Class :2nd stage
Subject: thermodynamics
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Experiment NO.5.: Latent heat

The purpose:-

1- Calculate the total amount of heat needed to convert the material from one case to another

2- Know the difference between heat quality and latent heat

Theory:-

Material found in three states, solid, liquid and gas. Its condition is generally determined by temperature and pressure that can be converted from one phase to another by heating or cooling or control on pressure. We assume we deal with water and we kept the pressure steady (atmospheric pressure), we started with water at freezing state, we notice that at increasing temperature its absorb energy to reach freezing point then it starts to melt at constant temperature to diffuse all the ice

Latent heat:- is the amount of heat needed to convert (1 "kg") of matter from one case to another, (from solid to liquid or gaseous) and It is considered characteristic of the material It is measured by the Joule unit

- To calculate the latent heat we use the equation $Q = m \cdot h$

Where

Q: The amount of energy lost or acquired from the substance as it is transformed from case to condition, Measured by the unit Joule ("J")

M: mass of substance measured by ("Kg")

H: latent heat of substance measured by ("J/Kg")

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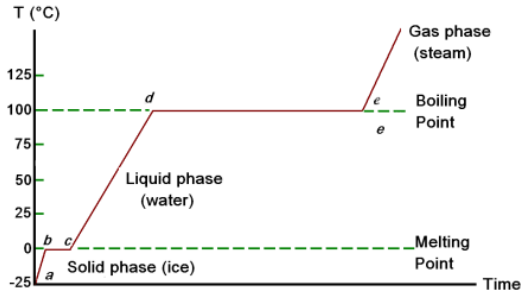

Figure (5-1): Phase displacement of water by constant pressure.

-There are two types of latent heat :-

A- Latent heat of Vaporization (Hv):- it means that the amount of heat required for evaporation (1 "kg") of the material without changing the temperature For example, it is known that water evaporates under normal pressure conditions at a constant temperature (100 ^{o}C), and this temperature remains constant until all water becomes vapor

- The equation for calculate the latent heat of vaporization well by

$Q = M*Hv$

Where

Hv: latent heat of vaporization

There is many ways to determine this energy, in this experiment will be passed vapor of water to calorimeter containing water, from calculation mass of water, and mass of converted vapor and initial and final temperatures, will be calculated heat of evaporation depending on the first law of thermodynamics can be written as:

$Q = Q1 + Q2$

=(Mw Cw + Mc Cc)(T2-T1)

Mw,Mc: mass of water and calorimeter.

Cw,Cc: specific heat of water and calorimeter.

T2,T1: is the initial and final temperature of calorimeter, respectively.

Amount of heat lost equal to mvHf + mwCw (T-T2)

Mv: mass of vapor.

Hf: latent heat

T:Boiling temperature of vapor from (2) and (3) we get:

$$Hv= \frac{(MwCw+McCc)(T-T2)-MvCw(T2-T1)}{Mv}$$

B- Latent heat of fusion (Hf):- Is the amount of heat needed to convert (1 "kg") of material from a solid state to a liquid state without a change in temperature

- The equation for calculate the latent heat of fusion will by

Q = M*Hv Where . Hf: latent heat of fusion

Apparatus:

Equipment and tools that used for calculate the latent heat of vaporization:

Glass cup with water, thermometer, flame

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Procedure:

1- Place a thermometer in a cup with water over the flame and heat until boiling

2- Note The thermometer is read when it reaches (100 Co)

3- The water begins to boil

4- Record the thermometer readings during boiling and after boiling

5- Draw a graphic relationship between time and temp.

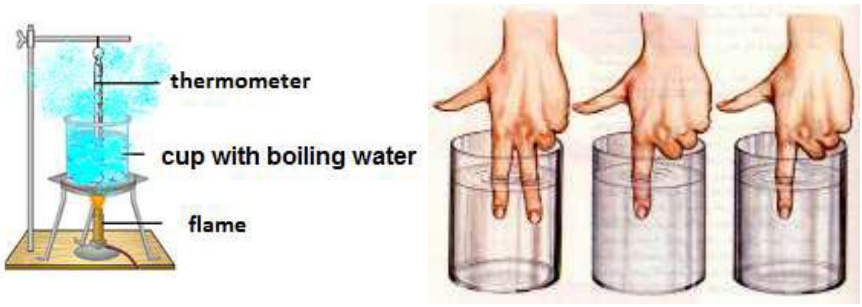

Figure (5-2):latent heat.

Not: - The thermometer temperature remains constant at (100^{o} C) until all water becomes vapor.

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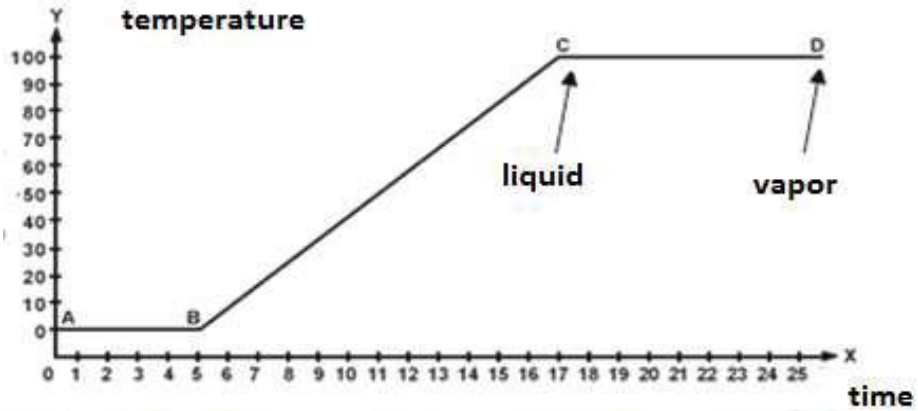
Conclusion:-

1- The temperature of the liquid does not rise during boiling: the heat obtained is consumed by breaking the bonds between the molecules of the liquid substance (water) to convert it into a gas substance (water vapor).

2- What happens when boiling (evaporation) can be represented in the following Graph



The relationship between temperature and time at boiling

Discussion:

1. Explain the Fusion process.
2. Explain the evaporation process.