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II M.Sc., MICROBIOLOGY
BIOPROCESS TECHNOLOGY
SEMESTER - IV
P16MB42
DESIGN OF FERMENTER

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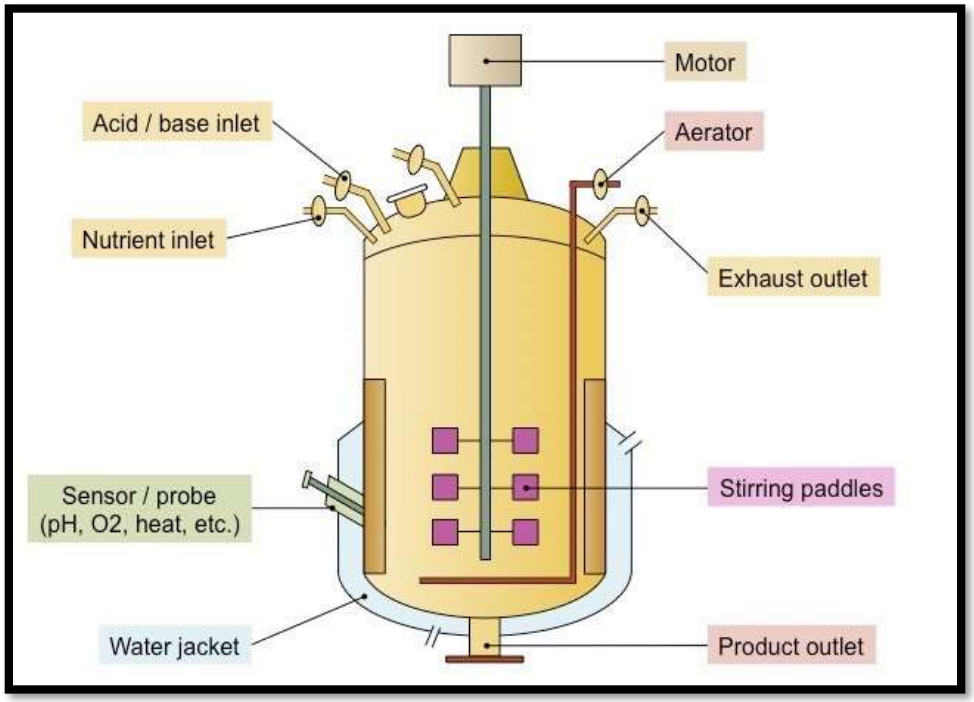
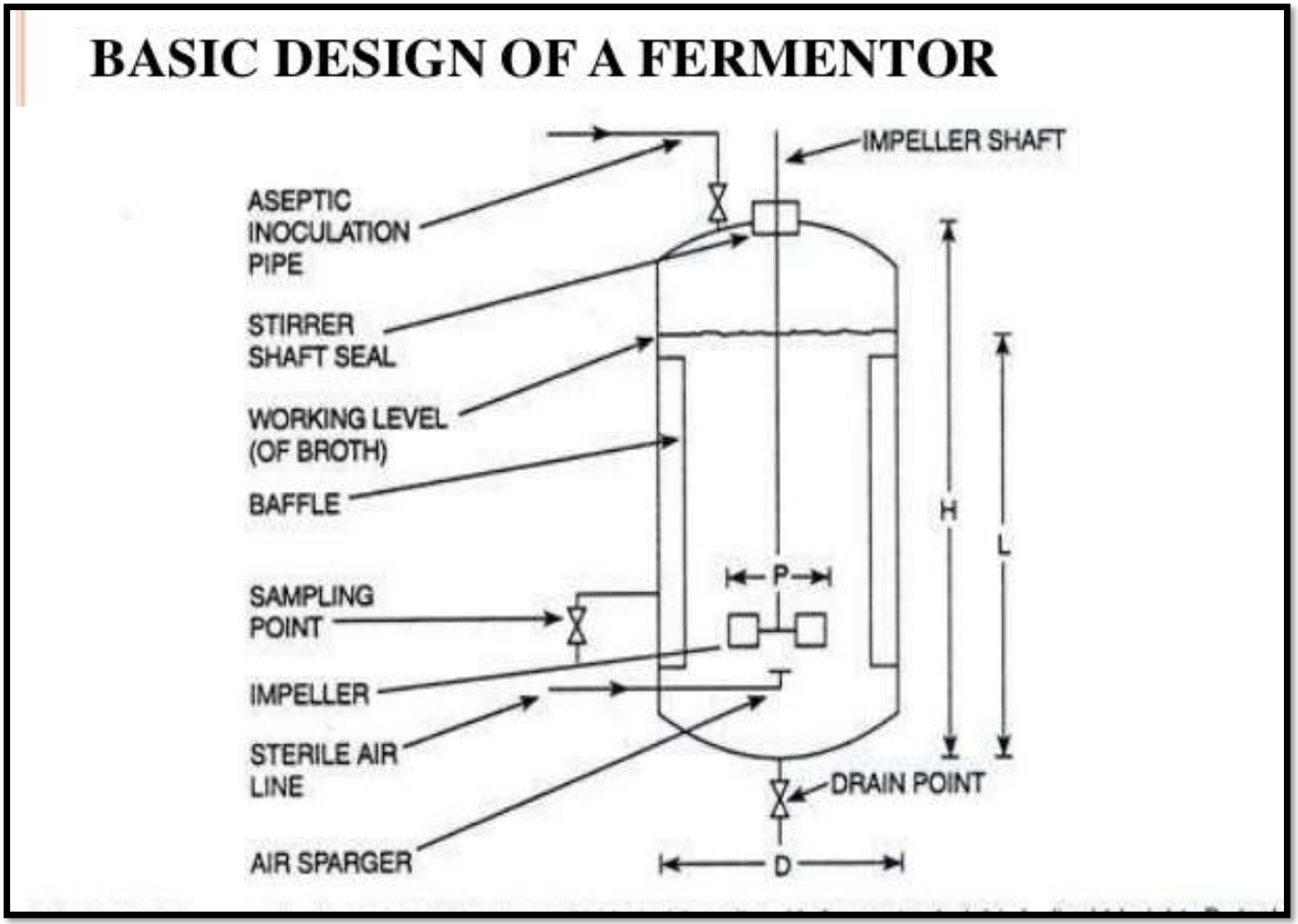
Fermenter

