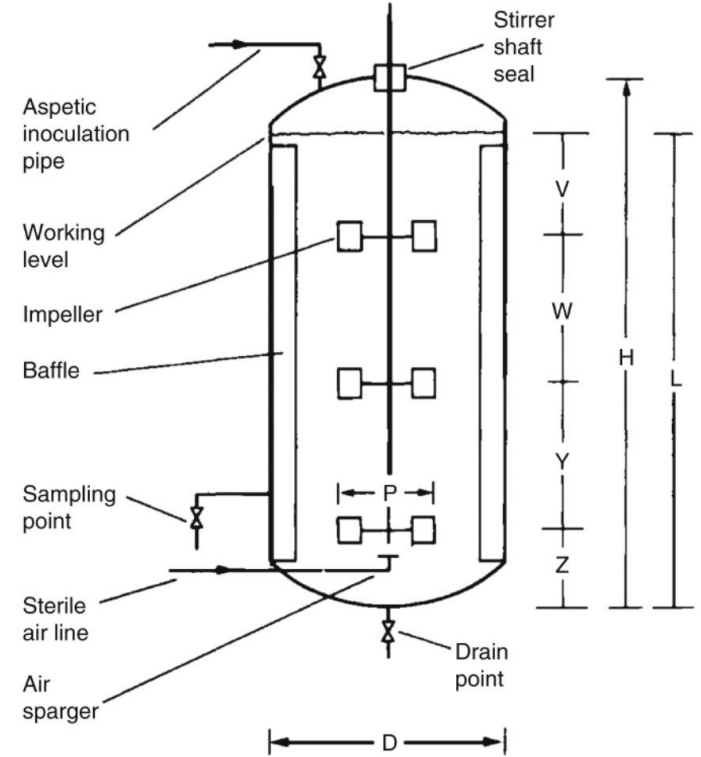


FIGURE 7.2 Diagram of a Fermenter With Three Multibladed Impellers

Parts of fermenter: Functions

- 1. Impeller (agitator):** To stir the media continuously and hence prevent cells from settling down and distribute oxygen throughout the medium. Impeller speed decreases as the size of the fermenter increases
- 2. Sparger (aerator):** Introduce sterile oxygen to the media in case of aerobic fermentation process
- 3. Baffles (vortex breaker):** Disrupt vortex and provide better mixing
- 4. Inlet Air filter:** Filter air before it enter the fermenter
- 5. Exhaust Air filter:** Trap and prevent contaminants from escaping
- 6. Rota meter:** Measure flow rate of Air or liquid
- 7. Pressure gauge:** Measure pressure inside the fermenter

8. **Temperature probe:** Measure and monitor change in temperature of the medium during the process
9. **Cooling jacket:** To maintain the temperature of the medium throughout the process
10. **pH probe:** Measure and monitor pH of the medium
11. **Dissolved oxygen probe:** Measure dissolved oxygen in the fermenter
12. **Level probe:** Measure the level of medium
13. **Foam probe:** Detect the presence of the foam
14. **Sampling point:** To obtain samples during the process
15. **Valves:** Regulates and controls the flow of liquids and gases

CONSTRUCTION MATERIALS

In fermentations with strict aseptic requirements, it is important to select materials that can withstand repeated steam sterilization cycles.

On a small scale (1–30 dm³) it is possible to use glass and/or stainless steel.

Glass is useful because it gives smooth surfaces, is nontoxic, corrosion proof, and it is usually easy to examine the interior of the vessel.

Basic Types of Fermenter

A glass vessel with a round or flat bottom and a top flanged carrying plate.

The large glass containers originally used were borosilicate battery jars.

All vessels of this type have to be sterilized by autoclaving.



FIGURE 7.4 Glass Fermenter With a Top-Flanged Carrying Plate (Inceltech L.H. Reading, England)

A glass cylinder with stainless-steel top and bottom plates.

These fermenters may be sterilized in situ, but 30 cm diameter is the upper size limit to safely withstand working pressures.

Vessels with two stainless steel plates cost approximately 50% more than those with just a top plate.



FIGURE 7.5 Three Glass Fermenters With Top and Bottom Plates (New Brunswick Scientific, Hatfield, England)

All fermenters are sterilized in situ, any materials used will have to be assessed on their ability to withstand pressure sterilization and corrosion and on their potential toxicity and cost.



FIGURE 7.6 Stainless Steel Fully Automatic 10-dm³ Fermenter Sterilizable-In-Situ (LSL, Luton, UK)

Pilot-scale and industrial-scale vessels are normally constructed of stainless steel or at least have a stainless-steel cladding to limit corrosion.



FIGURE 7.7 Stainless Steel Pilot Plant Fermenters (LSL, Luton, UK)

There are different types of fermentor used in industrially micro biology which includes

1. Stirred tank bioreactor
2. Tower bioreactors
3. Air lift bioreactors
4. Packed-bed bioreactors
5. Fluidized bed bioreactors
6. Photo bioreactors