One Of An Improved Type Of Vapour Compression Refrigeration Cycle On p-h Diagram Used in Refrigeration And Air-conditioning Systems

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ABSTRACT

The vapour compression system is one of the improved in technology after vapour absorption system in refrigeration and air-conditioning system. Since, the 1980s, the refrigeration industry has faced pressure to improved energy efficiency and reduce emissions of the chlorofluorocarbon compounds (CFC) which is used in vapour compression cooling.

Refrigeration is one of the leading method uses power in the U.S. The word 'refrigeration' refers to air conditioning for Homes, Buildings, Businesses and Refrigerators, Freezers, and Heat Pumps.

Manufacture of refrigerants and refrigeration and air-conditioning equipments, under the governmental agencies and environmental groups still working together for improve its efficiency.

INTRODUCTION

The word 'refrigeration' may be defined as the process of keeping an item cooled below the general temperature of its surroundings. In other words the process of removing heat from an item or substances and it gives desirable temperature up to 0°C or below and its continued extraction of heat from substances to cool or freeze. Here we use better refrigerant chemical to remove heat from items stored inside the system. Refrigerators are used for chilled or frozen storage of foods and meats etc.

The term 'air-conditioning' is that branch of engineering science which deals with the study of conditioning of air. In other words, we can say the process of heat removing from the space or inside the building, and it's maintaining desirable internal atmospheric conditions according to the human comfort. The most widely used method for air-conditioning of buildings and automobiles. It may be noted that a human being feels comfortable when the air is at 21°C with 56% relative humidity

Cooling.

In case a hot body looses heat and comes in the temperature of surroundings it is called as cooling.

Boiling and condensation.

Boiling is the process by which liquids are heated above their 'boiling point' and its changes from the liquid phase to the gaseous phase. Boiling is the converse process of condensation in which molecules in its gaseous phase is converted to a liquid.

Pressure vs. boiling points of liquid.

The boiling point or saturation temperature of liquids increases with increase in pressure and decreases with decrease in pressure.

Pressure and boiling point of water

Pressure	Boiling point
1bar	100°C
2bar	200°C
5bar	151°C

The boiling point of water or other liquids depends on the pressure applied on it. The boiling point of liquid is not fixed it varies the pressure applied over the liquid. If pressure increases with increase in boiling point and decreases with decrease in boiling point.

Pressure and boiling point of Ammonia

Pressure	Boiling point
1bar	-33°C
20bar	50°C

VAPOUR COMPRESSION REFRIGERATION SYSTEM

Now-a-days vapour compression refrigeration system is used for all purpose refrigeration. There are many refrigeration cycles and is the most widely used method for air-conditioning of buildings and automobiles. It is generally used for all industrial purposes from a small domestic refrigerator to a big air conditioning plant.

The refrigerants, mainly, used for this purpose are ammonia (NH_3), carbon dioxide (CO_2) and sulphur dioxide (SO_2) etc. The refrigerant used, does not leave the system, but it circulated throughout the system alternately condensing and evaporating.

