UNIT-III

PRINCIPLES OF REFRIGERATION

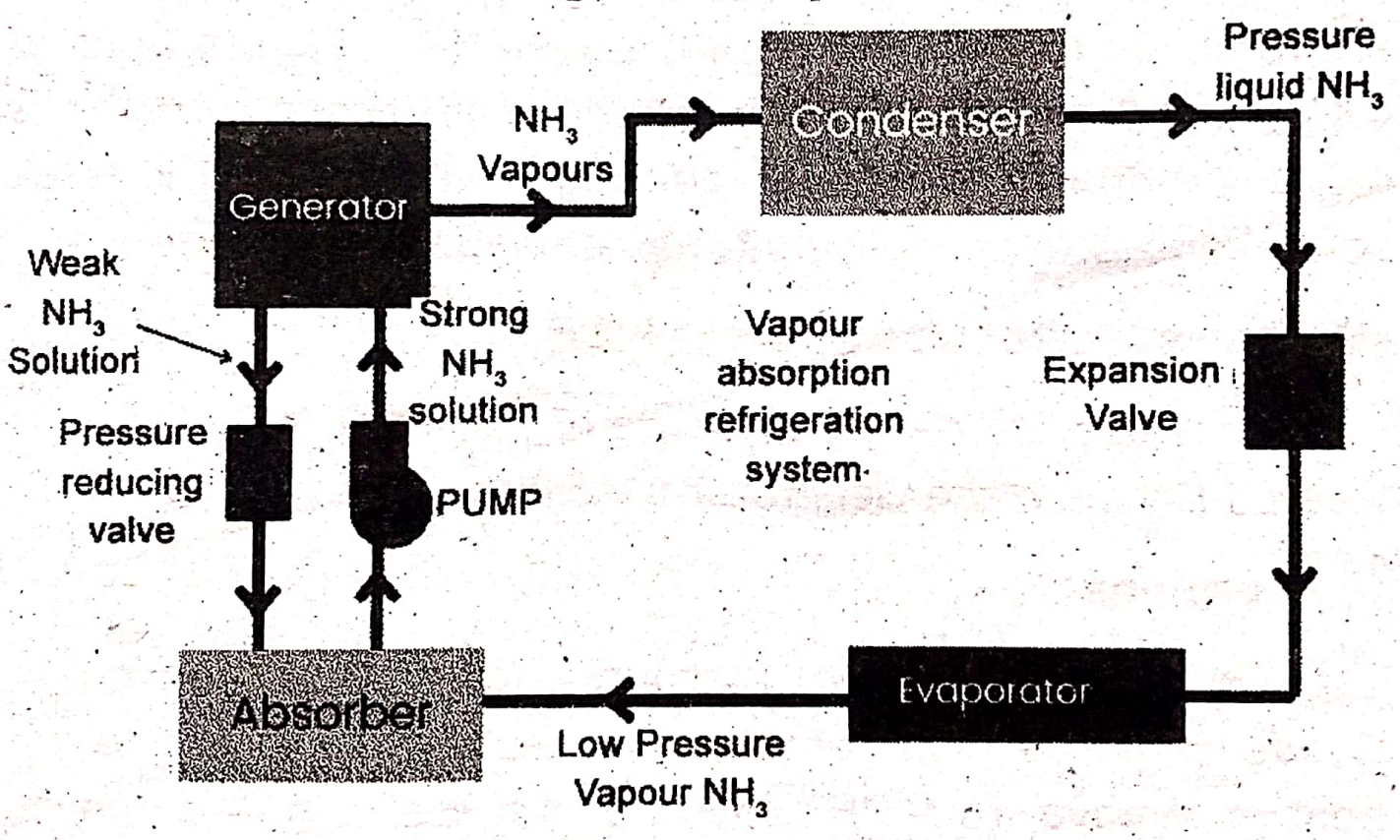
ESSAY QUESTIONS

starts over.

