

Example of phase rule in binary systems:

$$F = 3 - P \text{ for binary systems}$$

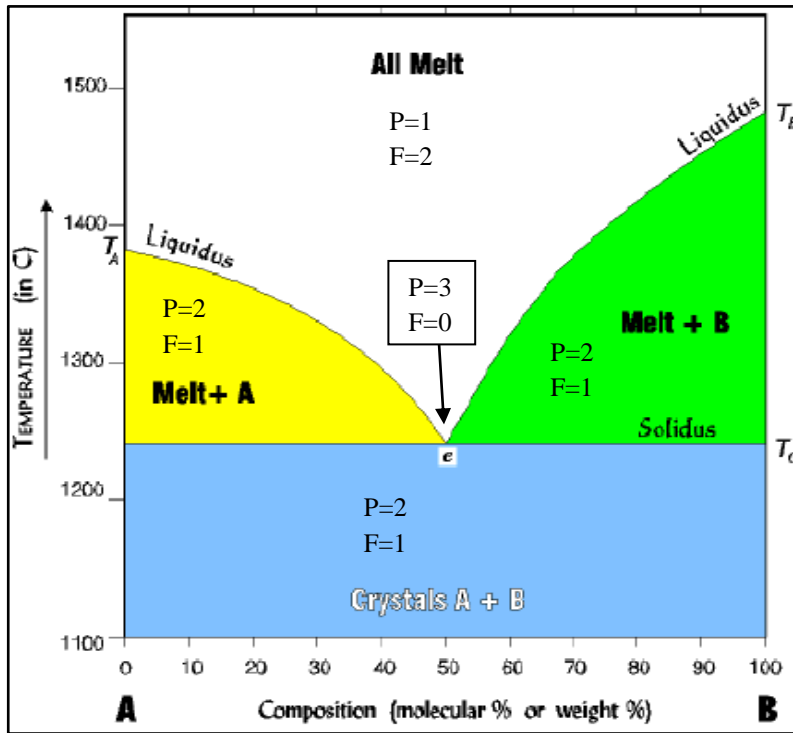


Fig.(14) Example of phase rule in binary system.

2-3-3 Intermediate compounds in binary systems:

Compounds composed of two or more components occur in a system and are referred to as **intermediate compounds**. In binary systems these compounds are composed of various ratios of the two components of the system. In fig. (15) the compound AB_2 is formed of the components A and B, there is one atom of A for every two atoms of B in the compound.

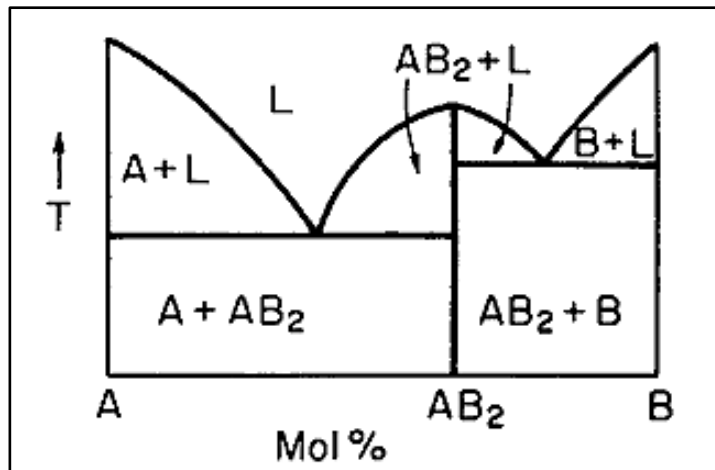


Fig. (15) Binary system with intermediate compound.

These intermediate compounds are classified with respect to their behavior during melting into:

1- Congruently melting compound: The compound AB_2 is called a congruently melting compound because it melts directly to a liquid of chemical composition identical to that of the crystalline compound, as in case of the components of system . Congruently melting compounds divide the system into separate, smaller binary systems. In the system in fig. (15), the compound AB_2 divides the system A-B into the systems AB_2 -A and AB_2 -B, both of which are simple eutectic systems.

In the system $MnO-Al_2O_3$, the position of the intermediate compound $MnO \cdot Al_2O_3$ on the weight percent axis is at 59% Al_2O_3 as shown in fig(16).

