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DEPARTMENT OF BIOCHEMISTRY

PAPER NAME: BASIC BIOTECHNOLOGY

TOPIC : FERMENTATION TECHNOLOGY

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FERMENTATION TECHNOLOGY

SYNOPSIS

- Fermentation
- Stages of fermentation
- Designing of Bioreactor
- Types of culture
- Fermentation Products
- Down stream process

FERMENTATION

Fermentation:

Anaerobic breakdown of organic materials by the action of anaerobic microorganisms or free enzymes.

- Fermentation process consists of three stages
- Upstream stage, Fermentation stage
- Downstream stage

STAGES OF FERMENTATION

- 1. Designing of bioreactor
- 2.Formulation of medium
- 3.Sterilization of medium
- 4.Isolation of microorganisms
- 5.Selection of right strain of microbe
- 6. Production of stock culture
- 7.Production of specific compound
- 8.Separation and purification of product

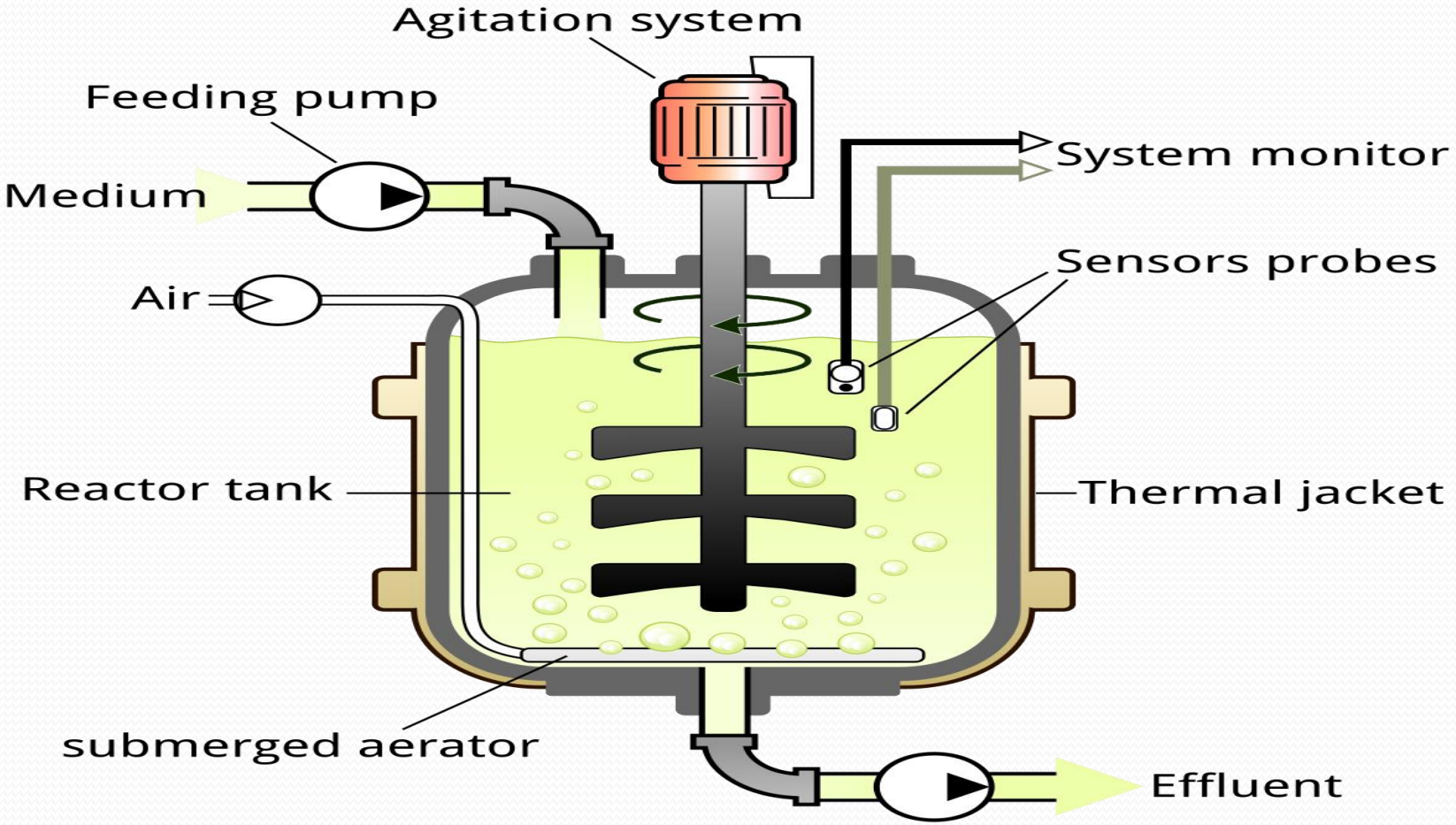
1.Designing of bioreactor

- Bioreactors
- Large sized vessels that provide a controlled environment for the mass culture of process organisms.
- 1.Stirred Tank Bioreactor
- 2.Cyclone column Bioreactor
- 3.Air lift Bioreactor
- 4.Tower Fermenter
- 5.Cylindro-conical bioreactor
- 6.Hollow fiber Bioreactor

Stirred Tank Bioreactor

- Upright cylindrical vessel
- Stirrer is fitted inside the vessel
- It mixes the air and nutrients
- Sterile air is pumped through pipeline
- Heating coil is used to raise the temperature
- Inside the vessel
- Vessel is covered with Water jacket
- Upper portion of vessel has two openings
