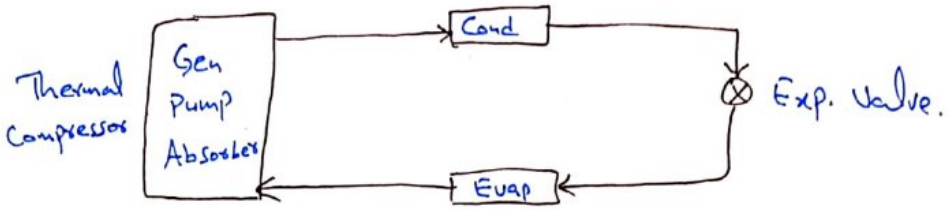
# Vapour Absorption Refrigeration System

There is no need of compressor, it is replaced by Generator, Pump, Absorber which is technically called thermal compressor.




Note:-

VC cycle is work operated cycle while

Absorption cycle is work on heat energy or temp gradient.

MAJOR Difference b/w Vapour Compression and vapour absorption cycle:

Vapour Compression ⇒ Work operated cycle

b/c pressure of vapour is increased by work of compressor.

Vapour Absorption System ⇒ Heat operated cycle.

Most of the operating cost is associated with providing heat that drives the vapour.

Work of Pump < Work of compression in V.C. system

Working substances:-

In vapour absorption refg system, we have two working substances.

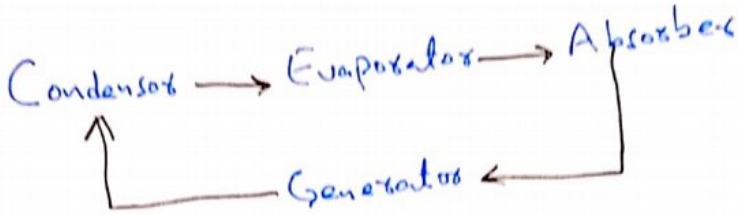
Refrigerant

Absorbant

Absorbant are the liquids having greater affinity for absorbing the refrigerant.

Secondly both the working substance can be separated easily from each other

Flow cycle of Refrigerant:-




Flow cycle for Absorbant:-

Absorbant will move from

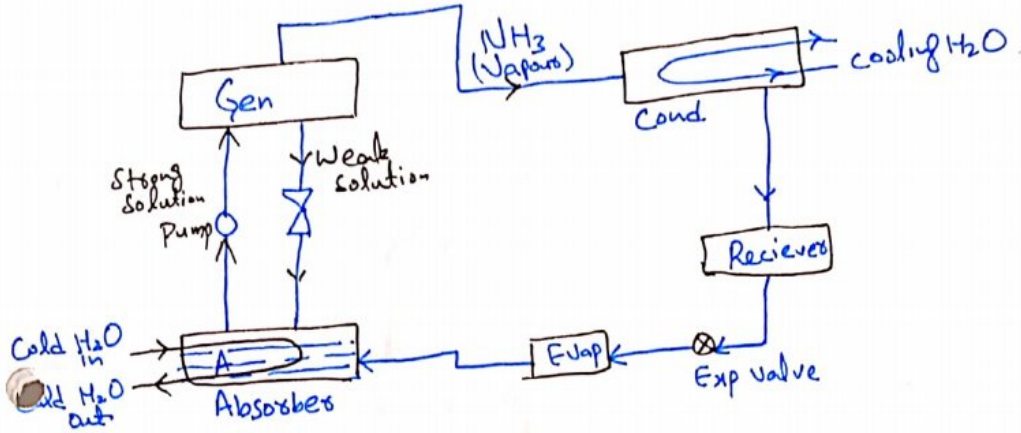
Absorber → Gen → Absorber

# LAYOUT OF A SIMPLE ABSORPTION SYSTEM

Aqua $NH_3$ Absorption Refrigeration System

Refrigerant :- Ammonia ($NH_3$)

Absorbant :- Water ($H_2O$)




Pump :-

It recieves the low Pr liquid in the form of aqua ammonia from absorber and rises the pr of liq, thereby delivering into the generator.

Generator :-

In the gen assembly heat from the high temp source drives up the vapours that has been absorb earlier in the absorber.

Thrugh a pr control valve which act as the pressure difference b/w Gen and absorber.

There is another cambination used in VAS is

(Absorber) LiBr & $H_2O$ (Refg)

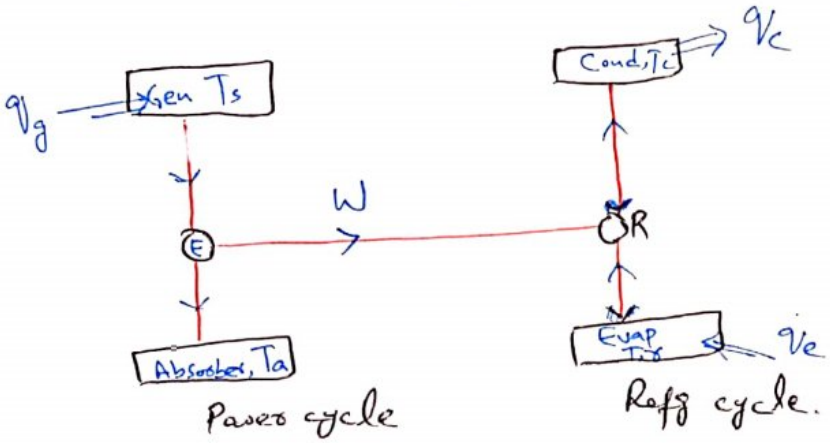
# Difference b/w Vapour Compression and Vapour Absorption System

