CPT

Non-renewable → resources that can be used only once

Renewable → resources that can be over and over again
↳ Eg:- wind, water → resources that can be recycled.

→ Sodium carbonate → used in glass, soap, textile industries

→ Unit operations :- refers to changes which occur in the mass and concentration of the material when energy is provided from external source and when there is no chemical change
Eg:- evaporation, boiling, distillation etc.
(physical changes)

→ ~~Unit~~

→ Unit process :- refers to change in the reactants present in the process ~~refers to change~~ resulting from a chemical reaction due to energy provided to materials.
Eg:- Oxidation, Nitration. etc.

→ How to separate S+L / L+G into individual components → unit operation

Solubility :- ability of solute (solid) to dissolve in liq solvent (general)

→ liquid - liquid mixture

immiscible
Eg:- oil and H_2O

miscible (liq-liq) (forming homogeneous soln)
Eg:- Ethanol and water

If density difference is high → gravity settling chambers (Decanters)

low density difference → centrifugal separators (centrifuge)
↳ force = $\frac{mv^2}{r}$

adsorption, sorption
read BK distn
Selective transfer of molecules of mix to surface

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Emulsion

A fine dispersion of minute droplets of one liquid into another in which it is not soluble or miscible

→ Surfactants are added for stabilization → otherwise phase separation might occur.

→ Particle stabilized (Pickering) → has both hydrophilic, lipophilic part
↳ particle will be at the interface

→ To break the emulsion,

① surfactant or stabilizing factors must be neutralized.

→ Anti emulsion → eliminate formation of emulsion

Miscible liquids

Distillation, extraction, adsorption with suitable adsorbent, membrane separation
Chromatography, centrifugation,

Gas - Gas mixture

Absorption, gas separation membrane.

chromatography
diff components will travel at diff speeds in stationary phase
or rather diff heights

solid - solid mixtures

Leaching, based on size (sieving),

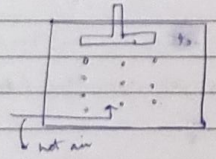
Solid - liq mix

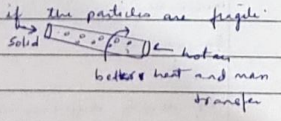
→ ① Dryers → weak interaction between S-L

ⓐ Tray dryers → hot air

ⓑ Rotary dryer → cannot be used if the particles are fragile.

ⓒ spray dryers (granulators) → for uniform size particles.





bed of heat and mass transfer

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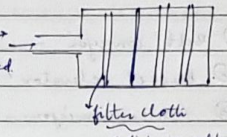
② Suspensions (slurry)

filtration

- Plate and frame filtration
- Rotary drum filtration

Hydrocloans.



Solid - gas (solid dispersed in gas)

① Filtration

Bag filter

② Cyclone separator } not for small particle size

③ Electro static precipitator → for small particle size

gas trapped in solid

① Desorption

② Concentration gradient driven

Gas - liq

① fine droplets of water in air ⇒ mist
passing through porous super absorbent

② passing through pool of liq

③ Compression

③ A has trapped in liq

Bubbling air through it

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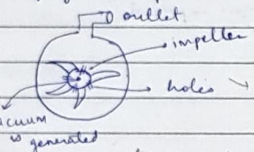
Transportation of solids

① Belt conveyor → not for fine particles because they might mix with air
② Bucket elevator
③ Screw conveyor
④ pneumatic conveyor → works on the principle of fluidization
↳ rotary valve is used so that fewer amount of particles can pass and to prevent clogging.
for fine particles.

Transportation of liq and gases

Pumps → rotodynamic → kinetic energy is imparted to the fluid by impeller
→ cannot be used when we have slurry (blockage) (alternative might spoil valves)

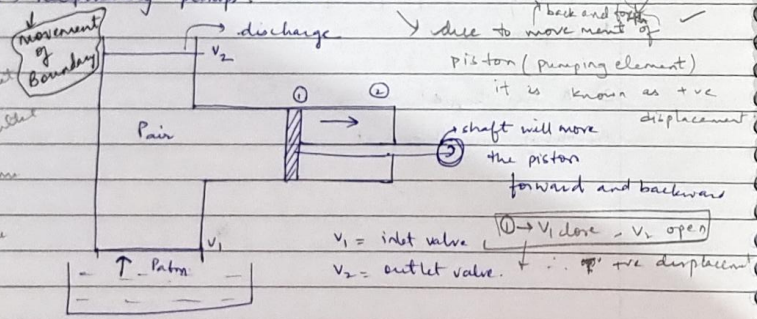
① Centrifugal pump
When the impeller rotates, centrifugal force will act and liq moves outside.



increase the mechanical energy of liquid increasing its velocity/pressure or elevation or all 3

② +ve displacement pumps (slurry) (self primed) (displacing from high pressure to low pressure), captures confined amt of liq and transfers it from suction to discharge

(a) Reciprocating pumps.



due to movement of piston (pumping element) it is known as +ve displacement
back and forth
shaft will move the piston forward and backward

V_1 = inlet valve
V_2 = outlet valve.