- One is to add inoculum another is to release the gas produced during fermentation.

Stirred Tank Bioreactor



Air lift Bioreactor

- Non mechanically agitated Bioreactor
- Large cylinder with large cap like mould &a small open cylinder.
- Small cylinder is kept in the large cylinder in a fixed position.
- Large cylinder-down flow tube
- Small cylinder –up flow tube.
- Up flow tube has wide mouth and it has radially arranged metal strips –Baffles.
- Base of up flow tube has pipe line to regulate the temperature of the system.
- Sterile air is pumped in to the base of the up flow tube and it lift the medium inside to the top of the tube.
- At the top air moves up leaving the medium in to the down flow tube and give a pressure to force the medium down wards.

Air lift Bioreactor

Airlift fermenter

- 1)Concentric draft tube airlift fermenter

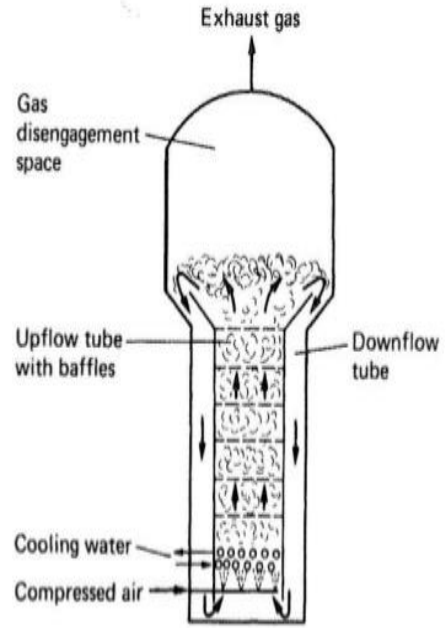


FIG. 7.47b. Air-lift fermenter with inner loop (Smith, 1980).

TOWER FERMENTER

- Non mechanically agitated bioreactor
- Long tube with closed ends
- Sterile air is pumped through its base
- It has water jacket around the vessel.
- Height and diameter 6:1 or 10:1
- Used for the Production of Citric acid tetracycline,
- Beer and Baker's yeast.

Tower fermenter

Cylindro-conical Bioreactor

- Cylindrical vessel with an inverted conical flask
- Surrounded by water jacket to cool fermenter
- Conical portion has an outlet for harvesting
- At the top an inlet to feed the bioreactor
- Thermometer at the bottom of conical flask
- Used for the production of beer, baker's yeast

Cylindro-conical Bioreactor

Fermenter tanks (cont.)

