Unit -2

UNIT 2

Design of Bio Process Vessels

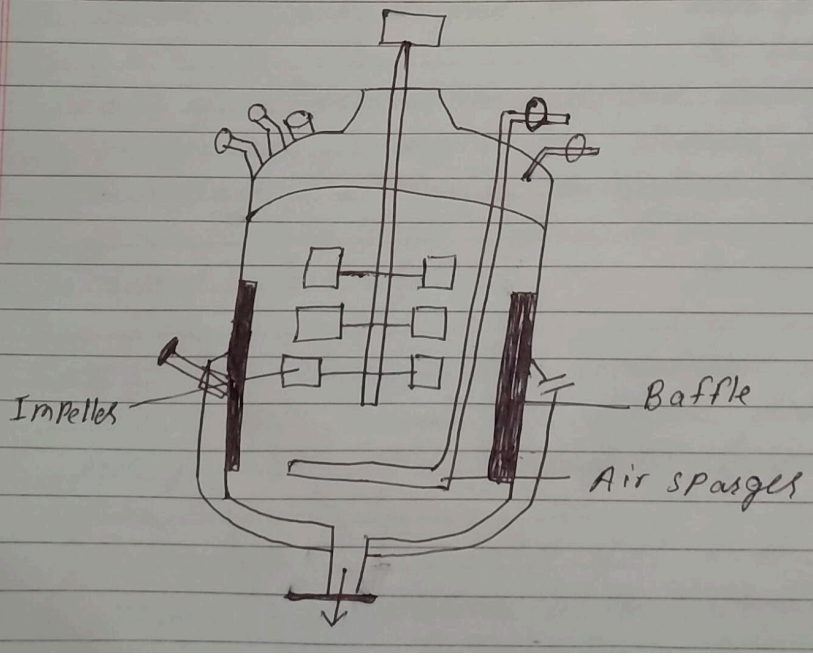
Introduction :—

Bioreactor – Can be described as a vessel which has provision of cell cultivation under sterile condition & control of environmental conditions e.g - pH, Temp, dissolved oxygen etc.

It Can be used for the cultivation of microbial plant or Animal cells.

This process can either be aerobic or anaerobic.

The bioreactor are commonly cylindrical, ranging in size from litres to cubic metres and are often made of stainless steel.



Significance of Impellers, Baffles, Sparger

Impellers :— An impellers is a rotating component of a centrifugal pump, usually made of iron, steel, bronze, brass, aluminium rubbers or plastic, which transfers energy from the motor that desires the pump to the fluid being pumped by accelerating the fluid outwards from the center of rotation.

An impellers is a rotating component of centrifugal pump which transfer energy from the motor that drives the pump to the fluid being pumped by accelerating the fluid outwards from the centers of rotation. The velocity achieved by the impellers transfer into pressure when the outwards movements of the fluid is confined by the pump casing, impellers are usually short cyclinders with an open inlet to accept incoming fluid vanes to push the fluid radially and a splined keyed or threaded bore to accept a drive-shaft.

The impellers made out of a cast material in many cases may be called rotor, also it is cheaper to cast the radial impellers right in the support it is fited on, which is put in motion by the gear box from an electric motor combustion engine or by stream drives turbine.

Baffles :—

Used to break the vortex formation in the vessel, which is usually highly Undesirable as it changes the center of gravity of the system and consumes additional power.

Baffles serves two purposes:

Divert (direct) the flow across the bundle to obtain a highest heat transfer coefficient.

Support the tubes for structural rigidity, preventing tubes vibrating and sagging.

Spargers :—

In aerobic cultivation process, the purpose of the spargers is to supply adequate oxygen to the growing cells.

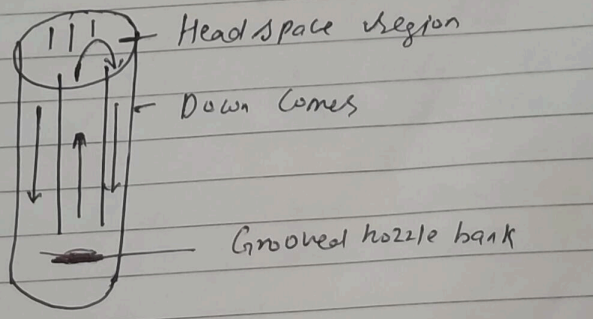
Types of culture / production Vessels;

(I) Airlift.
(II) Cyclone column
(III) ~~Packaged~~ packed Towes

(I) ~~Aift~~ Airlift :- In the airlift bioreactor, the medium of the vessel is divided into two interconnected zones by means of a baffle or draft tube.

- In one of the two zones referred to a risers the air/gas is pumped. The other zone that receives no gas is the down comer.

- The dispersion flow up the risers zone while the down flow occurs in the down comer.



Types of Airlift

Two types of airlift bioreactor

(1) Internal Loop:— has a single container with a central draft tube that creates interior liquid circulation channels.

These bioreactors are simple in design, with volume and circulation at a fixed rate for fermentor.

(2) External Loop :— possess an external loop so that the liquid circulates through separate independent channels.

These reactors can be suitably modified to suit the requirements of different fermentations.

Applications of Airlift Bioreactors:—

Airlift bioreactors are commonly employed for aerobic bioprocessing technology.

They ensure a controlled liquid flow in a recycle system in pumping.

Due to high efficiency, airlift bioreactors are sometimes ~~prefere~~ preferred e.g. - methanol production, waste water treatment, single cell protein, production.