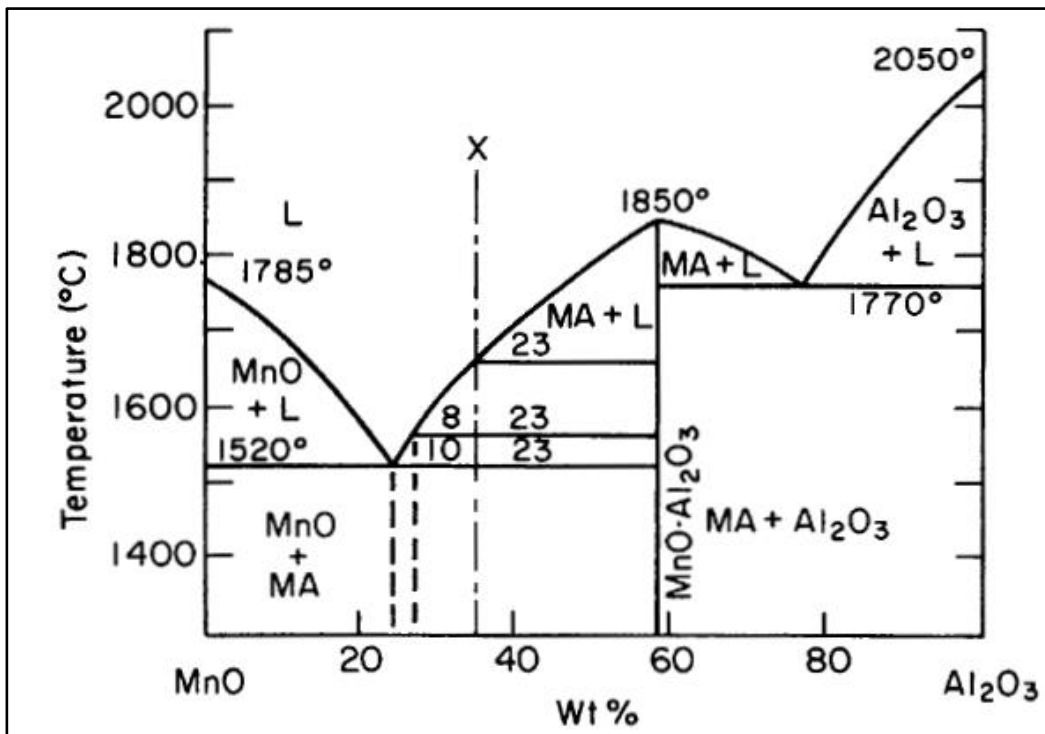


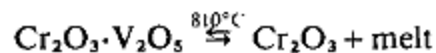
Fig. (16) System $MnO-Al_2O_3$ ($MA = MnO \cdot Al_2O_3$).

The isoplethal study in the system $MnO-Al_2O_3$ for composition 35% Al_2O_3 , 65% MnO is shown in table (2).

Table (2) Isoplethal study in the system MnO-Al₂O₃ for composition 35% Al₂O₃, 65%MnO

Temp (°C)	Proportions (phases)	% (Phases)	% Composition of phases (in terms of components)
1670	23 units melt <u>ε units crystals (MA)</u>	100 ε	$\begin{cases} \text{MnO} = 65 \\ \text{Al}_2\text{O}_3 = 35 \end{cases}$ $\begin{cases} \text{MnO} = 41 \\ \text{Al}_2\text{O}_3 = 59 \end{cases}$
1560	23 units melt 8 units crystals (MA) <u>31</u>	74 26	$\begin{cases} \text{MnO} = 73 \\ \text{Al}_2\text{O}_3 = 27 \end{cases}$ $\begin{cases} \text{MnO} = 41 \\ \text{Al}_2\text{O}_3 = 59 \end{cases}$
1520 ⁺	23 units melt 10 units crystals (MA) <u>33</u>	70 30	$\begin{cases} \text{MnO} = 75 \\ \text{Al}_2\text{O}_3 = 25 \end{cases}$ $\begin{cases} \text{MnO} = 41 \\ \text{Al}_2\text{O}_3 = 59 \end{cases}$
1520 ⁻	Melt solidifies to form eutectic microstructure 23 units eutectic xtals 10 units crystals (MA) <u>33</u>	70 30	$\begin{cases} \text{MnO} = 57.5 \\ \text{MnO} \cdot \text{Al}_2\text{O}_3 = 42.5 \end{cases}$ $\begin{cases} \text{MnO} = 41 \\ \text{Al}_2\text{O}_3 = 59 \end{cases}$