- Cylindro-conical vessels:
- Large stainless vessels- industrial use.
- Yeasts and wort pumped through bottom of vessel-reduce admission of O_2.
- Mostly supports bottom fermentation.
- Vessels equipped with cooling jackets and pressure relief valves.
- CIP fluids introduced through vessel by a CIP arm.
- Yeast is collected at bottom in the cone which can be cleaned easily.

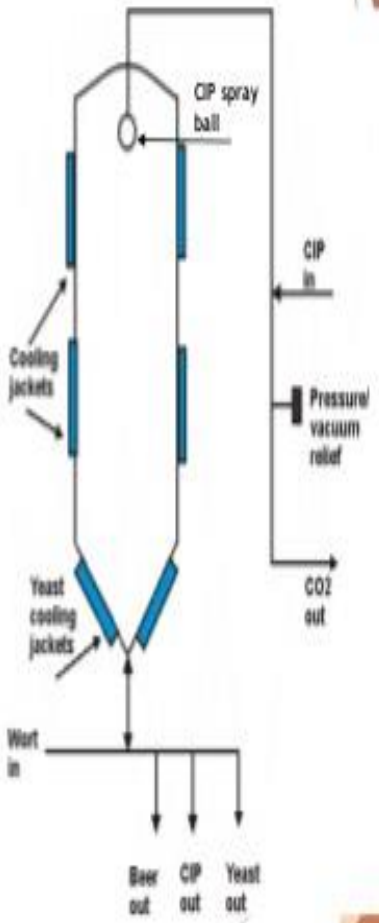
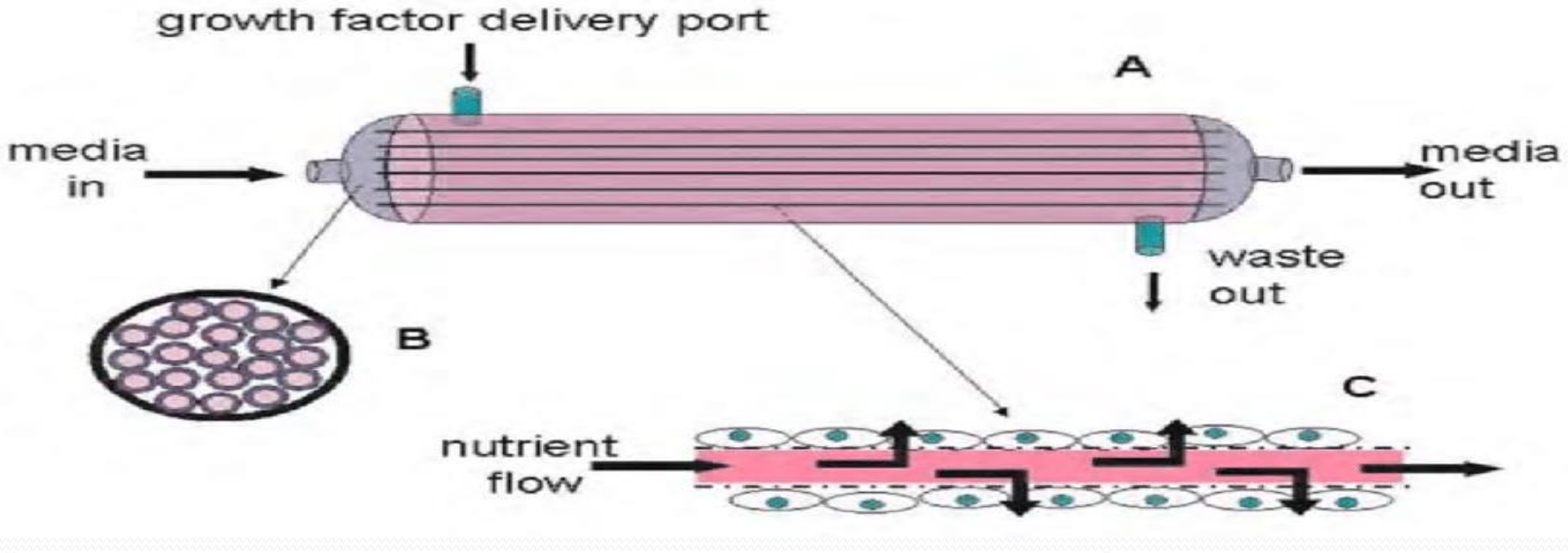
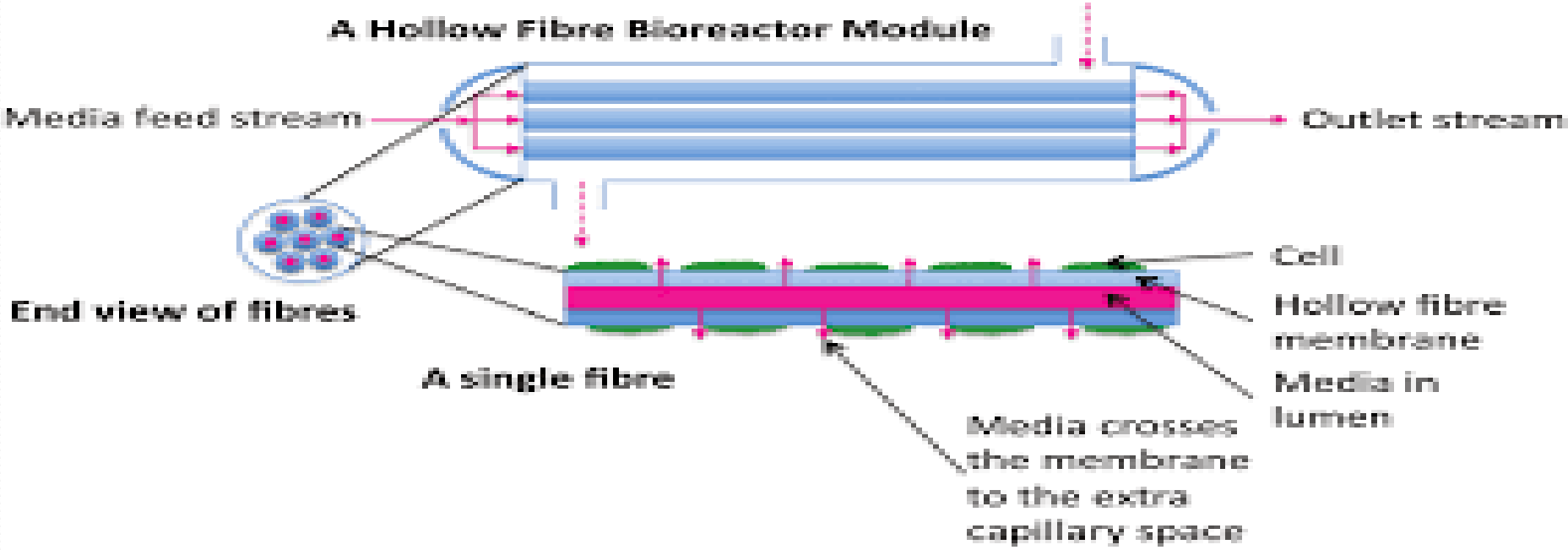


Figure 22: The cylindro-conical vessel.