A **fermenter** is basically a device in which the substrate of low value is utilized by living cells or enzymes to generate a product of higher value. It is a containment system designed to give right environment for optimal growth and metabolic activity of the organism.



Design of Fermenter



IDEAL FERMENTOR PROPERTIES

- Supports maximum growth of the organism
- Aseptical operation
- Adequate aeration and agitation
- Low power consuming
- Tempurature control system
- pH control system
- Sampling facilities

- Minimum evaporation loss
- Minimum use of labour
- Range of processes
- Smooth internal surfaces
- Similar in geometry to both smaller & larger vessels in pilot plant
- Cheapest material usuage
- Adequate service provisions

- Provision for control of contaminants
- Provision for intermittent addition of antifoams
- Inoculum introduction facility
- Mechanism for biomass/ product removal
- Setting for rapid incorporation of sterile air
- Withstands pressure
- Ease of manipulation

FERMENTOR'S STRUCTURAL COMPONENTS IN AERATION & AGITATION SYSTEM

- The agitator
- Stirrer glands & bearings
- Baffles
- The aeration system

AGITATOR

- Synonym : impeller
- Mounted to a shaft through a bearing in the lid
- Driven by an external power source or direct drive
- Direct drive - action varied by using different impeller blades

- Recent designs – driven by magnetic coupling to a motor mounted beneath the fermentor
- High speed of rotation ⟶ marked vortex occurs
- Spining of medium in circular direction

