

Processing steps

➤ Starchy materials are of 2 categories

1. Encased by grain hulls
2. Starch is readily available

Malting:-

- Seeds are moistened & allowed to sprout
- These seeds are powdered & the powder is called malt

Milling:-

- Grains are milled to expose the starch
- Material is ground as fine as possible

- But the fine flour is difficult to remove in distillation process . Pot stills may reduce the problem

Cooking (preparation of mash):-

- Starch is liquefied by boiling under pressure
- To dissolve the water soluble starches
- Always done with steam under pressure at 100°C
- Use less water during cooking & water may be added to dilute the mash
- So cooling time may be saved

New method :- Milling & cooking in one operation without use of water

- The cooked malt is called mash

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Conversion :-

- Conversion of starch to fermentable sugar (Maltose) by certain enzymes in the malt or by acid hydrolysis

Enzyme extracts:-

- Commercially available

- 3 basic types :

1. α amylase - produce dextrose
2. B amylase - produce maltose
3. Gluco amylase – reduce the remaining starch

Acid hydrolysis:-

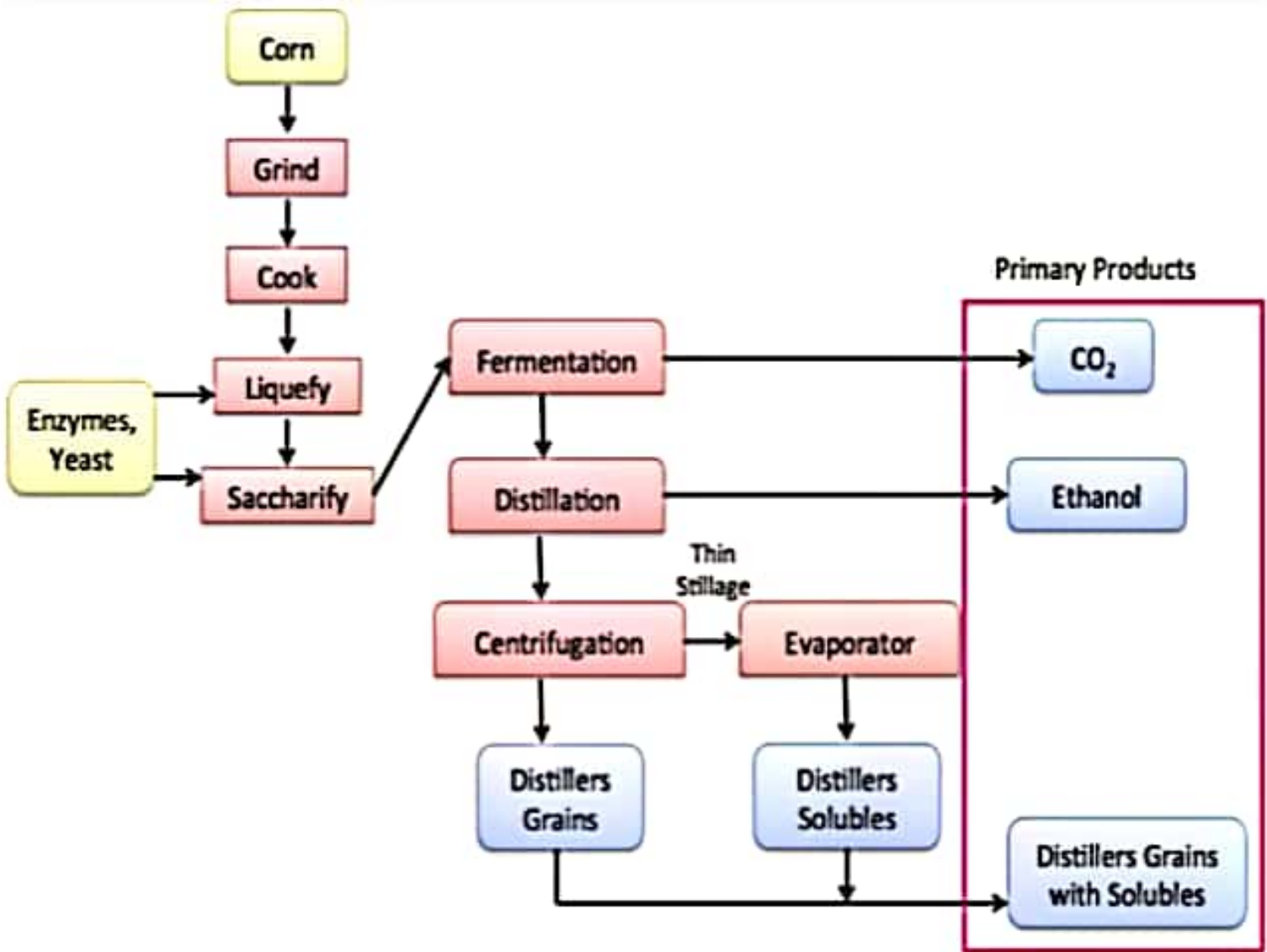
- Conversion by the action of acid
- Requires acid proof equipment and high temp
- Dilute mineral acid(H_2SO_4) is added to grain slurry
- Then immediately neutralized with calcium hydroxide