Hollow –fiber Bioreactor

- Non mechanically agitated bioreactor
- Horizontal cylindrical vessel with closed basin ends
- Has hollow fiber zone between two ends
- It has partition interconnected by horizontal hollow fibers.
- Out let to harvest the medium at one end
- Inlet to feed the inoculum at another end

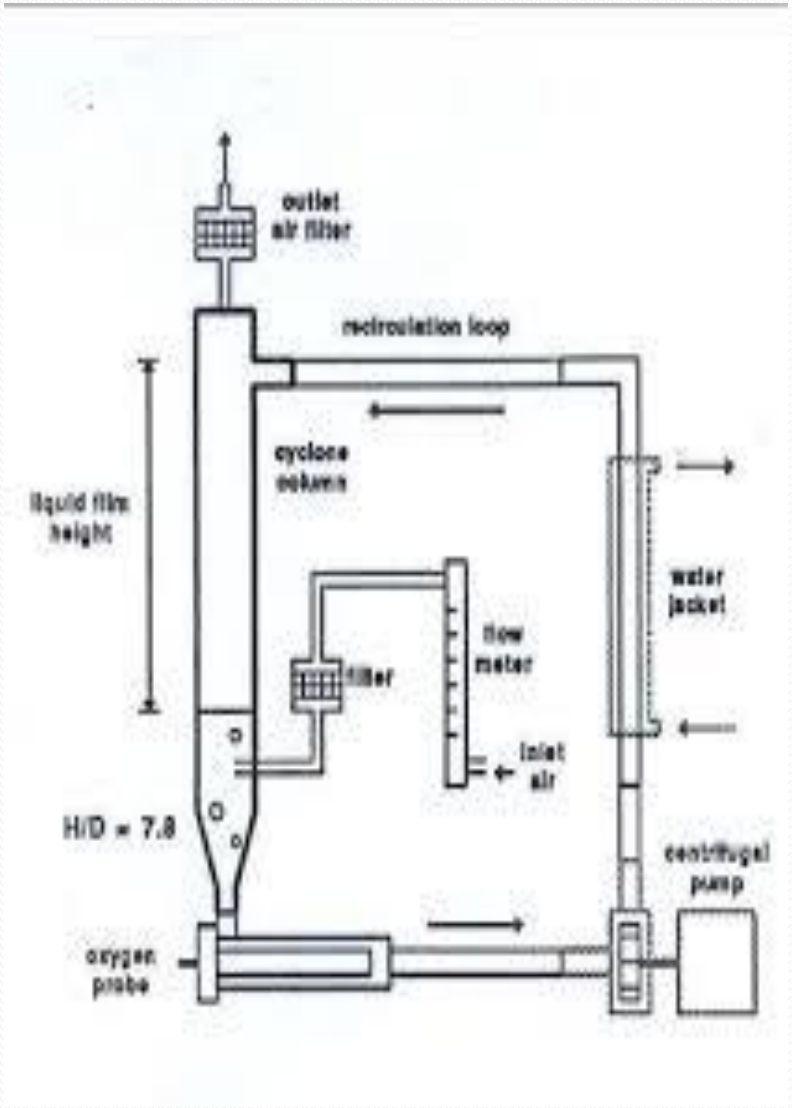

growth factor delivery port
A
media in
media out
waste out
B
C
nutrient flow
Optional feed stream through extracapillary space