2- **Incongruently melting compound**: which does not melt to a liquid of the same composition but change to a different liquid and another crystalline phase. Fig.(17) shows the system V₂O₅-Cr₂O₃ in which the intermediate compound Cr₂O₃·V₂O₅ transforms, on heating, to Cr₂O₃ and melt. Along line PN on the diagram, three phases are in equilibrium as shown by the reaction:



This reaction of incongruent melting is often called a peritectic reaction. A **peritectic reaction** is an isothermal three-phase reaction in which a crystalline phase is in equilibrium with another crystalline phase and a liquid.

The point **P** is called the **peritectic point**. Along the line **PN** there are three phases in equilibrium: $\text{Cr}_2\text{O}_3 \cdot \text{V}_2\text{O}_5$, Cr_2O_3 , and liquid of the composition at point P. The line **PN** is an isothermal line which represents the peritectic temperature.

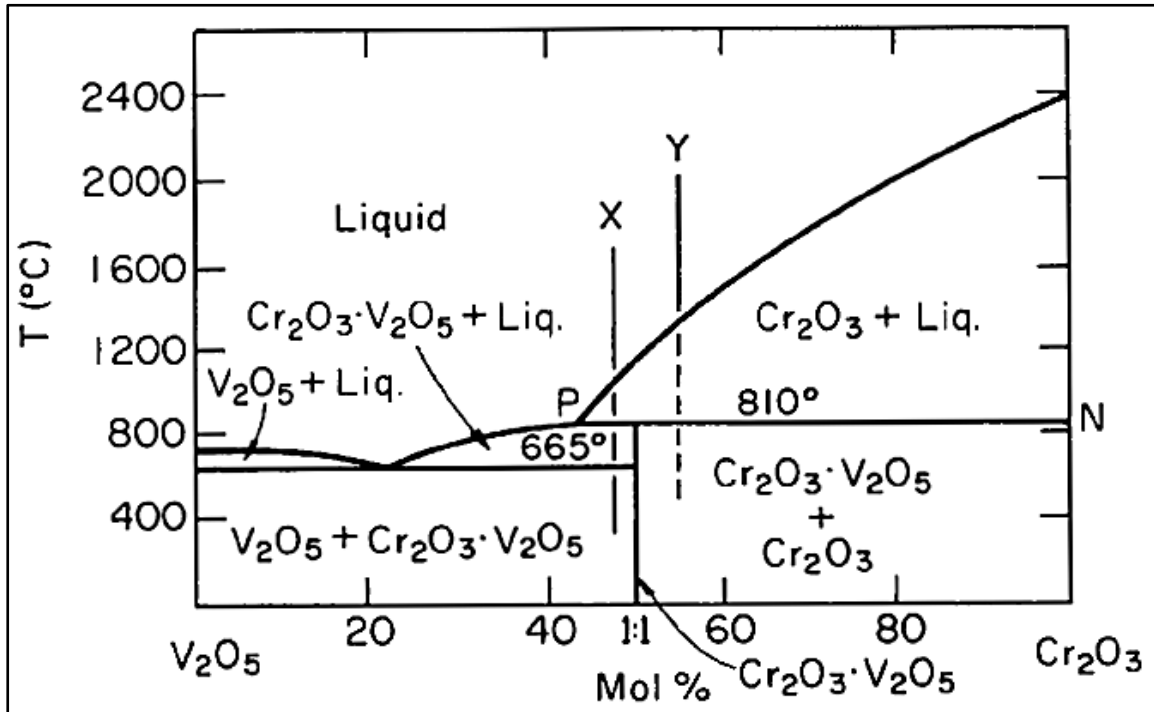


Fig.(17) System V_2O_5 - Cr_2O_3