MIXING OBJECTIVES IT ACHIEVE

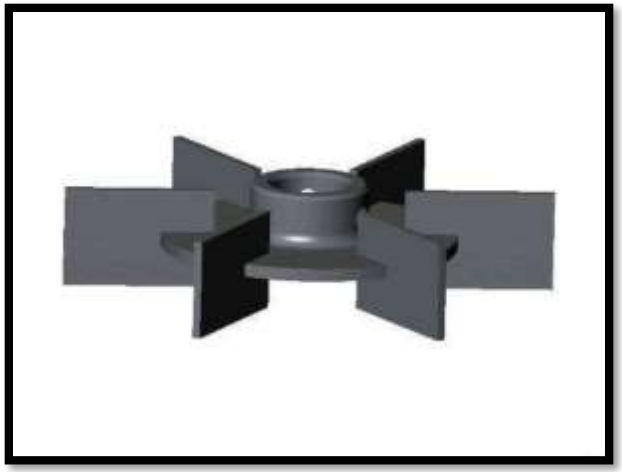
- Bulk fluid & gas phase mixing
- Air dispersion
- O_2 transfer
- Heat transfer
- Suspension of solid particles
- Maintenance of uniform environment throughout the vessel

CLASSIFICATION

- Disc turbine
- Vaned disc
- Variable pitch open turbine
- Marine propellers

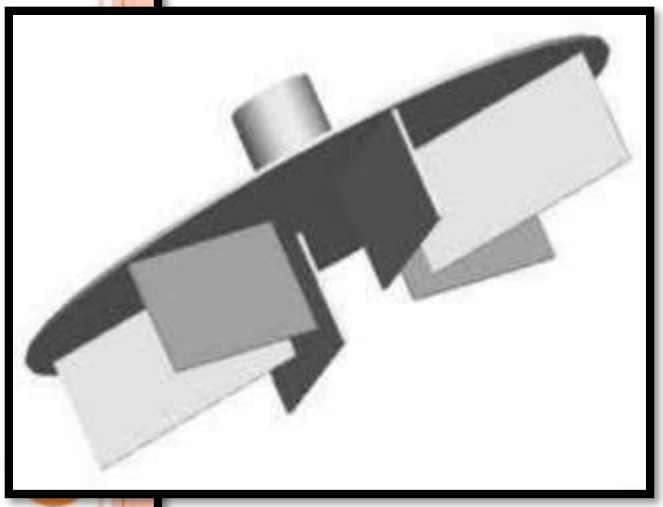
DISC TURBINE

- A disc with series of rectangular vanes set in a vertical plane around the circumference.
- Break up a fast air stream without itself becoming flooded in air bubbles



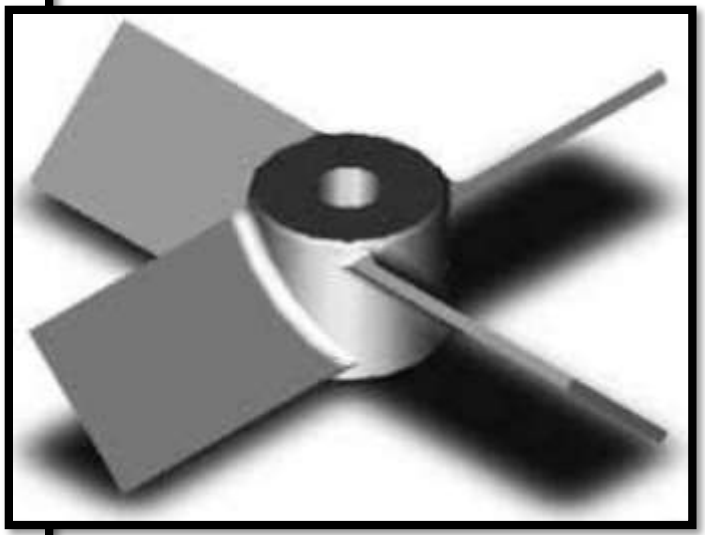
VANED DISC

- A series of rectangular vanes attached vertically to the underside
- Air from sparger hits it's underside & the air gets displaced towards the vanes
- Results in destruction of air bubbles