Mash cooling:-

- Mash is cooled after conversion & PH is checked
- Cooling coils are used for cooling
- Cooling time is reduced as much as possible

Fermentation

- Batch fermentation is commonly employed.
- Fermenter volume -- 600m³.
- 3% inoculum(3×10^6 /ml)
- With in 12 days yeast produce 10% ethanol
- when the process carried out at 35- 38°c , ph.4-4.5 max productivity was 1.9 g/h.
- 80%cells were removed in separator and brought back again into fermenter.
- When the high quality molasses is used, the max yield is 95%.



PRODUCT RECOVERY

- Cell biomass is separated by centrifugation or sedimentation.
- M.o desired end product – heated (aggregate) readily separated from broth by sedimentation.
- Desired end product metabolite.
 - intracellular - n.a , vit ,enz, a.b (gresofulvin)
 - extracellular - a.a, acitic acid, citric acid, alcohol,
[penicillin, streptomycin]

Separation of cell biomass

- Flocculation flotation
- Filtration centrifugation

flocculation:-

- Flocculating agent is added
 - hydrocolloids
 - inorganic salts
 - organic poly electrolyte
- produce large aggregate which still settle more readily

Flotation :-

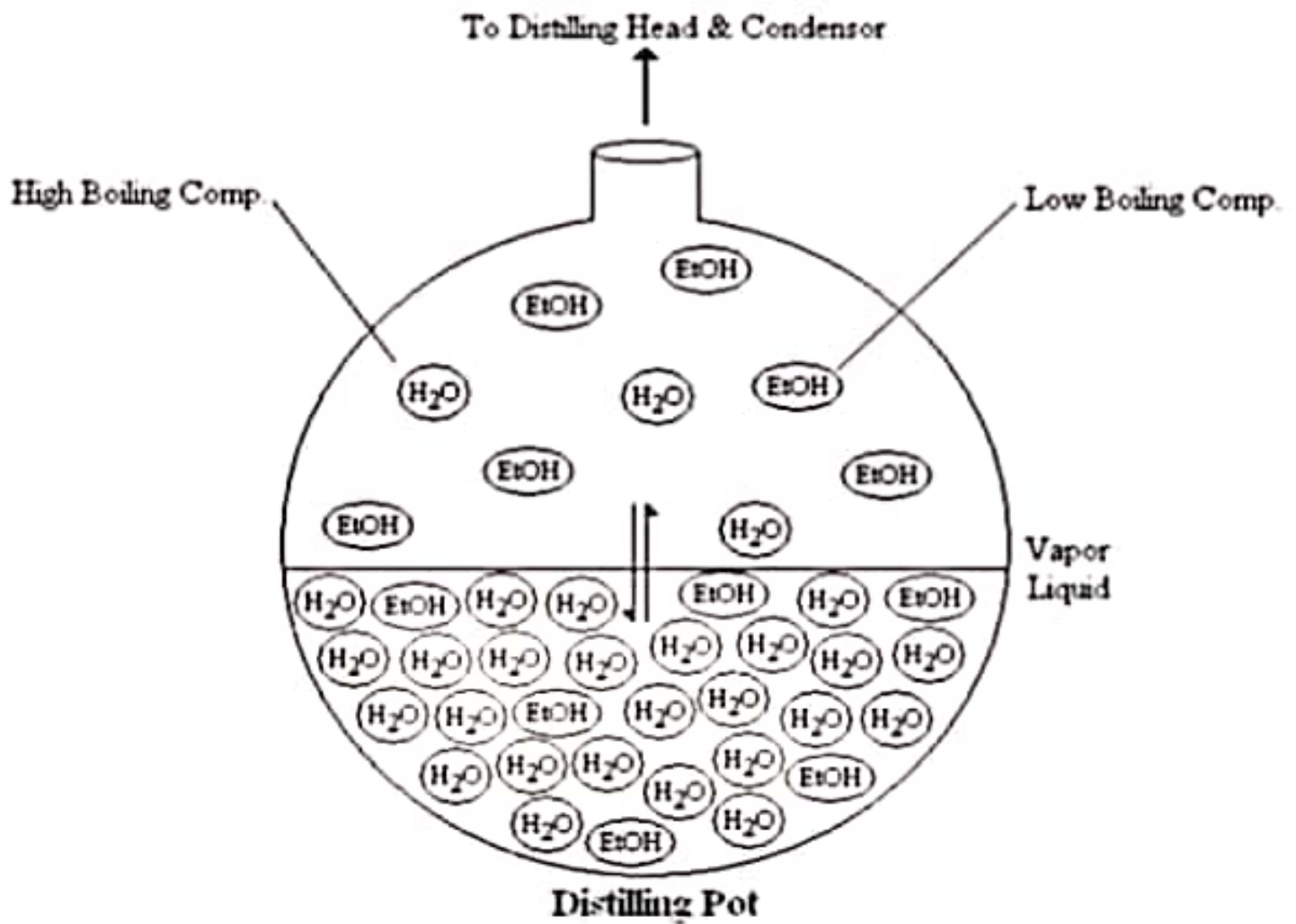
- by introducing gas into liquid
- Cells gets adsorbed to the gas bubbles & rise to the foam layer at the top of vessel
- That can be collected & removed from the bioreactor