Refrigeration cycle drawn on a pressure enthalpy diagram

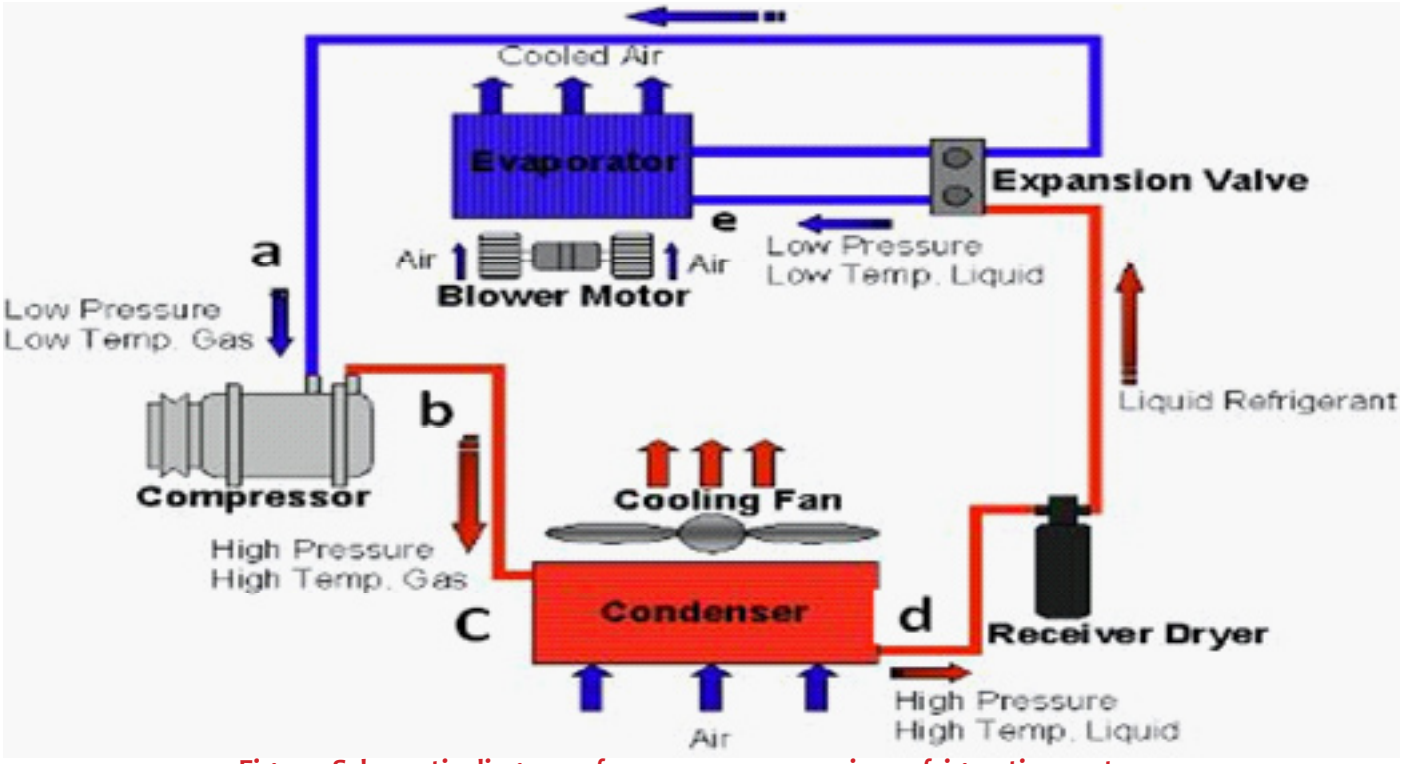

Figure: Schematic diagram of a vapour compression refrigeration system

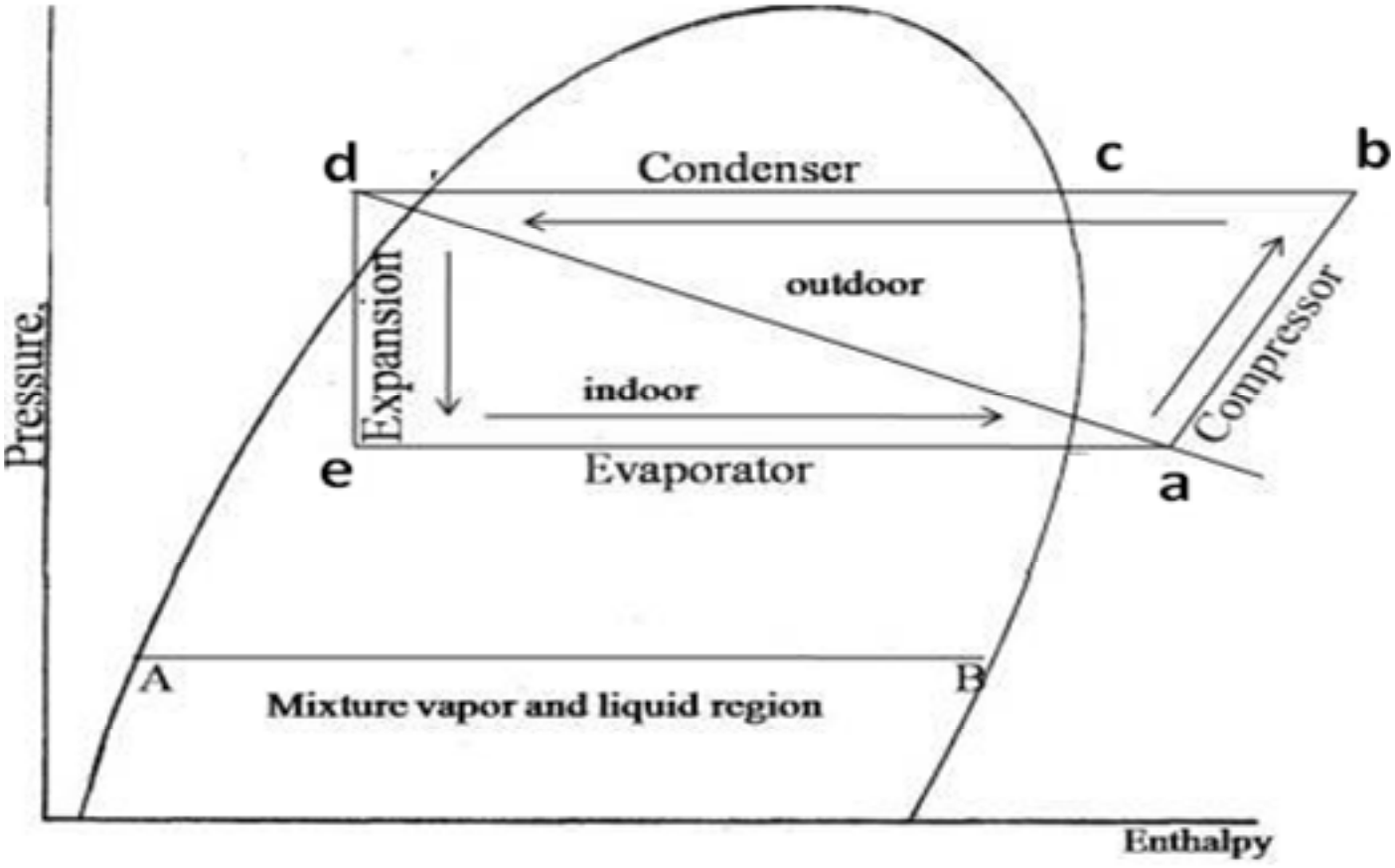

Figure: p-h diagram

The main components of a vapour compression refrigeration system are

1) Compression process (a-b)

The job of the compressor is to take low pressure and temperature vapour refrigerant from the evaporator and it compress it to a high pressure and temperature vapour refrigerant is discharged into the condenser.

- When we take a vapour refrigerant and its compressed it that process is isentropic in other words constant entropic process.
- At point 'b' is in the superheated vapour region.
- Now, from point (b-c) as the refrigerant vapours exit the compressor.
- Here, there is a change in volume, pressure and temperature that means work done.
- When ever there is change in volume in the gas the work is done.

If we take a gas and compress it that mean work done on the system, after the compressed gas moving the piston up that means work done by the system.

W.D = Force x displacement
= pressure x area x displacement
= PV = PdV.

2) Condensation process (c-d)

The function of the condenser is to receive high pressure and temperature vapour refrigerant and its convert high pressure and temperature refrigerant liquid.

- The most of the heat from the refrigerant is discharge in the condenser to the surroundings.
- Its fully saturated liquid state at point'd'.

3) Receiver

Receiver is the improved part of refrigeration system, its stored condensed liquid refrigerant from the condenser and it is supplied to the evaporator through the expansion valve or refrigerant control valve

Expansion process (d-e)