① → V_1 close, V_2 open
∴ it is +ve displacement

→ They trap some amt of fluid and discharge it at all times.

At some particular instant both inlet and outlet

Cavity volume ↑ at the suction side and then decreases at the discharge

__/__/____

When the piston moves from ① to ② → V_1 will open and it is filled with water. Now V_1 is closed and V_2 is opened and water is discharged.

→ Pa ∝ 1/Vol air
When Piston moves from ① to ②
Vol ↑ : P ↓ ✓ pressure gradient

Diaphragm pump (same principle like Reciprocating).

Diaphragm → flexible rubber like material
~~piston is moved with electric motor~~
is used instead of piston in reciprocating

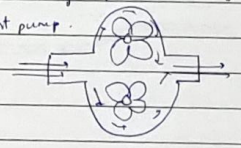
Fans → like centrifugal pumps. machine used to move fluid or air. Rotates the blades to move. (low speed machine) (generate low pressure)

Compressors :- reduces the volume of gas or liq by creating high pressure.
usually gas

Blowers :- increase the velocity of air or gas when passed through equipped impellers. high speed rotating devices → centrifugal or +ve displacement

Specific ratio

Rotary pumps :- +ve displacement pump.
↳ moderately viscous fluid like lubricating oil



Specific ratio = discharge pressure / Suction pressure
↳ high for compressor

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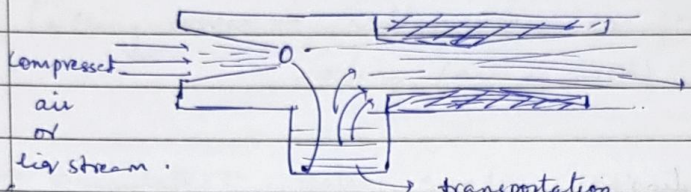
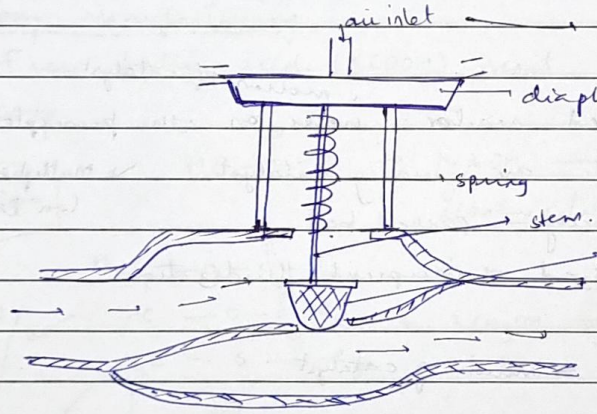
Jet ejector



motive fluid → used to create vacuum

venturi type → initial ✓

— **Control valve** :- controls fluid in a pipe by varying orifice size through which fluid flows.



because of air pressure diaphragm moves downward and plug moves down.

3 psi → open
15 psi → closed valve

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Storage

→ solids :- silo, bins, hoppers

→ cooling towers.

Reactors :

Non catalytic reaction

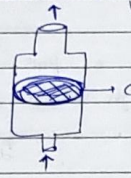
① Plug flow reactor

② CSTR

Catalytic reactors

① Packed bed reactor : ~~Used to~~ ~~improve~~

↳ chemical reaction takes place on the surface of catalyst



② fluidized bed reactor :- → motion of catalyst

↳ works on the principle of fluidization

↳ solid particle are usually catalyst → multiphase reactions can take place

advantages disadvantages

M lower velocity → packed bed

higher → fluidized → incipient fluidization.

③ Slurry reactor → motion of catalyst

④ Trickle bed reactor → G, L, S are involved → 3 phase reactor

liq flow downward, gas flows upward over packed bed (catalyst)

liq is dispersed phase, gas is continuous.