Q. 3. What is vapour absorption refrigeration system?

Vapour absorption refrigeration system is one of the types of refrigeration systems. As compared to the Vapour compression system, In the vapour absorption system compressor is Replaced by Generator, Absorber & Pump.In this System, Ammonia (NH_3) is used as Refrigerant & Water + Ammonia is used as Absorbent.

Vapour absorption refrigeration system diagram:



Construction:

It consists of Condenser, Generator, Absorber, Expansion Valve, Pressure Reducing Valve & Pump.

(A) Absorber :

From Evaporator, Vapour NH_3 Enters into Absorber. An absorber is already filled with Absorbent (water+NH_3). Absorbent absorbs the NH_3 vapours and strong NH_3 solution is forms. During Absorption of NH_3, heat is generated.

If temperature inside the absorber increases, water will lose absorbing capacity so a strong NH3 Solution will Not form. Hence cooling is available at absorber.

(B) Pump :

It is used to suck the strong NH_3 solution from absorber & deliver to Generator.

(C) Generator :

It is used to heat the NH_3 solution with the help of heating coils. From pump, strong NH_3 enters into the Generator. This NH_3 heated by generator, hence high-pressure NH_3 vapours are form. from generator high-pressure NH_3 vapours Goes to condenser & remaining weak solution from generator returns to absorber through pressure reducing Valve (PRV). If this weak solution goes to condenser, it may damage the system.

(D) Pressure Reducing Valve (PRV):

It is used to reduce pressure of weak NH_3 solution. It is located Between the Generator & Absorber.

(E) Condenser:

From evaporator, NH_3 vapours enter into the Condenser. Condensation is heat removal process. Hence in condenser heat is remove from NH_3 vapours with the help of a cooling

Medium. After condenser, high-pressure liquid NH_3 goes to expansion valve.

(F) Expansion valve:

Expansion Valve is located between the condenser & evaporator. After the condenser, high-pressure liquid NH_3 enters into expansion valve. Expansion Valve converts the high-pressure liquid NH_3 to low-pressure vapour NH_3 by expansion. After expansion valve, Liquid NH_3 goes to evaporator.

(G) Evaporator :

After expansion valve, low-Pressure NH_3 vapours enters into the evaporator. Evaporator absorbs the heat from enclosed room (to be cooled) with the help of NH_3. After Evaporator, vapour NH_3 goes to absorber.

Vapour absorption refrigeration system working :

(1) When vapour NH_3 from evaporator enters into the absorber, it gets absorbed by absorbent (water + NH_3) and strong NH_3 solution forms.

(2) The strong NH3 solution from absorber suck by pump & deliver to generator.

(3) When strong NH_3 solution enters into Generator, Generator heat the NH_3 solution with the help of heating coils.

(4) From generator high-pressure vapour NH_3 forms which is flows through condenser. The weak solution remains in generator is returns to absorber through pressure reducing valve.

(5) When high-pressure vapour NH_3 enters into condenser, condenser removes the heat from vapour NH_3 with the help of cooling medium.

(6) After condenser, high-pressure liquid NH_3 enters into the expansion valve, where it expands and converted into low-pPressure vapour NH_3.

