· Refrigeration Equipments ·

Compressor :-

① Hermitcally shield compressor :-

→ In this the compressor and motor are installed on a steel shell.

→ occupies less space and noise generation is low.
→ Used in domestic application.
→ Maintenance is difficult and Motor cooling is achieved by rejecting heat to the suction vapour to compressor. This results in super heating of vapour hence increasing work input and decreasing COP of unit

② Open type Compressor :-

→ Compressor and motor are install on seprate shafts and joined by a belt and pulley arrangment
→ Maintenance is easy and Motor cools by itself
→ Used in Industrial application.
→ occuipes large space & Noise generation is high.

(3) Semi hermitic Compressor :-

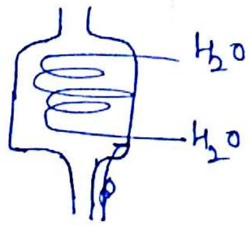
Motor and Compressor are install on seprate shaft and shield seprately they are Connected by belt and pulley arrangment. The merit and demerit are in b/w the above two Compressor.

Condensor

Condensor
- Air Cooled
  - < 5TR
  - → Window A/c
  - → Domestic Ref.
- Water Cooled
  - Shell & tube
  - Shell & Coil
  - Evoporative

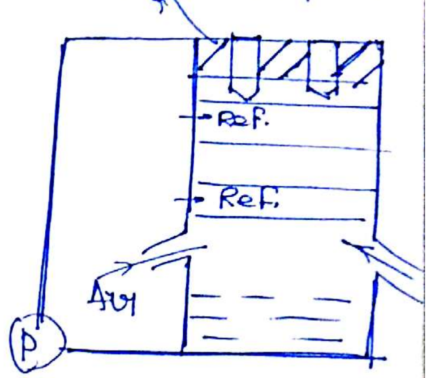
Shell & tube

Shell & Coil



→ used when pure water available

Evoporative



→ Use when water shortage

* In both Shell and tube and Shell & Coil type Condensor the refrigerant flows through the shell. The flow through tube is avoided to avoid the pressure loss of refrigerant.

→ Shell and Coil type condensor can be used only when Pure water is available because of scaling problem in the coil.

→ Evaporative condensor is used where there is shortage of water. Water absorbs heat from the refrigerent and is further cooled due to evaporative action as it comes in contact with the ~~air~~ air.

* Heat rejection Factor / Heat rej. ratio :-

$$\text{Heat rejection ratio} = \frac{\dot{Q}_{rej}}{R.E.} = \frac{Q_{Rej}}{R.E.}$$

$$= \frac{W_{I/P} + R.E.}{R.E.}$$

Heat rejection ratio $\equiv$

$$\boxed{HRR = \frac{1}{COP} + 1}$$

Heat rejection Ratio signifies the size of the condensor. In hermitically shield unit since COP is less, HRR is high hence larger size condensor are required.

Evaporators :-

Coil type:-  window A/c.

Plate type: Domestic Ref.

Expansion devices

expansion devices.

- Const. Area type
  - → capillary tube
    - Domestic ref.
    - window A/c
- Variable Area.
  - Automatic exp. valve
  - Thermostatic expansion valve (TEV)

Automatic expansion Valve:-

→ maintain const. pressure in the evaporator

→ used when load is almost constant. (For eq. Milk chilling plants)

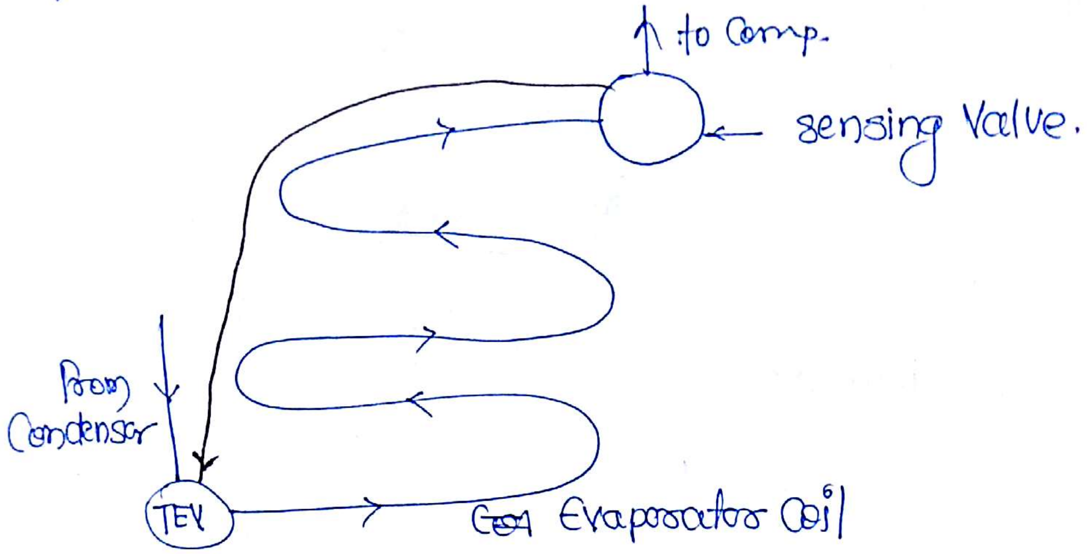
Thermostatic expansion Valve:

→ Maintain Constant degree of superheat in evaporator.

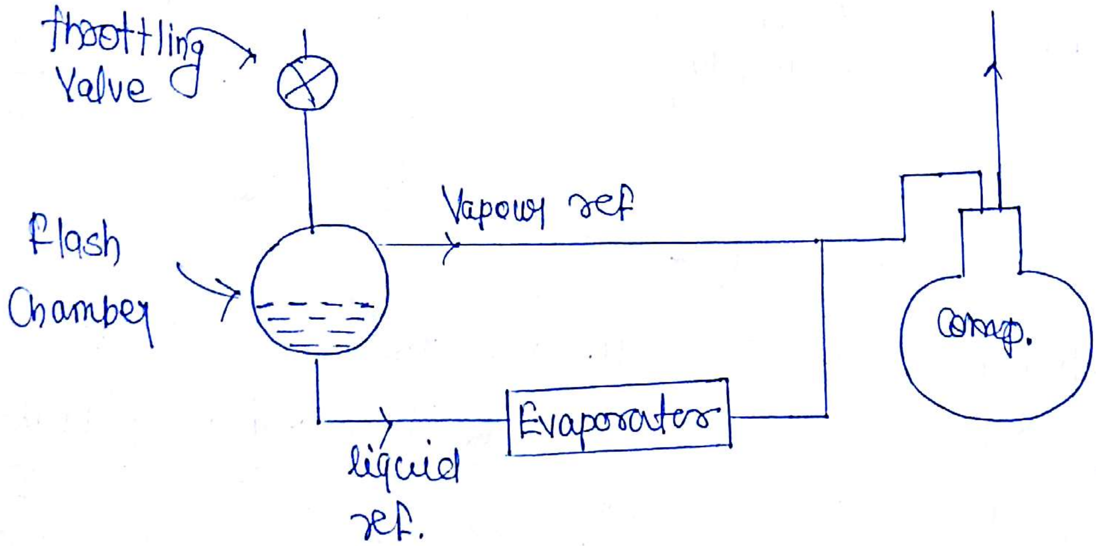
→ used when load is variable ([illegible]

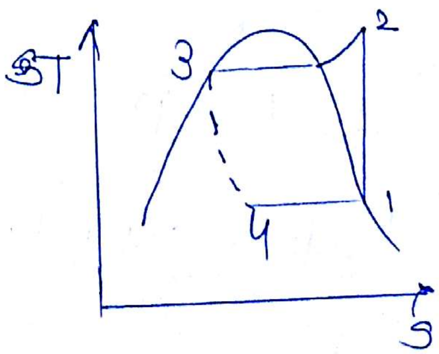
* → sensing bulb is locating at the exit of evaporator.

- Alternative overfeeding & starving of refrigerant in the evaporator coil leads to hunting in the thermostatic expansion valve.



Flash chamber:—



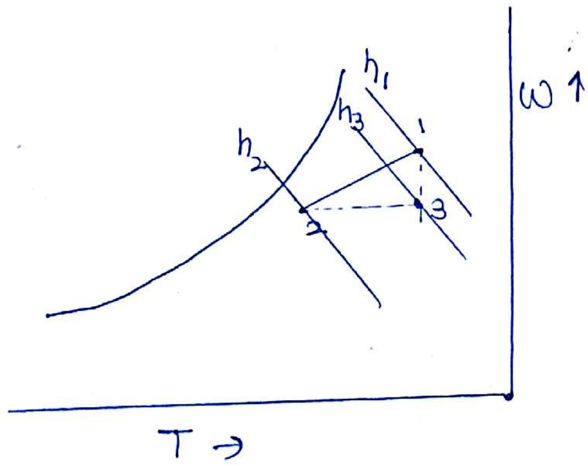


Theoretically there is no improvement in COP but practically as the vapour is bypass the pressure loss during the flow reduces hence COP improve ~~slightly~~ slightly.