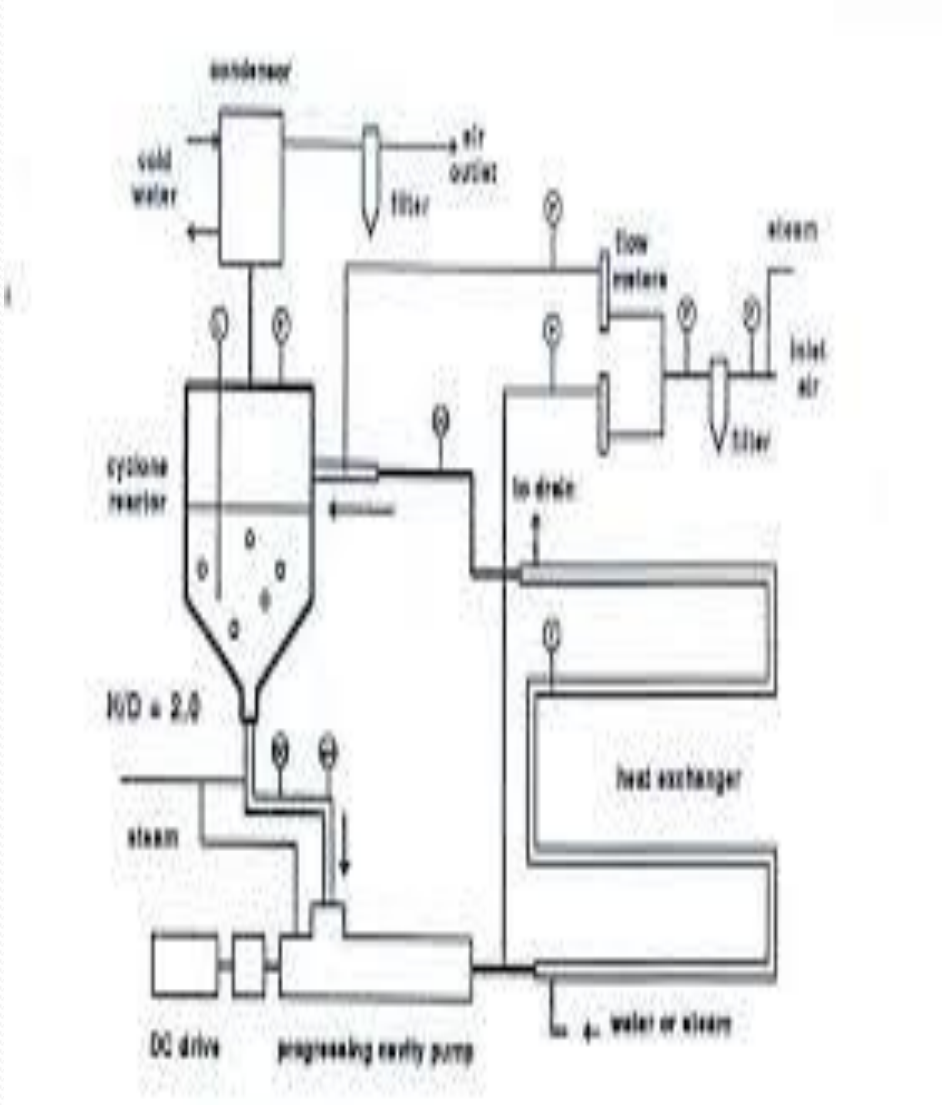

A Hollow Fibre Bioreactor Module
Media feed stream
Outlet stream
End view of fibres
A single fibre
Cell
Hollow fibre membrane
Media in lumen
Media crosses the membrane to the extra capillary space

CYCLONE COLUMN BIOREACTOR

- Reactor consist of cylindrical vessel with conical base.
- The nutrients and stock culture are feed into reactor at the conical base.
- The outlet is used for harvesting the product.
- The circulating pump is connected to both the end of the reaction vessel which help to pump the sterile air into the top of the bioreactor.
- Used in the culture of filamentous microbes producing foam thereby favors good gas exchange

Cyclone column Bioreactor





TYPES OF CULTURE

- Batch culture
- Continuous culture
- Synchronous culture
- Fed-batch culture

Selection of Microorganisms

Product	**Organisms**
Vitamin B12	*Propionibacterium shermanii*
Citric acid	*Aspergillus niger*
Amylase	*Aspergillus oryzae*
Protease	*Bacillus licheniformis*
Penicillin	*Penicillium notatum*

Fermentation products

- Vitamin B12 - Stirred tank fermenter
- Single cell protein - Air lift fermenter
- Tetracycline, Citric acid - Tower fermenter
- Beer, Baker's yeast - Cylindro-conical fermenter
- Monoclonal antibodies - Hollow Fiber fermenter
- Filamentous microbes - Cyclone column fermenter

Down stream process

- Separation of Biomass
- Cell disruption
- Concentration of broth
- Separation of metabolites
- Metabolite specific purification

THANK YOU