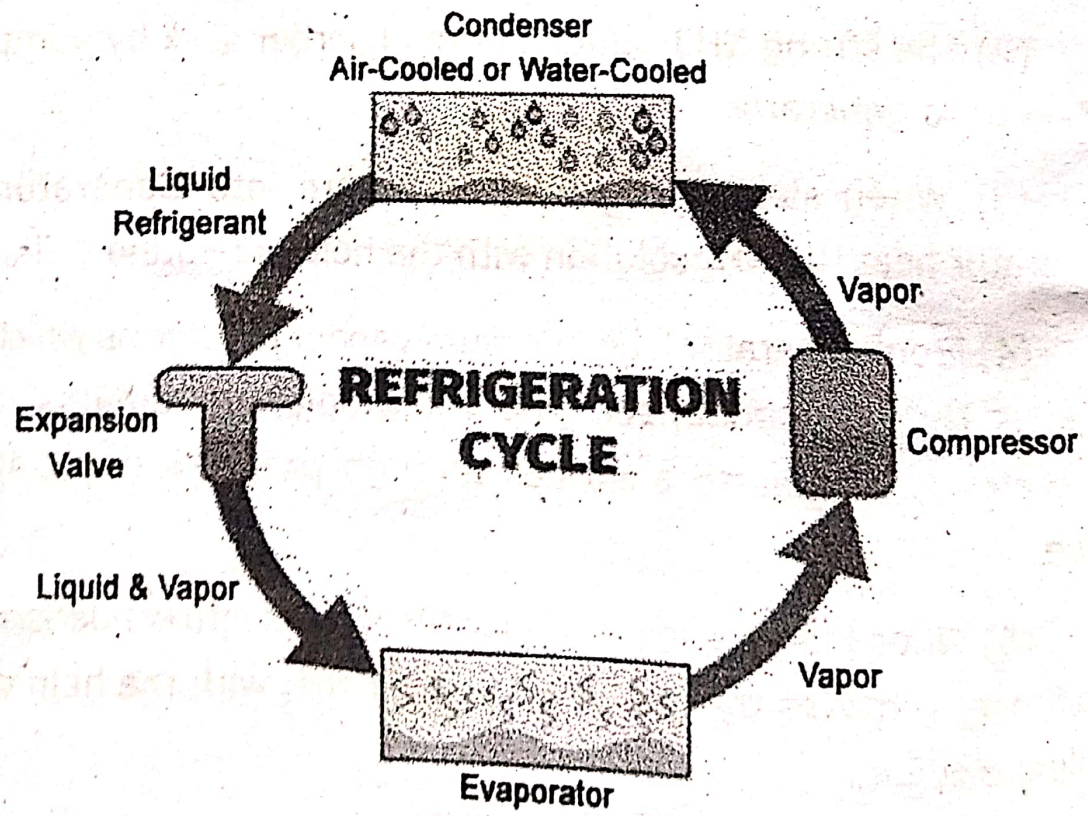
(7) After expansion valve, vapour NH_3 enters into the evaporator, where It absorbs heat from enclosed room (to be cooled).

(8) After evaporator, vapour NH_3 again enters into the Absorber.

Hence in this way cycle continues and provides cooling to enclosed room.

Q. 4. What is Refrigeration cycle? and explain with block diagram.

Refrigeration means cooling a space, substance or system to lower and/or maintain its temperature below the ambient one (while the removed heat is rejected at a higher temperature). In other words, refrigeration is artificial (human-made) cooling.



Refrigeration Cycle :

Refrigeration cycle is a cycle of mechanical system in which transmission of heat flow from one place at a lower temperature to another place at a higher temperature by continuously circulating, evaporating and condensing a fixed supply of refrigerant in a closed system.

Refrigeration cycle is thermodynamic cycle to generate refrigerating effect with the use of evaporator, compressor, condenser & expansion valve. It is also called heat pump cycle .

Thus, a heat pump is called as a "heater" if the objective is to warm the heat sink (as when warming the inside of a home on a cold day), or a "refrigerator" or "cooler" if the objective is to cool the heat source (as in the normal operation of a freezer).

Refrigeration Cycle Diagram :