VARIALBLE PITCH OPEN TURBINE

- Vanes are attached directly to a boss on the agitator shaft
- Air bubbles hit any surface by its action
- Flood when superfial velocity exceed 21m/h



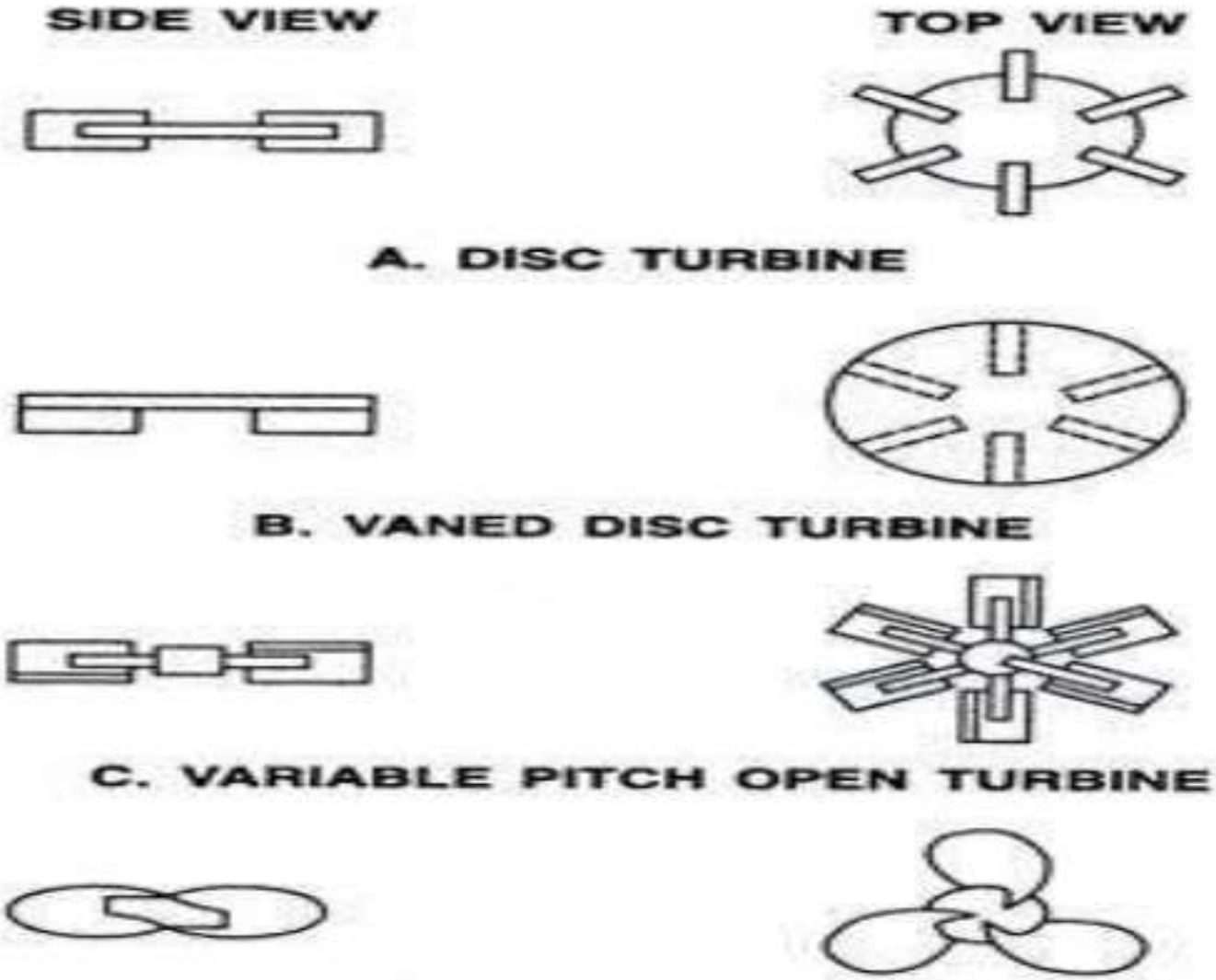


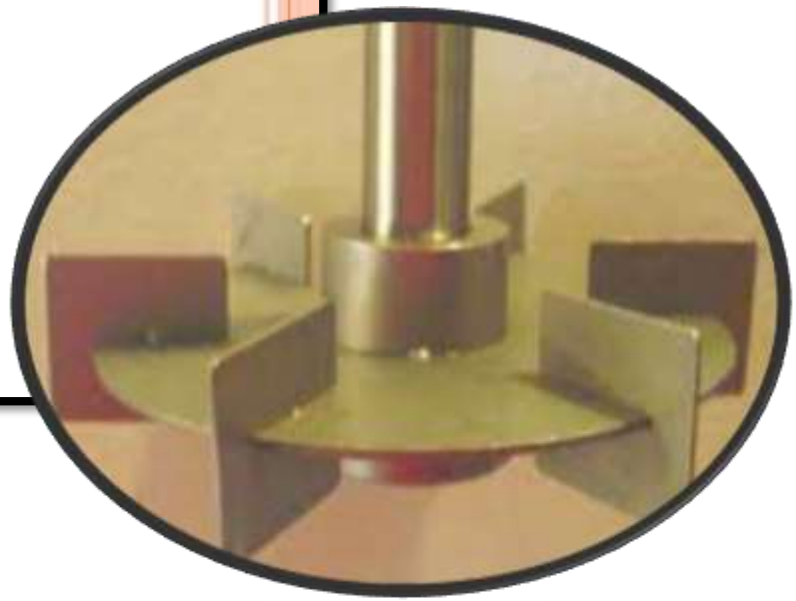
FIG. 14.1. Different types of agitators : A. disc turbine; B. vaned disc; C. open turbine, variable pitch; and D. marine propeller agitators.