In general, the performance of the airlift bioreactors is dependent on the pumping (injection) of air and the liquid circulation.

(2) Cyclone column Bioreactor:—

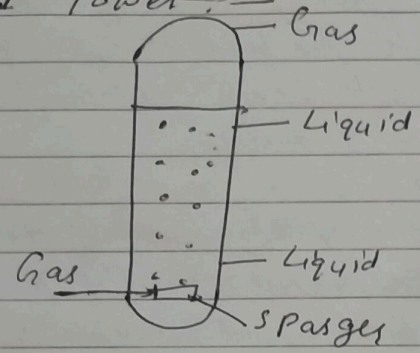
In the Cyclone (Bubble) column bioreactor, the air or gas is introduced at the base of the column through perforated pipes or plates or metal micro porus sparger.

The flow rate of the air/gas influence the performance factors — O_2 transfer mixing.

The bubble (cyclone) bioreactor may be fitted with perforated plates to improve performance.

The vessel used for bubble column bioreactors is usually cylindrical with an aspect ratio of 4-6.

(3) ~~packed Tower~~ :—



(3) packed Tower:—

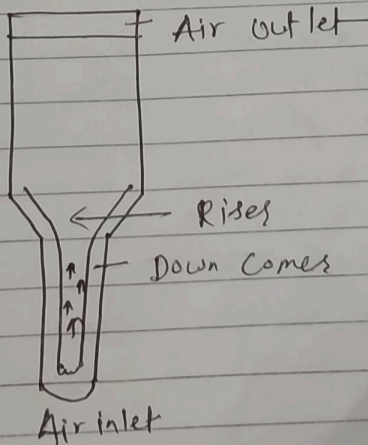
A pressure-cycle fermentor with large dimensions constitute a tower bioreactor.

A high hydrostatic pressure generated at the bottom of the reactor increase the solubility of O_2 in the medium.

At the top of the risers, (with expanded top) reduces pressure and facilitates explosion of CO_2.

The medium flows back in the down comers and completes the cycle.

The advantage with tower bioreactor is that it has high aeration capacities without having moving parts.



Principles of upstream processing – media preparation

The pre-fermentation stage
→ Isolation
→ Improvement
→ producing of microorganisms.

Screening method; isolate microbes to produce diesred products.

Two method

(1) primary screening checking the quality of microbes done in agar plate

(2) Secondary screening checking the quantitive of microbes done in liquid media

microbes isolated from natural sources thus is improved to get productive strains by using.

(i) Recombination
(ii) mutation
(iii) Cell fusion
(iv) Gene cloning.

Media formulation / preparation :—

Growth medium must have essential nutrients for microbial growth for successful fermentation process.

Two kind of media
(i) Inoculum media — enrich the culture
(ii) production media — Contains Carbons and Nitrogen.

Raw materials : Corn molasses, cellulose, corn, steep liquor soyabean, sugar, beet, molasses etc. —

Upstream processing includes formulation of the fermentation medium, sterilization of air, and fermenter inoculum preparation and inoculation of the medium.

The fermentation medium should contain an energy source, a carbon, a nitrogen and micronutrients required for the growth of the M.O along with the water and oxygen is necessary.

A medium which is used for a large scale fermentation, in order to ensure the sustainibility of the operation,

The following Characteristics :—

(i) It should be cheap and easily available.

(ii) It should maximize the growth of the M.O productivity and rate of the formation of the desired product.

(iii) It should minimize the formation of undesired products.

Usually waste products from other industrial processes, such as molasses, lignocelluloses wastes, cheese, are used to substrate for many industrial fermentations.

Sterilization

Sterilization is essential for preventing the contamination with any undesired products.

Air is sterilised by membrane filteration while the medium is usually heat sterilized.

Any nutrient component which is heat liable is filtes-sterilized sterilised and later added to the sterilised medium.

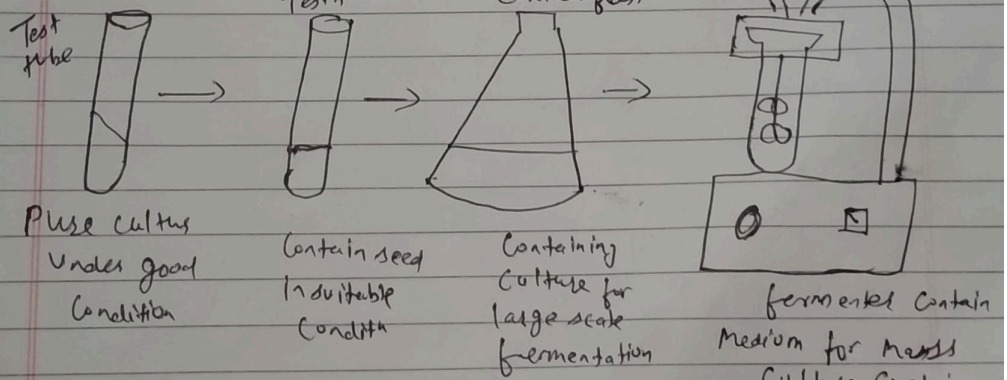
The fermenter may be sterilised together with the medium or separately.

Inoculum build up is the preparation of the seed culture in amount sufficient to be used in the larger fermenter vessel.

This involves growing the m.o obtained from the pure stock culture in several consecutive fermenter.

This process cut down the time required for the growth of m.o in the fermenter thereby increasing the rate of productivity.

Then the seed culture obtained through this process is used to inoculate the fermentation medium.



Thank you