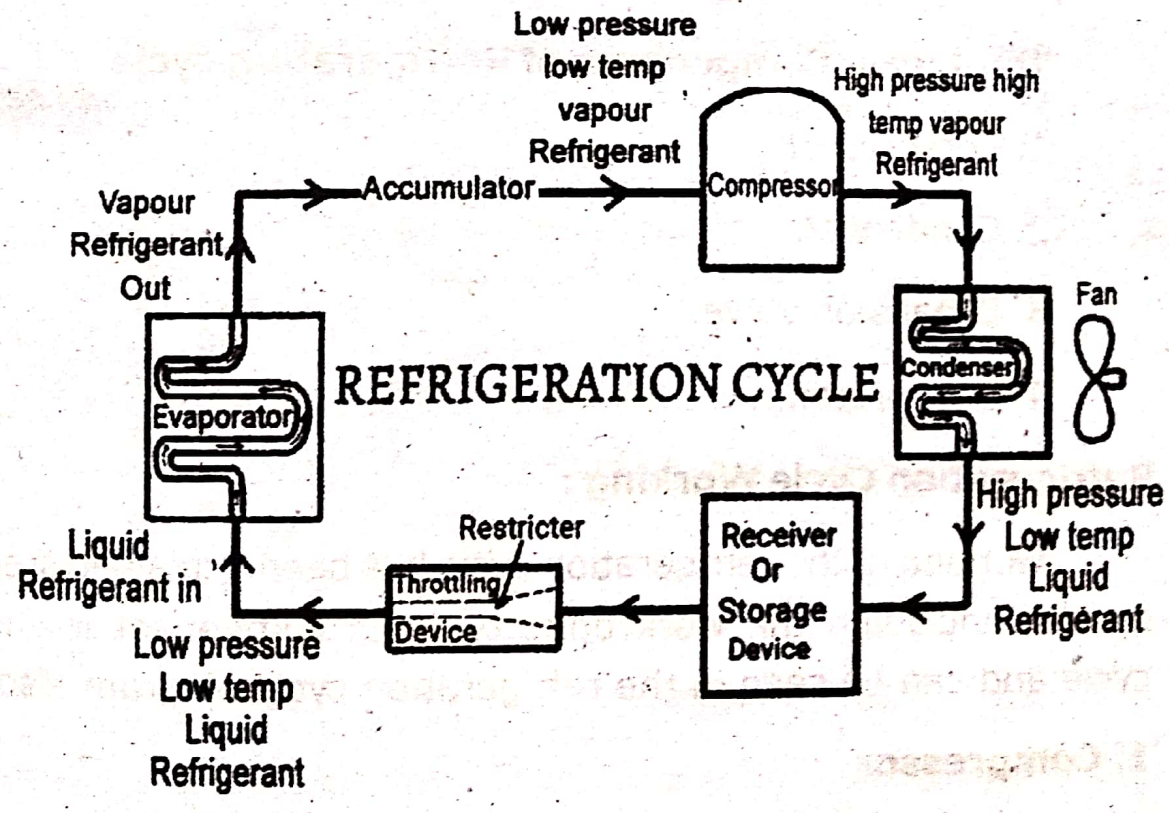


Fig : Refrigeration Cycle Diagram

Vapor Compression Cycle :

Vapour Compression Refrigeration Cycle is the most widely used refrigeration system. Vapor-compression cycle refrigeration is a process that uses the physics of phase change heat transfer and the unique properties of a refrigerant to transfer heat from a relatively cold source to a hot medium.

Basic Refrigeration Cycle :

The basic components of any refrigeration system working on the vapour compression cycle are the compressor, condenser, expansion valve and evaporator and the refrigerant fluid which is alternatively vaporized and liquefied during the refrigeration cycle.

The temperature at which a fluid boils or condenses is known as the saturation temperature.

Components of Refrigeration Cycle :

The 4 main **Components of Refrigeration cycle**

1. Compressor.
2. Condenser.
3. Expansion valve.
4. Evaporator.

Refrigeration Cycle Working :

Working of the refrigeration cycle has been explained step by step including the work done by each component in the cycle and can be seen in the refrigeration cycle diagram also.

1. Compressor

The compressor in a refrigeration system helps in raising the pressure of the vaporizer refrigerant, causing its **saturation**

temperature to rise, so that it is higher than that of the the sea water or air, cooling the condenser. The compressor also promotes circulation of refrigerant by pumping it around the system.Compression takes place to raise the temperature and refrigerant pressure.

2. Condenser :

In the condenser the refrigerant is liquefied by being subcooled to below the saturation temperature relating to the compressor delivery pressure, by the circulating sea water or air for domestic refrigerator.

Latent heat, originally from the evaporator, is then transferred to the cooling medium. The liquid refrigerant, still at the pressure produced by the compressor, passes to the receiver and then to the expansion valve. Heat is transferred from the refrigerant to a flow of water.