→ Packed v/s trickle

__/__/__

fatty acid → carboxylic acid with long carbon chain

Fertilizers (notes) (madhuni) (slides)

Prilling tower → molten urea to solid granules by cooling (air is used)

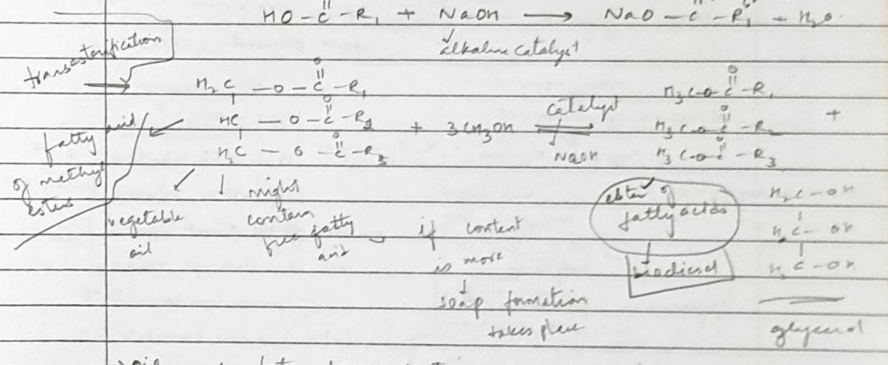
→ Granulators :- rotary grinder mat are used to grind scrap parts ~~and~~ Break down products (or) form grains from powdery substance.

→ Biomass :- Biomass in the form of fuel wood is used for heating and cooking

Wood, crops, manure, garbage - -

Soap manufacturing

Free fatty acids (RCOOH) react with NaOH to form soap



→ Oil and fats ~~are~~ contain small amt of water and free fatty acids (RCOOH). If water content is relatively high, it can hydrolyze triglycerides and form ~~to~~ free fatty acids. If the content of FFA is high soap will be formed

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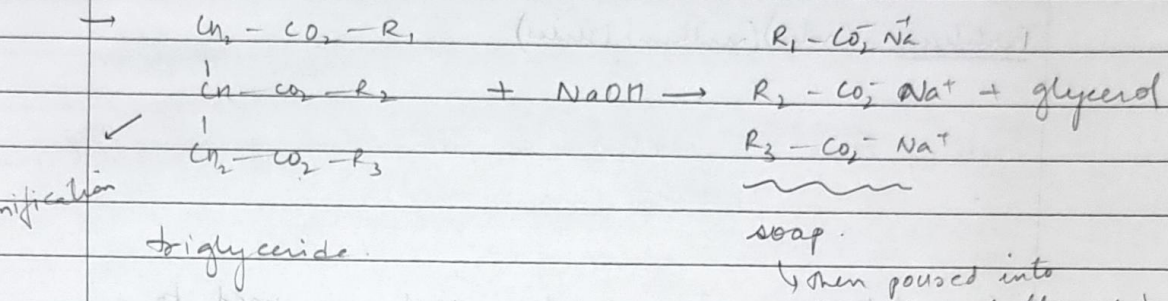


Soap
Saponification

triglyceride

soap
↳ then poured into mould and allowed to harden

A little glycerol is left to make soap smooth and soft

glycerol is separated

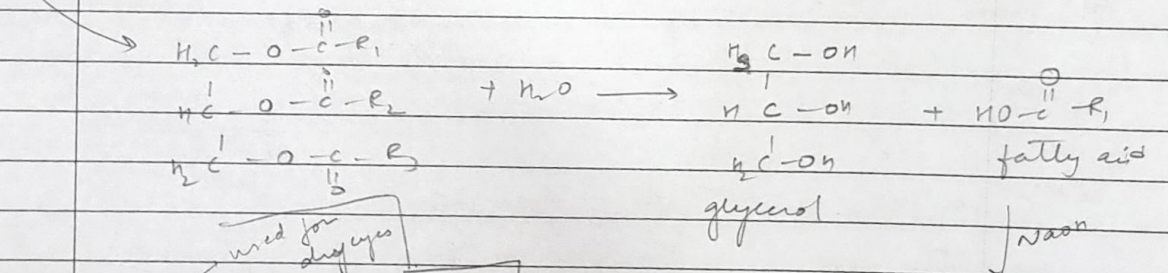
Castor oil → produces lather

glycerin and glycerol are same

Natural fat
~~Fatty acid~~ + H_2O → FFA + glycerol
(vegetable oil)

↓ NaOH
soap

soap + glycerol → (salt) → soap rises at the top
glycerol settles down



used for drug uses

glycerin → eyes burn =

used chemical → prevent + dryness and softens skin