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Application of One Component System i-e Sulphur.

For Degree Part II(H) Paper : III, Lecture : 03.

Dr. Shailesh Kumar Jha.
Asst Prof. (Guest)
Dept of Chemistry
Marwari College DBC.

Sulphur is also a One Component System Although there are four allotropic modification a different Crystalline form of Sulphur which represent it's four phases. These four phases are as follows:

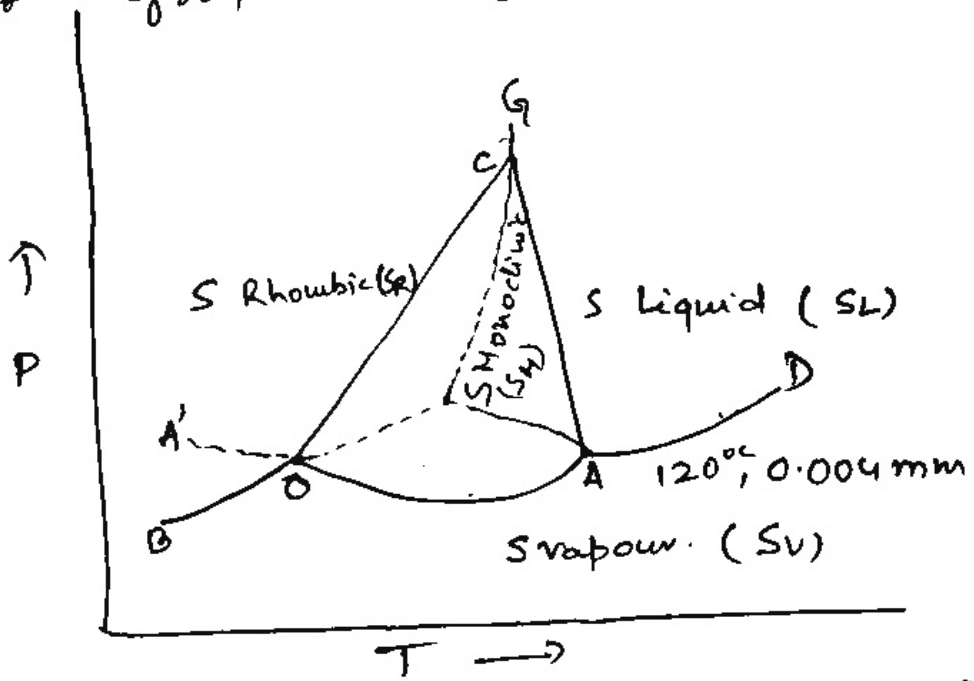
i) Rhombic Sulphur (S_R)
ii) Monoclinic Sulphur (S_L)
iii) Liquid Sulphur (S_L) &
iv) Vapour Sulphur (S_V).

Means there are four phase ($P = 4$) but the no. of Component is only one ($C = 1$), So by using Gibbs equation if we Calculate the no. of degree of freedom by using the formula:

$$F = C - P + 2$$
$$= 1 - 4 + 2$$
$$= -1$$

Degree of freedom can not be negative it represent all four phase can not Co-exist in equilibrium, maximum three phases can exist in equilibrium in any System.

When we represent all four phases by a graph where we draw it P & T then we get graph as follows:



We devide this phase diagram into two parts as water system i) Areas ii) Curve. In the above phase diagram there are four areas i.e BOCG represent to SR, the area BOAD area GCAD represent to SL, the area BOA represent to SV, and the area COA represent to SM. In each four areas there is only one phase, so each area will have the no. of degree of freedom as follows

$$F = C - P + 2$$

$$= 1 - 1 + 2$$

$$= 2$$

which represent to two variables i.e P & T.

Curves :- the and their notation a representation can be summarised as follows

Name of curve	Equilibrium exist between	Called.
I BO	S_R & S_V	Vapour/Sublimation Curve.
II OA	S_M & S_V	Sublimation/Vapour pressure Curve.
III AD	S_L & S_V	vapour pressure "
IV OC	S_R & S_M	Transition Curve.
V AC	S_M & S_L	Melting pt Curve
VI CQ	S_R & S_L	melting Curve

I Curve: BO:

In this Curve sulphur Rhombic(S_R) & Sulphur vapour (S_V) exist in equilibrium with each other, which is also called Sublimation Curve a vapour pressure Curve. This Curve represent the effect of temperature on vapour pressure or sublimation of S_R. At point 'O' S_R and S_V can exist in equilibrium with each other. In this Curve the degree of freedom :-

$$F = C - P + 2$$
$$= 1 - 2 + 2$$
$$= 1$$

$F = 1$ means Curve is Monovariable i.e P or T.

II Curve OA :—

In this Curve Sulphur mono clinic(S_M) & Sulphur vapour(S_V) Co-exist in

equilibrium. At point 'O' S_R, S_M & S_V co-exist in equilibrium so this point is also called triple point, it means in triple point S_L do not participate, hence maximum three phase i.e S_R, S_M & S_V can show triple point. Again, the component is one & phases are three at triple point so

$$F = C - P + 2$$
$$= 1 - 3 + 2$$
$$= 0$$

We know at triple point the degree of freedom becomes zero.

II Curve AD

Along the curve AD Sulphur liquid and Sulphur vapour (S_V) can co-exist in equilibrium. Again at point 'A' triple point can exist where S_M, S_L & S_V can co-exist to show triple point. Again here the the degrees of freedom will be zero. The temperature at point D is known as critical temperature.

iv) Curve OC:

In this curve sulphur Rhombic (SR) and Sulphur Monoclinic (SM) can Co-exist in equilibrium. OC is also called transition curve and it explain the effect of pressure on transition, and temperature at that time is transition temperature. This curve end to 'C' point which is last point so beyond it SM can not exist.

v) Curve AC: - In this curve sulphur Monoclinic (SM) & Sulphur liquid (SL) can Co-exist in equilibrium. Actually Curve AC represent effect of pressure on melting point of SM.

vi) Curve CG:- Along this curve Sulphur Rhombic (SR) and Sulphur liquid (SL) can co-exist at equilibrium. It explain the effect of pressure on the melting point of SR in this zone.

Now altogether there are four area where in each area degree of freedom is two only but there are Six Curve which show degree of freedom (1-2+2) is one except formation of triple point where the degree of freedom becomes zero.

Teacher's Signature : _____