3. Expansion valve :

The expansion valve is the regulator through which the refrigerant flow from the high-pressure side of the system to the low-pressure side. Its throttling effect dictates the compressor delivery pressure which must be sufficient to give the refrigerant a saturation temperature which is higher than the temperature of the cooling medium.The pressure drop through the regulator causes the saturation. Temperature of the refrigerant to fall so that it boils at low temperature of the evaporator. In fact, as the liquid passes through the expansion valve, the pressure drop makes its saturation temperature fall below its actual temperature.

Some of the liquid boils off at the expansion valve taking latent heat from the remainder and causing its temperature to drop.The expansion valve throttles the liquid refrigerant and maintains the pressure difference between the

condenser and evaporator, while supplying refrigerant to the evaporator at the correct rate. It is thermostatically controlled in modern systems.When the refrigerant enters the throttling valve, it expands and releases pressure. Consequently, the temperature drops at this stage.

4. Evaporator :

The refrigerant entering the evaporator coil at a temperature lower than that of the surrounding. Secondary coolant (air or brine) receives latent heat and evaporates. Later the heat is given off in the condenser, when the refrigerant is again compressed and liquefied. It evaporates and absorbs latent heat of vaporization. For a small refrigerator the evaporator cools without forced circulation of secondary coolant. In larger installation, the evaporator cools air or brine which are circulated as secondary refrigerants.

Four cycles to the refrigeration system :

The 4 main Components of Refrigeration cycle are :

(I) Compressor.

(II) Condenser.

(III) Expansion valve.

(Iv) Evaporator.

SHORT ANSWER QUESTIONS

Q. 3. What is refrigerant and how does. It help your air conditioner?

Refrigerant is a compound typically found in either a fluid or gaseous state. It readily absorbs heat from the environment and can provide refrigeration or air conditioning when combined with other components such as compressors and evaporators. Let's discuss how refrigerant works in your air conditioner, types of refrigerants and governing laws.

Working of Refrigerant :

Air conditioners contain refrigerant inside copper coils. As refrigerant absorbs heat from indoor air, it transitions from a low-pressure gas to a high-pressure liquid. Air conditioning components send the refrigerant outside where a fan blows hot air over the coils and exhausts it to the exterior.The refrigerant then cools down and turns back into a low-pressure gas. Another fan located inside the home blows air over the cool coils to distribute the resulting cold air throughout the building. Then the cycle repeats.

Types of Refrigerants :

The most common refrigerants used for air conditioning over the years include:

(i) Chlorofluorocarbons (CFCs), including R12.

(ii) Hydrochlorofluorocarbons (HCFCs), including R22.

(iii) Hydrofluorocarbons (HFCs), including R410A and R134.

Q. 4. Explain about ideal refrigerant.

The ideal refrigerant would be nontoxic and non-flammable and should have :

(a) Zero ozone depletion potential (ODP),

(b) Zero global warming potential (GWP),

(c) Short atmospheric lifetime.

These factors have become one of the main driving forces in selection of a refrigerant fluid, which should also have

(i) A large refrigeration effect requiring a small mass flow rate,

(ii) A small amount of work to be done during compression,

(iii) A small vapour specific volume.

These characteristics would result in a smaller compressor and a lower power requirement. Additionally, for reliable plant operation,

(i) the temperature of the discharge superheated vapour from the compressor should be low (Generally, 130°C is a maximum), to avoid oil breakdown;

(ii) the evaporating pressure should be above atmospheric, and the condensing pressure should be below the critical pressure of the refrigerant.

VERY SHORT ANSWER QUESTIONS

Q. 3. What you mean by natural refrigeration?

Natural refrigeration was achieved by natural means such as the use of ice or evaporative cooling. In earlier times, ice was either: 1. Transported from colder regions, 2. Harvested in winter and stored in ice houses for summer use or, 3. Made during night by cooling of water by radiation to stratosphere.

Q. 5. What is meant by vapour compression refrigeration system?

Vapour-compression refrigeration or vapor-compression refrigeration system (VCRS), in which the refrigerant undergoes phase changes, is one of the many refrigeration cycles and is the most widely used method for air-conditioning of buildings and automobiles.