PENANG SANGAM HIGH SCHOOL

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LESSON NOTES-26

School: PENANG SANGAM HIGH **Year/Level: 11**

Subject: APPLIED TECHNOLOGY

Strand	AT 11.6: APPLIED ENGINEERING
Sub Strand	AT6.3 REFRIGERATION AND AIR CONDITIONING
Content Learning Outcome	AT11.6.3.1 Demonstrate knowledge on safety, materials, tools and processes and develop practical skills in basic refrigeration & air conditioning.

REFRIGERATION AND AIR CONDITIONING

Refrigeration:

It can be defined as the process of transferring heat from a low temperature region to a high temperature region. In other words it is the process of cooling a substance.

Principle of refrigeration:

The principle of refrigeration is based on second law of thermodynamics. It states that heat does not flow from a low temperature body to a high temperature body without the help of an external work. In refrigeration process, since the heat has to be transferred from a low temperature body to a high temperature body some external work has to be done according to the second law of thermodynamics as shown. This external work is done by means of compressor, condenser etc.

Terms in refrigeration

1. Refrigerator
   It is a machine used to extract heat from a body at low temperature and reject this heat to a body at high temperature. Thus it cools the body.
2. Refrigerant
   It is substance, which is used as a working fluid in refrigerators. The refrigerant has low boiling point, which means that it vaporizes at low temperature and takes away the heat from a substance.

Examples: Freon 12 used in Domestic refrigerators. Freon 22 used in Air Conditioners.

Properties of good refrigerant:

1. Have low freezing and boiling point
2. Have high COP
3. Be non-toxic and non-corrosive to metal
4. Be non-explosive 5. Easily be liquefied

3. Capacity of Refrigerator

It is defined as the rate at which heat can be removed from the cold body. Simply it is the rate at which refrigeration can be produced. Its unit is expressed in terms of Ton of Refrigeration.

4 Refrigeration Effect

It is defined as the ratio of the quantity of heat removed to the time taken. Refrigeration Effect = Heat removed / Time taken.

5. Coefficient of Performance (COP)

It is defined as the ratio of heat absorbed in a given time (Refrigeration Effect) to the work done.

$$\text{COP} = \frac{\text{Refrigeration Effect}}{\text{Work done}}$$

Types of Refrigerators:

1. Vapor Compression Refrigerators
2. Vapor Absorption Refrigerators

Vapor Compression Refrigeration System

This type of refrigeration system is the most commonly used system in domestic refrigerators. In VCRS the vapor alternatively undergoes a change of phase from vapor to liquid and vice versa during a cycle.

Construction:

Vapor compression refrigeration system has the following components at its basic parts.

1. **Compressor:** The function of the compressor is to compress the input refrigerant of low pressure and low temperature. As a result the pressure and the temperature of the refrigerant increases. Generally reciprocating compressors are used in a refrigeration system. An external motor is used to drive the compressor.

2. **Condenser:** The condenser is a coil of tubes, which are made of copper. This is used to condense the refrigerant which is in the form of vapor. And convert into liquid.

3. **Expansion Valve:** this is otherwise called throttle valve. This valve is used to control the flow rate of refrigerant and also to reduce the pressure of the refrigerant.

4. Evaporator: This is the part in which the cooling takes place. This is kept in the space where cooling is required. It is a coil of tubes made up of copper.

Working Principle

The refrigerant, which is at low pressure and low temperature flows into the compressor. In the compressor the refrigerant is compressed and converted into a high pressure and high temperature refrigerant.

This high pressure and high temperature refrigerant in vapor form then passes through the condenser where it is condensed into high pressure liquid refrigerant. The high pressure liquid refrigerant thus produced passes through the expansion valve. In the expansion valve the pressure and temperature of the refrigerant drops and it partly evaporates. It is the allowed to flow into the evaporator at a controlled rate. In the evaporator, the partly liquid and vapor refrigerant is mostly evaporated and converted into a low pressure vapor. During this process, the refrigerant absorbs its latent heat of vaporization from the material that is to be cooled. Thus the body is cooled in the evaporator.