| V.C. System | Vapour Absorption System |
|---|---|
| 1:- System has more wear and tear b/c of moving parts | 1:- There are less moving parts, so the system is quite and has less wear and tear. |
| 2:- It works on mechanical energy by compressor i.e work operated cycle. | It works on thermal energy i.e Heat operated cycle. |
| Mechanical energy is about $\frac{1}{4}$ times of the refrigerating effect | Heat energy is about $\frac{1}{5}$ times of the refrigerating effect. |
| ~~Phase change/ ~~ The system has poor performance on partial loads. | The performance of the system not affected by load variation. |
| System is used when the high mechanical energy is available. | System can be used at remote places and it can work on the simple kerosene oil. |
| Charging of Refg is easier | Charging of refg is difficult. |
| The chance of leakage of refg is high. | There is no compressor/reciprocating component to cause leakage. |
| Liq traces in the ~~Hgm~~ suction line may damage the compressor. | Liq traces of the refg present in the piping and exist of evaporator causing no damage. |
| Equipment of accesories in V.C. system is simple in construction. | Equipment of the system is some what complicated. As such its economical employment must be justifiable. in location of places where suitable source of heat is available and no electricity is available |

$COP)_{absorption} = \frac{\text{Heat extracted by/from Evaporator}}{\text{W.D by Pump + Heat supplied to the generator}}$

$= \frac{\text{Heat extracted/Refg effect}}{\text{Heat supplied to the generator}}$ W.D by pump is negligible.

$= \frac{\text{Refg Rate}}{\text{Rate of heat added to the generator}}$



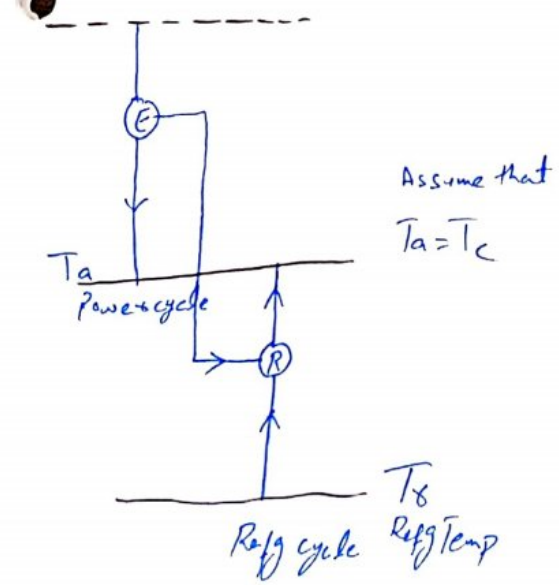

Let

$Q_g$ = Heat energy recieved by generator at absolute tem $T_s$

$Q_a$ = Quantity of heat rejected by absorber at $T_a$

$Q_e$ = " " " absorbed in the Evaporator at $T_r$

$Q_c$ = " " " rejected at condensor at $T_c$.




Assume that $T_a = T_c$

Refg Cycle:-

$COP)_{refg} = \frac{N}{W}$

$= \frac{Q_e}{W}$

$= \frac{Q_e}{T_a - T_r} \rightarrow I$

Thermal/Power cycle:-

$\eta_{th} = \frac{\text{output}}{H.S}$

$= \frac{W}{Q_g}$

$= \frac{T_s - T_a}{T_s}$

$$COP)_{abs} = \frac{Q_e}{Q_g} = \frac{Q_e}{W} \times \frac{W}{Q_g}$$

$$\boxed{COP)_{abs} = COP)_{Ref} \times \eta_{th}}$$

From eqn I

$$Q_e = \frac{T_\delta}{T_a - T_\delta} \times W$$

From eqn II

$$Q_g = \frac{T_s}{T_s - T_a} \times W$$

Now

$$COP)_{abs} = \frac{Q_e}{Q_g} = \frac{\frac{T_\delta}{T_a - T_\delta} \times W}{\frac{T_s}{T_s - T_a} \times W}$$

$$COP)_{abs} = \frac{T_\delta}{T_s}\left(\frac{T_s - T_a}{T_a - T_\delta}\right)$$

Conclusion:-

$\uparrow T_s$ COP $\uparrow$

$\uparrow T_\delta$ COP $\uparrow$

But $\uparrow T_a$ COP $\downarrow$

What is the cop of ideal heat operated system that has a source temp of heat 100°C, A refg temp is 5°C and an ambient temp is 30°C

$T_s = 100 + 273 = 373°K$

$T_\delta = 5 + 273 = 278°K$

$T_a = 30 + 273 = 303°K.$

$$COP)_{abs} = \frac{T_\delta}{T_s}\left(\frac{T_s - T_a}{T_a - T_\delta}\right)$$

$$COP)_{abs} = \frac{278}{373}\left(\frac{373 - 303}{303 - 278}\right)$$

$$= 2.089 \cdot \text{Ans}$$

Example 14.9 & 14.10 THERMODYNAMICS BY T.D. Eastop. (5th Edition)