Float Valve:-

These valves are used for regulating the level of liquid refrigerant. It is called as high side float valve if used on high pressure side i.e. Condensor. and called as low side flot valve if used on low pressure side i.e. evaporator.

Sensible Heat Factor & latent heat factor:-



Total heat removed

$$TH = h_1 - h_2$$

latent heat $LH = h_1 - h_3$

Sensible heat $SH = h_3 - h_2$

$$SHF = \frac{h_3 - h_2}{h_1 - h_3} \qquad LHF = \frac{h_1 - h_3}{h_1 - h_3}$$

$$\boxed{SHF + LHF = 1}$$

Q.27
P.g.54

outside

$\dot{m}_a = 50\ kg/sec.$

DBT = 45 °C

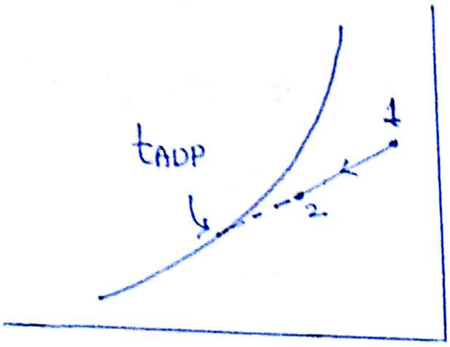
$\phi = 30\%$

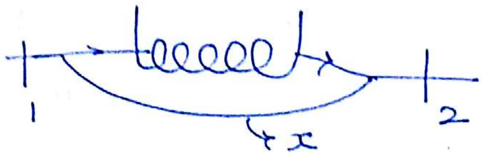
inside

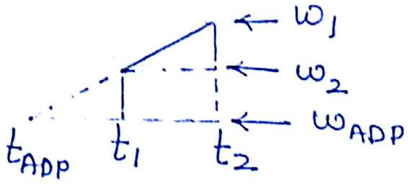
$t = 25°C$

$\phi = 50\%$

By pass Factor & Contact Factor (η)
(Coil eff.)







*

$$BPF = \frac{t_2 - t_{ADP}}{t_1 - t_{ADP}} = \frac{\omega_2 - \omega_{ADP}}{\omega_1 - \omega_{ADP}} \simeq \frac{h_2 - h_{ADP}}{h_1 - h_{ADP}}$$

Contact Factor

*

$$\eta = \frac{t_1 - t_2}{t_1 - t_{ADP}} = \text{[crossed out]}$$

$$\boxed{BPF + \eta = 1}$$

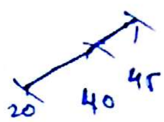
Note ① The by pass factor depends on the placing of the coil. it also depends on the air velocity, as the air velocity increases by pass factor increases.

Q.29
Pg 159

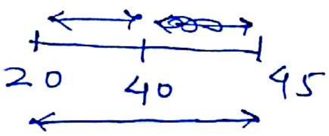
(2) latent heat factor is high when the relative humidity is high eg. during rainy season
LHF is also high for the place of high occupancy like movie hall, auditorium.

Que Air at 20°C DBT and 40% RH is heated to 40°C using electric heater. The surface temp. of the coil is 45°C, the bypass factor will be.

$$BF = \frac{45-40}{45-20}$$



$$BF = \frac{5}{25} = \frac{1}{5} = 0.2$$



Ques In an air conditioning process 5 KJ/min of heat is extracted from the room if the SHF = 0.8, then the latent heat load is