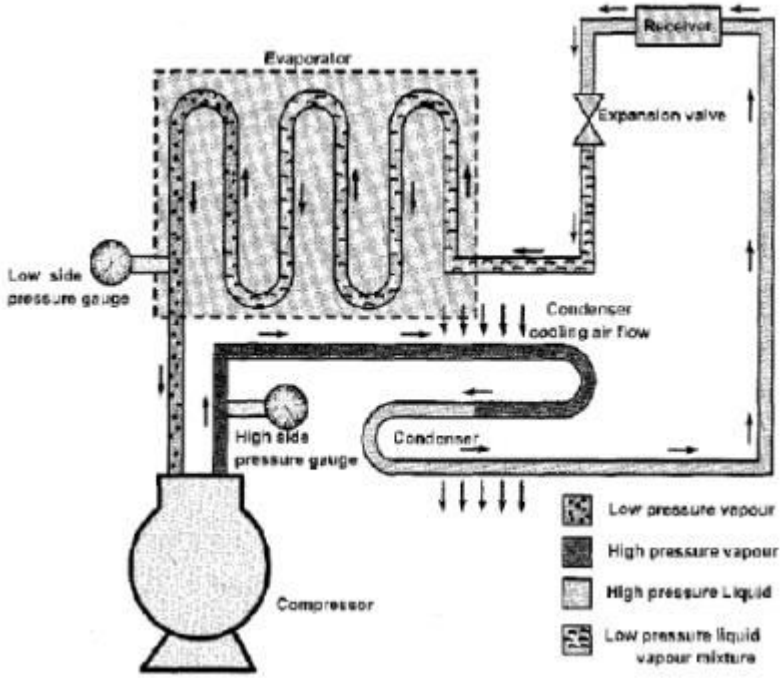
Then the low pressure vapor refrigerant enters the compressor and the cycle is repeated. Thus a material is cooled in vapor compression system. Vapor Absorption Refrigeration System: The compressor in the vapor compression refrigeration system consumes lot of energy. To avoid this, the vapor absorption refrigeration system has been developed. In this system, the compression process of vapor compression cycle is eliminated. Instead of that the three following process are introduced.

- Ammonia vapor is absorbed into water

- This mixture is pumped into a high pressure cycle

• This solution is heated to produce ammonia vapor.

Working Principal Diagram



Construction: The vapor absorption refrigeration system has the following components.

Generator: the generator receives the strong solution of aqua-ammonia from the absorber and heats it. Because of this heating, the aqua-ammonia solution gets separated into ammonia vapor at high pressure and hot weak ammonia solution which contains mostly water.

Condenser: The condenser converts the high pressure ammonia vapor received from the generator into high pressure ammonia liquid. This condensation is done by means of circulating cool water.

Expansion valve: This valve is otherwise called the throttling valve since the expansion, which takes place here, is throttling. While passing through this valve, the liquid ammonia gets expanded and gets converted into low pressure and low temperature ammonia.

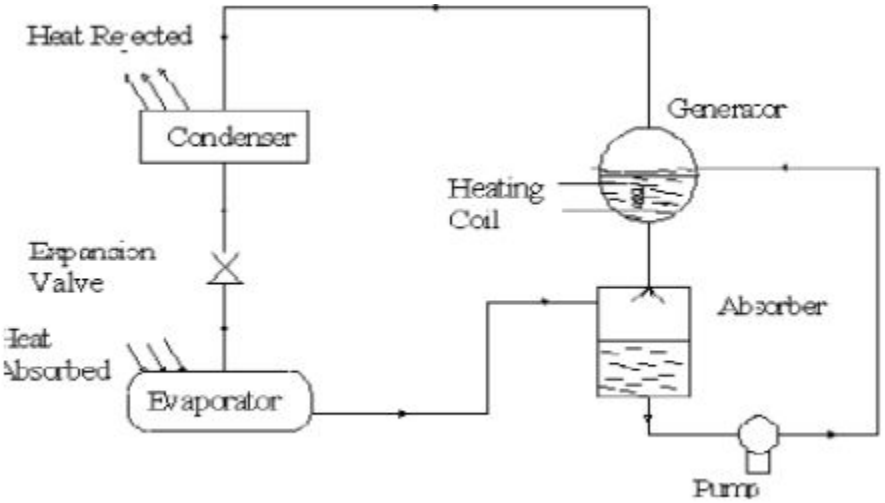
Evaporator: The evaporator is otherwise known as cold chamber. Here the refrigerant absorbs the heat from the material which is to be cooled and gets evaporated. It has many coils made of copper.

Absorber: The absorber receives the low pressure ammonia vapor from the evaporator and the weak ammonia solution from the generator and mixes them well to form a strong solution of aqua-ammonia.

Working Principle

The working fluid in vapor absorption refrigeration system is normally ammonia.

The ammonia vapor and water are mixed to form a strong solution of aqua-ammonia in the absorber. This aquaammonia solution is then pumped into the generator. In the generator, this solution is heated. Because of heating, ammonia gets evaporated at high pressure and leaves behind the weak ammonia solution, which mostly contains water.



Layout of a Window Room Air Conditioner

It is called a window air conditioner because it is usually fixed in a window. The Window or Room air conditioner is used to cool a single room or a large space. This window room air conditioner system has four main components.

They are:

- An entire cooling system, which includes a condenser, compressor and an evaporator.
- A fan and adjustable grills to ensure proper circulation of air.
- A filter, which is made of fiber, mesh or glass wool to remove the impurities in the air.
- Controlling equipment to regulate the properties of the air.

SHORT ANSWER QUESTIONS

1. Explain the terms:
   A. Generator:

   _____
   _____

   B. Condenser:

   _____
   _____

   C. Evaporator:

   _____
   _____

   D. Name two types of Refrigerators:

   _____
   _____

THE END