Filtration:-

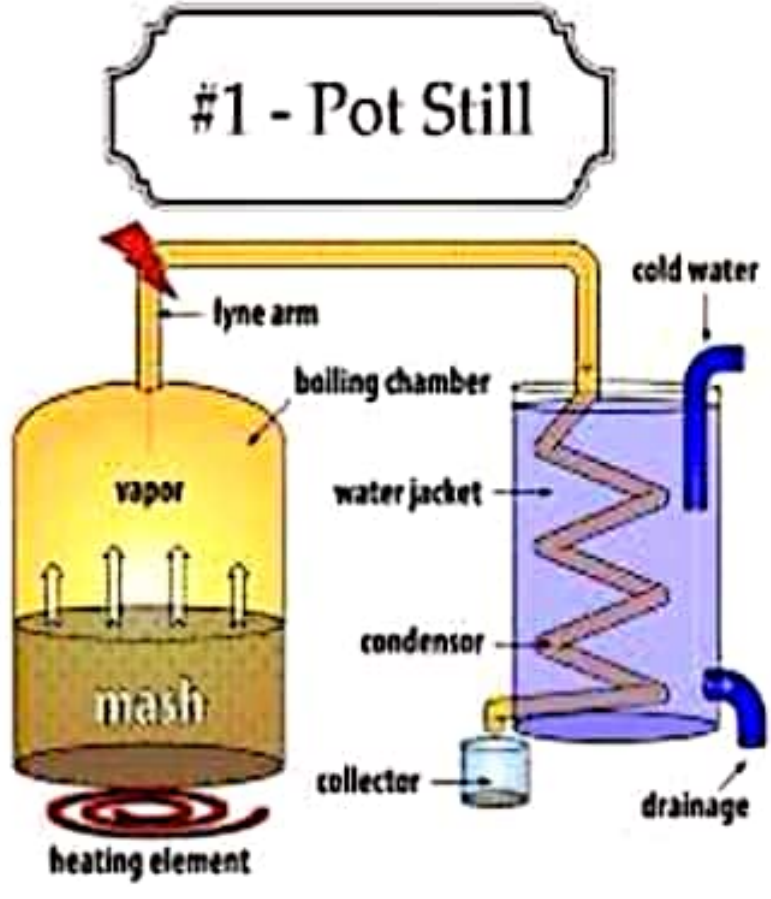
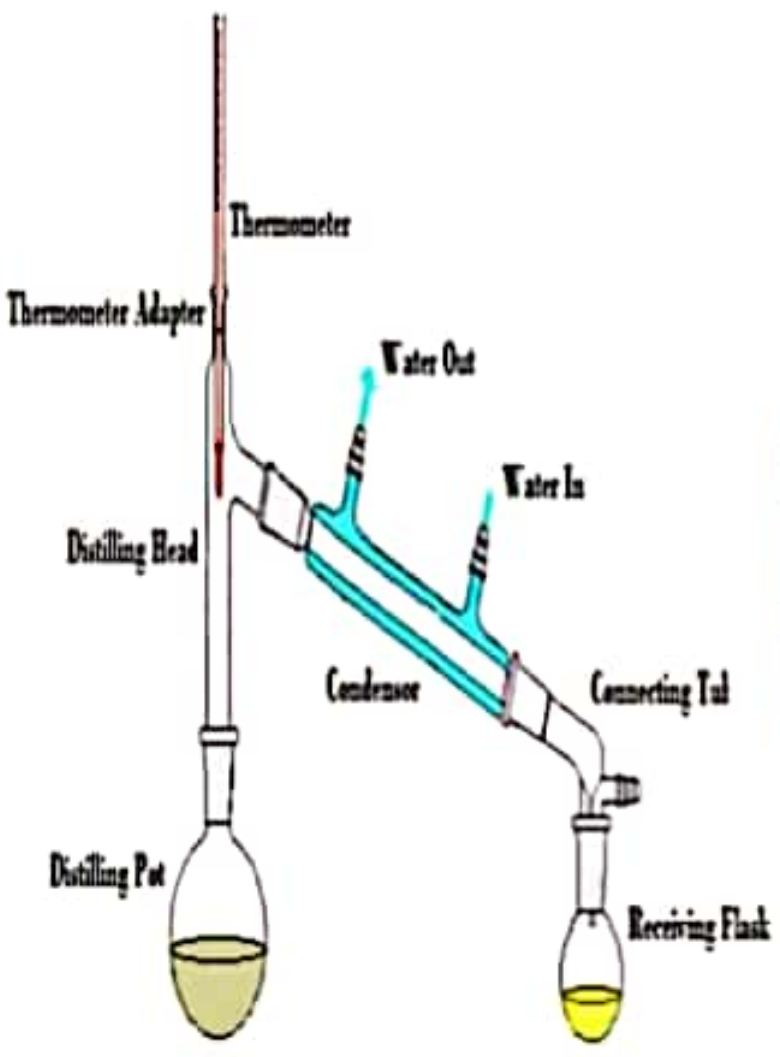
- Bacterial cultures – absolute filters
- filamentous Fungi- depth filters
- static & cross flow filtration

Distillation

- Separation for a mixture of liquids
- It relies on differences in B.P of component liquids to be separated
- The mixture to be separated is added to the distilled pot & is heated
- Low B.P will vaporize first. this vapors passes into distilling head & then into condenser.
- With in the condenser the vapor is cooled & it liquefies.
- The resulting liquid is then collected in receiving flask



#1 - Pot Still



Ethanol B.P - 78.5°C

Water B.P - 100°C

Purification:-

By chromatography

HPLC

GLC

Applications

- solvent in the manufacture of varnishes and perfumes
- Preservative for biological specimens
- In the preparation of essence and flavorings

- In many medicines and drugs.
- As a disinfectant and in tinctures.
- Used as a biofuel (99.2%).
- Medically ethanol is soporific.
- Used as antiseptic.
- Fluid in many alcohol thermometer.
- 92.4% ethanol is used as solvent in cosmetics pharmaceuticals and chemical industry

Byproduct

- **DDGS** (distillers dried grain with solubles)
- **Co₂**— used for the production of dry ice and preparation of soft drinks
- **Yeast biomass**- animal fodder (contains proteins &vit)

Ethanol Production Process