MARINE PROPELLER

- Blades are attached directly to a boss on the agitator shaft
- Air bubbles hit surface
- A single low shear impeller
- Mainly used in animla cell culture vessel
- Flood when superfial velocity exceed 21m/h

MODERN AGITATORS

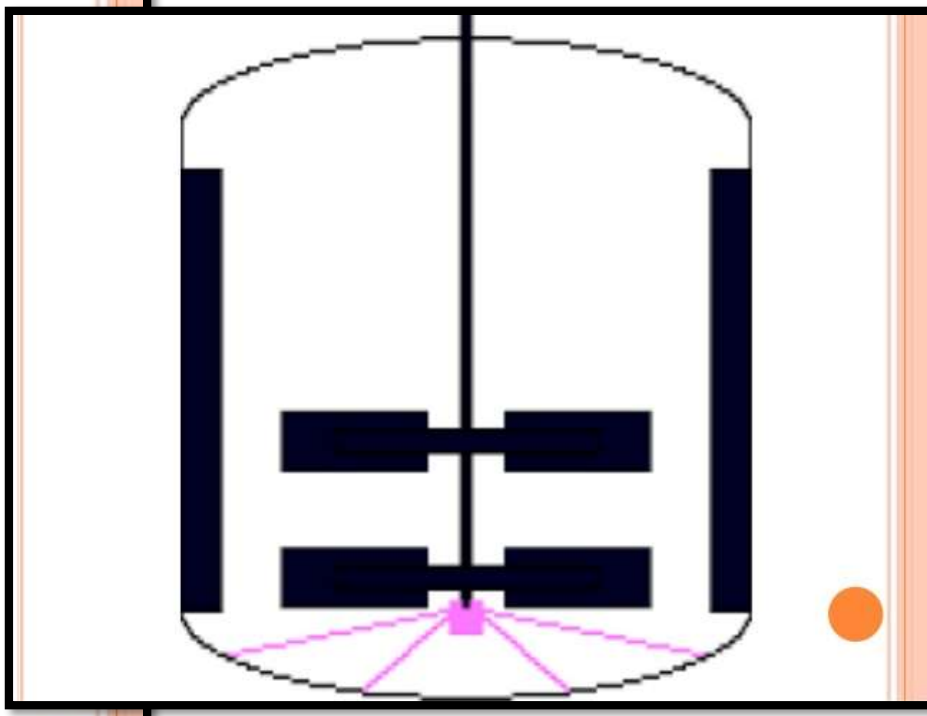
- Rushton disc turbine
- Scaba 6SRGT
- Prochem maxflow T
- Lightening A315
- Ekato intermig