The job of expansion valve is to reduce the pressure of the liquid refrigerant keeping its total enthalpy constant in other words adiabatic process.

- H = U+PV
  Where,
  U = Specific Internal Energy,
  Vs = Specific Volume,
  P = Pressure.

4) Evaporation Process (e-a)
At point 'e' represents a mixture of mostly liquid but, some vapour in the refrigerant that then enter in the evaporator.

An evaporator consists of coil of pipe in which liquid-vapour refrigerant at low pressure and temperature is evaporated and changed into vapour refrigerant at low pressure and temperature. In evaporating, the liquid vapour refrigerant absorbs its latent heat.

BENEFITS AND DRAWBACKS OF VAPOUR COMPRESION REFRIGERATION SYSTEM OVER AIR REFRIGERATION SYSTEM.

Benefits

- It has higher coefficient of performance then the air refrigeration system.
- It has less running cost

It can be employed over a large range of temperature.

Drawbacks

- The beginning cost is high.
- The prevention of leakage of the refrigerant is the major problem in vapour compression system

Uses

- Now-a-days refrigerators are widely used for keep foods fresh and prevent them from spoiling and growing bacteria.
- It is used for comfort air-conditioning in hospitals, theaters, etc.
- It is used for controlling humidity of air in the manufacture and heat treatment of steels.
- It is generally used for all industrial purposes from small domestic refrigerators to a big air-conditioning plant.

CONCLUSION

From the refrigeration laboratory, the pressure, enthalpy, and temperature were calculated at the four state point of the vapour compression refrigeration cycle. With the state point properties and the power drawn by the compressor the COP can be determined from the work input to the compressor as the work applied to the working fluid.