The Phase Rule and Different Components

Physical pharmacy **college of Pharmacy**

Lab-2-

- **phase rule** : is a relationship for determining the least number required to define the state of the system.
- **phase** : is homogeneous physically distinct portion of the system which is separated from other parts of the system by bounding surfaces
- (e.g. **water** & its **vapor** is **one component two phase system**)

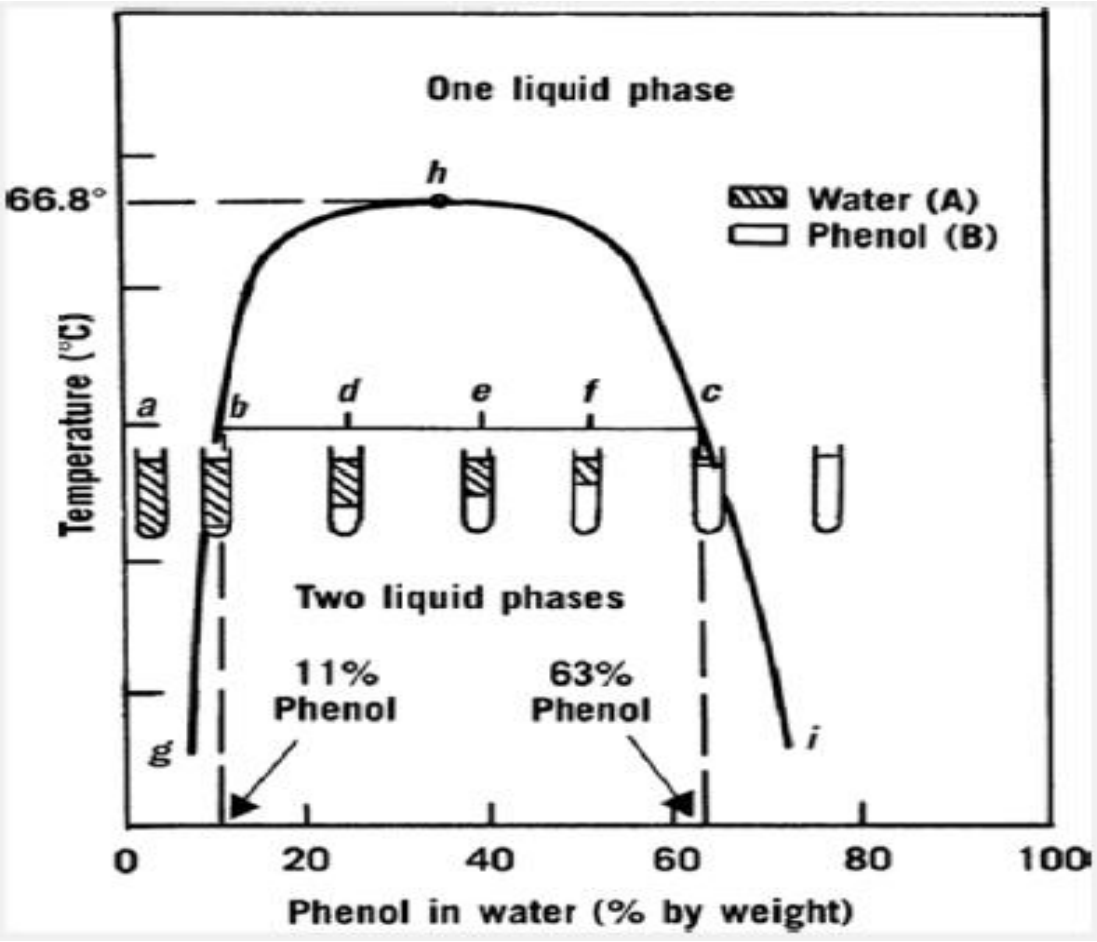
- **Number of component :is the smallest number of constituents by which the phase of equilibrium system can be expressed as a chemical formula or equation.**

Two component systems containing liquid phase

- as we know ethyl **alcohol & water** are **miscible** in all proportions , while **water & mercury** are completely ***immiscible*** regardless the amount of each.
- Between these two extremes lie a whole range of system which exhibit a partial miscibility (or immiscibility) such as water & phenol , as their miscibility affected by two factors **conc. & temp**.

- to illustrate the effect of conc. & temp. we prepare the following conc. Of phenol in water by % weight as the total wt. is (10 gm)
- **2%,7%,9%,11%,24%,40%,55%,63%,70%,&75 % (w/w)**
- (e.g. 2% 0.2 gm phenol + 9.8 gm H_2O)

To see the effect of temp. & conc. ,we draw graph paper of temp. versus conc.



- ***binodal curve* :-** is the curve that separates two phase area from one phase area .
- ***tie line* :- is the line drawn across the region of two phases (conjugate phases) as each temp. has its own tie line.**
- ***upper consolute temp. or critical solu. Temp. :*** is the maximum temp. at which two phase region exists .
- **Water & phenol system it is 66.8 as all combinations above this temp. is completely miscible & give one phase system.**
- ***mass ratio:*** **is the relative amount by wt. of conjugate phase ,it depends on the position in tie line & temp.**

properties of the tie –line in two component systems:-

1-it is parallel to the base line

2-all systems prepared along the tie line at equilibrium separated into two conjugate phases of constant composition.

- For instance, consider a system containing 24% by weight of phenol and 76% by weight of water (point **d** in the diagram). At equilibrium two liquid phases have been presented in the tube. The upper one, A, has a composition of 11% phenol in water (point **b** on the diagram), whereas the lower layer, B, contains 63% phenol (point c on the diagram). The relative weights of the two phases can be calculated by the equation

$$\frac{\text{Weight of phase A}}{\text{weight of phase B}} = \frac{\text{Length dc}}{\text{Length bd}}$$

63-24/24-11 =39/13 =3/1

Homework

- Q: At 25 ℃ a tie line 7%---------70%, find the mass ratio and the composition of each phase of 40% w/w phenol by water at this temperature note that the total weight is 10 gm?

advantages of binodal curve :-

- Binodal curve or phase diagram is used to formulate systems containing more than component in single liq. phase product
- e.g. solid phenol is necrotic sub. So in pharmacy we use solution of phenol in water (76%w/w) which has freezing point 3.5℃ compared to liquefied phenol (90% w/w) which has freezing point 17C^{o}

Procedure

- **Prepare the following percent W/W phenol/water(10 gm total) 2%,7%,9%,11% ,24%,40%,55 %,63%,70%,75%.**
- **Put test tube in a fixed temperature in water bath (25 C^0) or (left test tube at room temp.) and keep it for 10 minutes at that tem**p.
- **Take the test tubes out and before their temp has changed record which one has 2 phases and which has one phase.**
- **Repeat the work at higher temp using the following temp.40C^0, 50C^0, 70C^0.**
- Draw a curve temp verses concentrations showing your 2 phases area and one phase area in the curve.
- **Draw tie line for each temp.**
- Take 40% W/W for example to find the mass ratio and the composition of each phase at different temp.
- **Mention the upper consulate temp**


Thank
you