BAFFLES

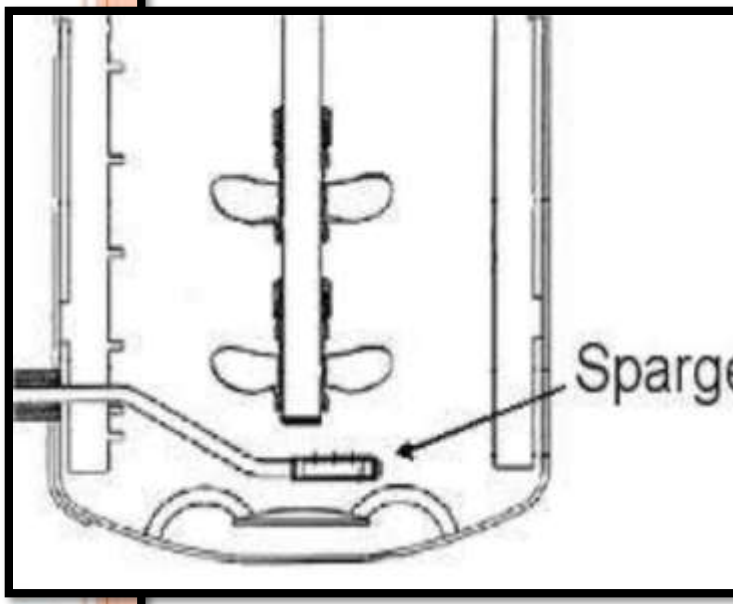
- Metal strips
- $1/10^{th}$ of the vessel diameter
- Attached radially to wall
- 4 baffles (normal)
- Wider baffles - high agitation effect

- Narrower baffles – low agitation effect
- Can be attached with cooling coils
- Not found in lab scale fermentors
- Vertical baffles – increased aeration



AERATION SYSTEM

- Syn : sparger
- A device that introduce air into medium
- Has a pipe with minute holes (1/64 - 1/32 inch or large)
- Hole – allows air under P to escape into medium
- For mycelial growth – ¼ inch holes
- Impeller blades disperses air released through sparger into medium



SPARGER TYPES

- Porous
- Orifice
- Nozzle

POROUS SPARGER

- Made of sintered glass, ceramics or metal
- Used mainly on a las scale fermentors
- Bubble size produced – 10-100 times larger than pores
- Throughput of air is low – P drop across it
- Clogging of pores

ORIFICE SPARGER

- Those with drilled air holes on their under surface of the tubes making up ring or cross

- Without agitation used to a limited extend in yeast manufacture & effluent treatment

NOZZLE SPARGER

- Modern mechanically stirred fermentors use them
- Single open or partially closed pipes
- Ideally, positioned centrally below impeller
- Causes lower P drops
- no clogging of pores

CONCLUSION

- Fermentor – platform for industrial fermentation
- Aeration & agitation system components – impeller, baffles, sparger, and stirrer & glands
- Impeller - spin medium in circular motion
- Baffles – metal strips radially attached to wall
- Sparger – introduce air into fermentor

THANK YOU