Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Second Year)

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Unit: II

Module Name: Phase diagram of two component systems involving Eutectics

Module No: 14

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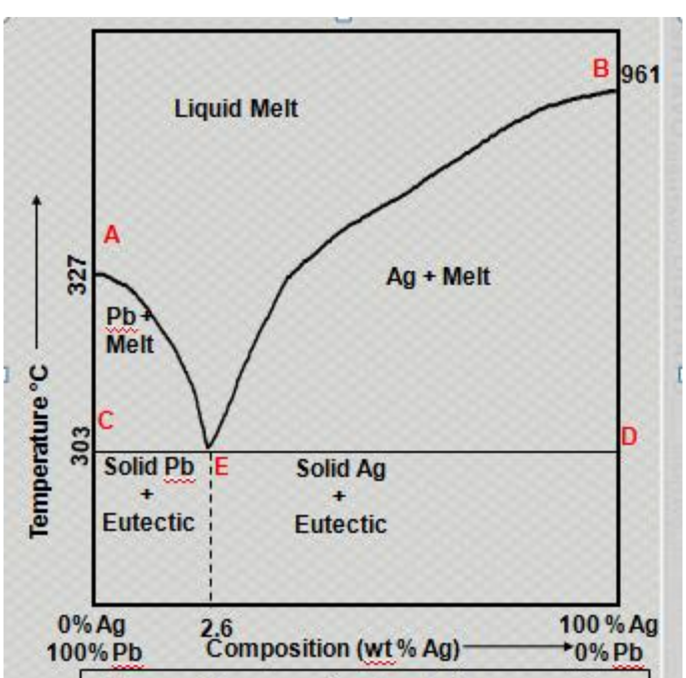
NOTES

THE LEAD-SILVER SYSTEM

This system has two components and four phases.
The phases are :
(i) solid silver (ii) solid lead (iii) solution of molten silver and lead and
(iv) vapour.
The boiling points of silver and lead being considerably high, the vapour phase is practically absent. Thus Pb/ Ag is a condensed system with three phases. In such a case, pressure can have no effect on the system. Therefore we need consider only the two remaining variables, namely the temperature (T) and concentration (C).
Thus, Reduced phase rule equation is used.

i.e $F' = C - P + 1$.



Phase diagram for lead-silver system

The salient features of the diagram are :
(a) Two curves, AE and BE
(b) Eutectic point, E
(c) Three areas: (i) above AEB (ii) below AE (iii) below BE

Curve AE:- the Freezing point curve of Pb. A represents the freezing point or melting point of solid Lead and the curve AE shows that the addition of Silver lowers the melting point along it. The phases in equilibrium along Ae are solid Lead and melt. Applying the reduced phase rule equation
$F' = C – P + 1 = 2 – 2 + 1 = 1$
Thus the system Pb/Melt is monovariant.

Curve BE:- the Freezing point curve of Ag. B represents the melting point of solid Silver and the curve BE shows that the melting point is lowered by addition of Pb. The phases in equilibrium along BE are solid Silver and solution. The system is monovariant.

The Eutectic point E. The curves AE and BE intersect at E, which is called the eutectic point.
Here three phases solid Ag, solid Pb, and solution are in equilibrium. Applying the reduced phase
rule equation
$F' = C – P + 1 = 2 – 3 + 1 = 0$
Thus the system Ag/Pb/solution at E is nonvariant. Both the variables, temperature and composition are fixed. If you raise the temperature above the eutectic temperature, the solid phases Ag and Pb disappear and if you cool below it, you will land in the solid Pb/Ag area where solution phase is nonexistent.

The Area above AEB. This region represents the single phase system, the solution of molten Ag and Pb. Applying the reduced phase rule equation, we have
$F' = C – P + 1 = 2 – 1 + 1 = 2$
Thus the system solution Pb/Ag is bivariant.

The area below AE represents the phases Pb + solution, while that **below BE** the phases Ag+ solution. All these areas have two phases and one degree of freedom,
$F = C – P + 1 = 2 – 2 + 1 = 1$

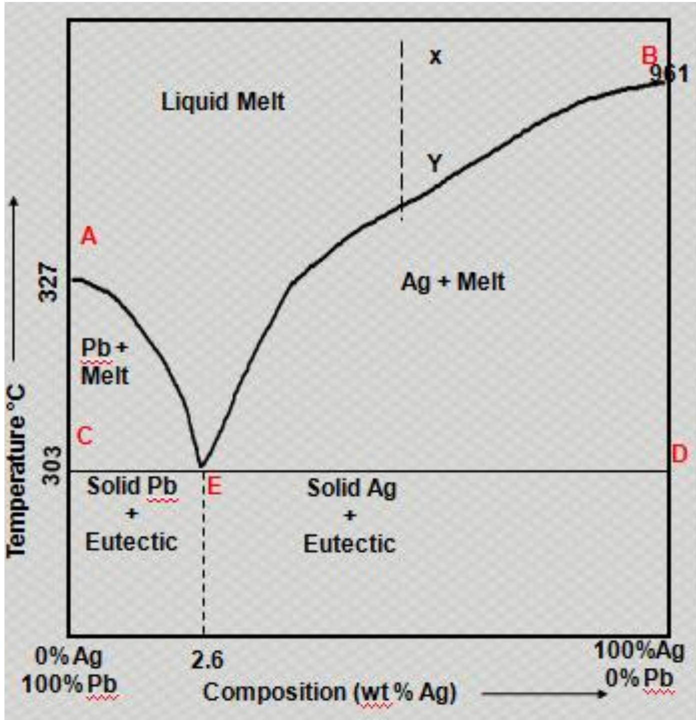


Fig. 2

Pattinson's Process for the Desilverisation of Argentiferous Lead

This process of recovery of silver from argentiferous lead is based on the facts contained in the diagram (Fig. 2). The argentiferous lead containing small amount of silver (less than 0.1%) is melted well above the melting temperature of pure lead (327ºC). Let the point X represent the system 'molten lead' on the diagram. It is then allowed to cool when the temperature of the melt falls along the dashed line XY. As the temperature corresponding to Y on the curve BC is reached solid lead begins to separate and the solution would contain relatively larger amount of silver. On further cooling, more of lead separates and we travel along the curve BC until the eutectic point C is reached. Lead is continuously removed by means of ladles and the percentage of silver in the melt goes on increasing. At C, an alloy containing 2.5% Ag and 97.5% Pb is obtained. This is treated for the recovery of silver profitably.