$$SHF = \frac{SH}{TH}$$

~~SH = 5 × 0.8/10 = 4~~

SH = 4 KJ/min

LH = 1 KJ/min

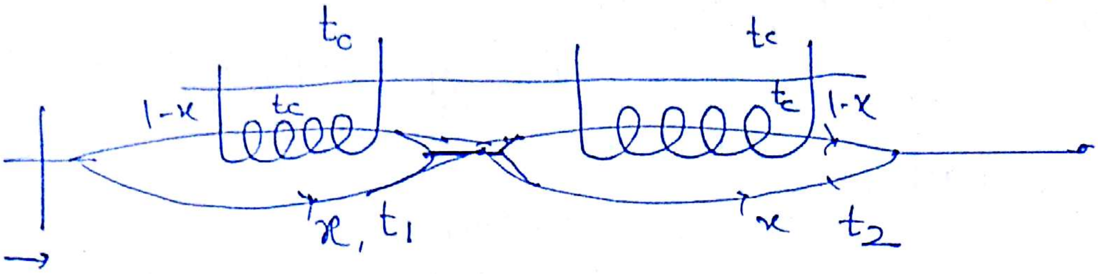
SHF + LHF = 1

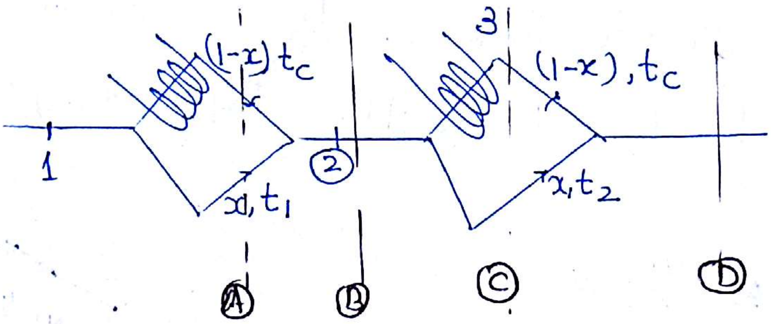
LHF = 0.2

$$LH = 0.2 \times 5 = 1 \text{ KJ/min}$$

Effective bypass Factors:-

Note: for calculation of effective BF Dry Air is Considered





energy Consv. (A) → (B)

$$(1-x)h_c + x h_1 = 1 \times h_2$$

$$(1-x)C_{pa} t_c + x C_{pa} t_1 = C_{pa} t_2$$

$$(1-x) t_c + x t_1 = t_2 \quad -①$$

Similarly (C) & D

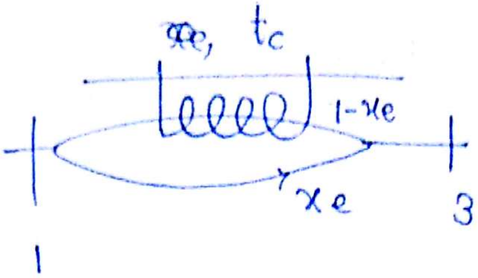
$$(1-x) t_c + x t_2 = t_3 \quad -②$$

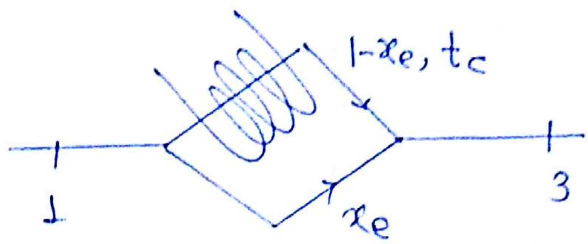
From ① & ②

$$(1-x) t_c + x\{(1-x) t_c + x t_1\} = t_3$$

$$t_c - x t_c + x t_c - x^2 t_c + x^2 t_1 = t_3$$

$$(1-x^2) t_c + x^2 t_1 = t_3 \quad -③$$





$$(1 - x_e)\, t_c + x_e\, t_1 = t_3 \quad -④$$

$$(1 - x^2)\, t_c + x^2\, t_1 = t_3 \quad -③$$

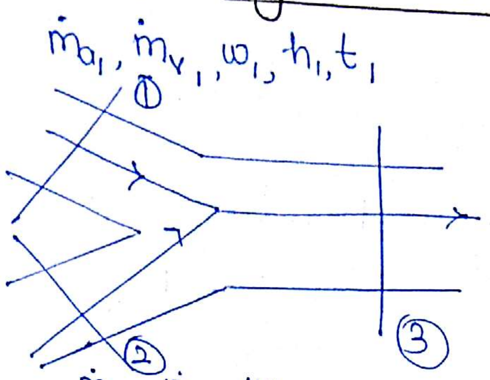
from ③ & ④

$$\therefore \; x_e = x^2$$

<u>For 'n' coils</u>

$$\boxed{x_e = x^n}$$

Adiabatic Mixing of Air streams:-



① Consv. of mass

(a) dry air $m_{a_1} + m_{a_2} = m_{a_3}$ —ⓐ

(b) water vapour

$m_{v_1} + m_{v_2} = m_{v_3}$ —ⓑ

∴ (No Condensation)

→ $\omega = \dfrac{m_v}{m_a}$

From ⓑ

$$\omega_1 m_{a_1} + \omega_2 m_{a_2} = \omega_3 m_{a_3}$$

$$\omega_1 m_{a_1} + \omega_2 m_{a_2} = \omega_3 m_{a_1} + \omega_3 m_{a_2}$$

* $$\boxed{\frac{m_{a_1}}{m_{a_2}} = \frac{\omega_3 - \omega_2}{\omega_1 - \omega_3}}$$

Similarly ② energy consv.

$$m_{a_1} h_1 + m_{a_2} h_2 = m_{a_3} h_3$$

→ $$\boxed{\frac{m_{a_1}}{m_{a_2}} = \frac{h_3 - h_2}{h_1 - h_3}}$$