2nd Sept, 10 "Lecture-1"

"BASIC CONCEPTS"

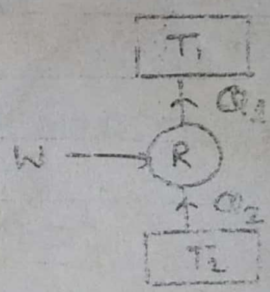
Refrigeration: It is the process of producing lower temp. compared to surroundings. As lower temps are to be maintained continuously, refrigeration systems are must run on cycle.

Refrigerants– Refrigerants are substances which are used for producing lower temps e.g; Ammonia, CO_2, R-11, air, water, R 12, R-134 etc.

Refrigeration Effect (RE): It is the amount of heat that is to be extracted from the storage base space in order to maintain lower temp.

$$COP = \frac{Q_2}{W}$$

$$COP = \frac{RE}{W}$$



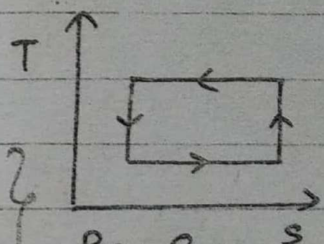
Unit of Refrigeration (Ton of Refrigeration, TR):
It is the amount of heat that is to be extracted from 1 ton of water at 0°C in order to convert it into ice at 0°C in one day. Therefore, ton of refrigeration (TR) represents heat transfer rate.

{ 1 TR = 3.5 KW = 3.5 kJ/sec = 210 kJ/min }

Ideal Refrigeration Cycle :- Ideal refrigeration cycle is reversed Carnot cycle.

$$\left\{ COP_{max} = \frac{T_l}{T_h - T_l} \right\}$$

$$\left\{ COP_{max} = COP_{ideal} = COP_{rev.\,carnot} = \frac{T_l}{T_h - T_l} \right\}$$



Rev. Carnot Cycle

Significance of COP :- For a given refrigeration load, smaller W i/p represents higher COP & lesser electrical energy consumption & hence lower running cost. This means higher cop & hence higher COP is desirable.

$$COP = \frac{RE}{W_{in}}$$

$$\dot{m} = \frac{m}{t} - \frac{kg}{sec}$$

$\dot{m}$ - mass flow rate of refrigerant

$$COP = \frac{RE}{W_{in}} \times \frac{\dot{m}}{\dot{m}}$$

$$\dot{m} \times W_{in} = P_{in}$$

$$(\dot{m}(RE) = RC)$$

$$\left\{ COP = \frac{RC}{P_{in}} \right\}$$

RC - Refrigeration Capacity

P_{in} - Power Input

Probl^m- A Carnot refrigerator requires 1.5 kW per ton of refrigeration to maintain a region at -30°C, then the COP of refrigerator is.

Sol^m -

$P_{in} = 1.5 kW$

$1 TR = RC$

$RC = 3.5 kW$

$$COP = \frac{RC}{P_{in}}$$

$$= \frac{3.5}{1.5}$$

$$= 2.33$$ Ans.

Probl^m. A refrigerating m/c working on reversed Carnot cycle takes out 2 kW from a system while working b/w temp. limits 300 K & 200 K. Find the COP & power consumed.

Sol^m -

$$COP = \frac{T_e}{T_h - T_e}$$

$$= \frac{200}{300-200}$$

$$= 2$$ Ans

$$COP = \frac{RC}{P_{in}}$$

$$P_{in} = \frac{RC}{COP} = \frac{2}{2} = 1 \text{ kW}$$ Ans.