REFRIGERATION & AIR CONDITIONING

* **Refrigeration**: It is defined as the method of producing and maintaining lower temperature in a specificied space as compared to its sourrounding.

• **Principle** - It works on second law of thermodynamics which states that it is impossible to construct an engine working on thermodynamic cycle to transfer heat from lower temperature to higher temperature without the aid of an external energy.

∴ In refrigerator power is to be supplied to remove the heat continuously from a refrigerated space in order to maintain lower temperature than the surrounding.

* **Terms used in refrigeration**:-

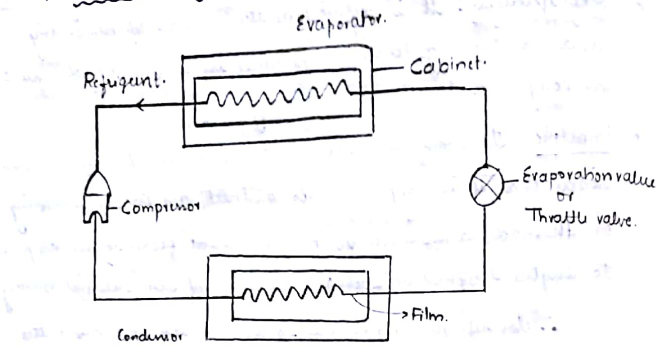
⊙ **Refrigerant** - It is a working media used in refrigerator which absorbs heat energy by evaporation from a specified space in order to maintain lower temp and rejects heat to the surrounding by condensation without undergoing any chemical change.

⊙ **Refrigeration effect** - It is defined as the rate at which heat is absorbed from a specified space in cycle or amount of cooling effect produced in specified space [kW / KJ/s]

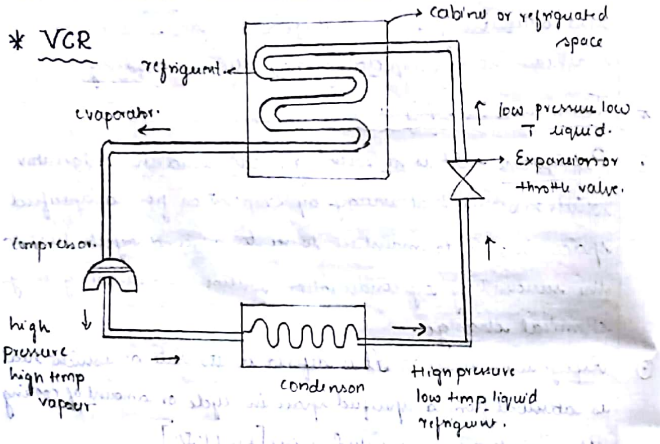
⊙ **Co-efficient of performance** - It is defined as the ratio of cooling effect produced to the power supplied. It is reciprocal of thermal efficiency of a heat engine.

⊙ **Ton of refrigeration** - Refrigeration effect is expressed in terms of "Ton of refrigeration" TR. It is defined as the amount of cooling effect produced due to melting of 1 ton of ice from and at 0°C in 24 hours.

* Parts of Refrigerator.



* VCR



$$COP = \frac{\text{Desired effect}}{\text{Required effect.}} = \frac{\text{Cooling effect produced}}{\text{Work or power supplied}} = \frac{Q}{W}$$

$$\text{Relative COP} = \frac{\text{Actual COP}}{\text{Theordical COP.}}$$

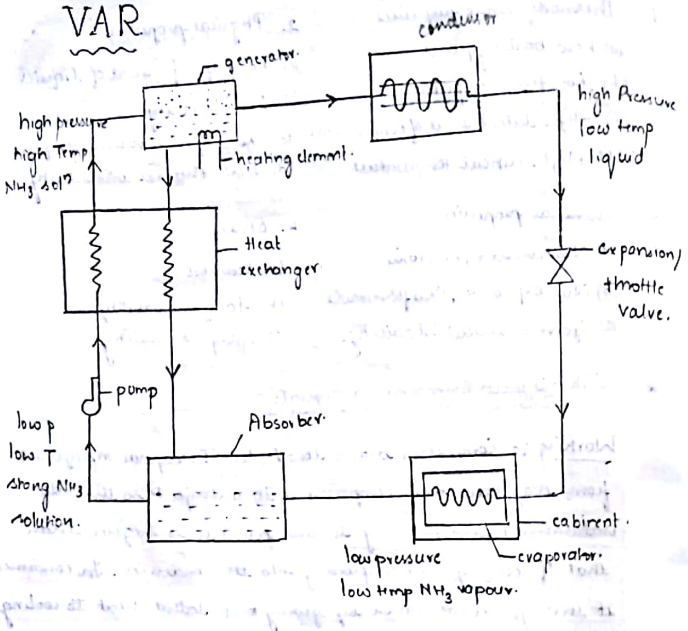
* Properties of good refrigerant.

1. Thermodynamic properties
   (a) Low boiling point
   (b) Low freezing point
   (c) High latent heat of evaporation
   (d) High critical temperature.
2. Physical properties
   (a) Low specific heat of liquid
   (b) Low viscosity
   (c) Low specific volume of vapour
   (d) High thermal conductivity.
3. Chemical properties.
   (a) Non corrosive, non toxic
   (b) Non explosive, non flammable
   (c) Good chemical stability.
4. Others
   (a) Low cost
   (b) Easy availability
   (c) Easy handling.

* VCR - Vapour Compression refrigerator.

Working :- Compressor draws low P, low T. vapour refrigerant from evaporator and compress it to a high P so that the saturation T corresponding to this pressure is higher than that of cooling media flowing into the condenser. In condenser it undergoes condensation by giving out latent heat to cooling media flowing into the condenser. Now the high P condensed saturated liquid refrigerant enters into the expansion valve where it expands to low P, low T liquid. This low P low T liquid refrigerant enters the evaporator coil. Since liquid refrigerant T is less than the surrounding T it undergoes evaporation by absorbing latent heat from the surrounding (space to be refrigerated). The low T, low P saturated vapour from the evaporator is drawn into compressor and cycle repeats. Heat is continuously extracted from the refrigerated space, thereby keeping it at the required lower Temperature.

VAR



It consists of following parts :-

1. Absorber
2. Pump
3. Generator
4. Heat exchanger
5. Condenser
6. Expansion valve
7. Evaporator.

Working :-

The absorber absorbs low P, low T dry NH_3 vapour refrigerant from evaporator and it becomes strong NH_3 solution by dissolving in weak NH_3 solution. This strong NH_3 solution is then pumped into a generator through the heat exchanger at high P. While passing through the heat exchanger strong NH_3 solution is warmed up by the hot weak solution flowing back to the absorber from the generator. In generator, warm strong NH_3 solution is heated by an external source ; due to this ammonia vapour gets separated. This high P, high T vapour flows into the condenser. In condenser it undergoes condensation by giving out latent heat to cooling media. Now the high P condensed saturated liquid refrigerant enters the expansion valve, where it expands to low P, low T liquid. This low P, low T liquid refrigerant enters the evaporator coil. Since liquid refrigerant T is less than the surrounding T it undergoes evaporation by absorbing latent heat from the surrounding (space to be refrigerated). The low T, low P saturated vapour from the evaporator enters into absorber and cycle repeats.