University of Al-Ameed
College of Pharmacy

2nd stage , 1st Semester

Practical Physical pharmacy

Two component systems containing liquid phases/Lab2

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Introduction

The Phase Rule:

- When the equilibrium between any number of phases is influenced only by temperature, pressure and concentration but not influenced by gravity, or electrical or magnetic forces or by surface action then the number of Degrees of Freedom (F) of the system is related to the number of Components (C) and of Phases (P) by the phase rule equation: **F= C – P +2**

- It is very useful to understand the effect of intensive variables, such as temperature, pressure, or concentration, on the equilibrium between phases as well as between chemical constituents.

Phase

Phase: is defined as any homogeneous and physically distinct part of a system having all physical and chemical properties the same throughout the system. A system may consist of one phase or more than one phase.

Examples:-

- A system containing only liquid water is one-phase system.
- A system containing liquid water and water vapour (gas) is a two phase system.
- A system containing liquid water, water vapour and solid ice is a three phase system.
- Pure substances (solid, liquid, or gas) made of one chemical species only, is considered as one phase.

Component

Component: is a substance in the system with a defined chemical structure.

- Note:- A phase may contain one or more component.

Number of Component: is defined as the least number of independent chemical constituents in terms of which the composition of every phase can be expressed by means of a chemical equation. For example:

1. Two component: e.g. water and ethanol , oil and water
2. Three component: e.g. chloroform with acetic acid and water

Examples:-

- **Water system** has three phases, ice, water and water vapour and the composition of all these phases is expressed in terms of one chemical individual water. Thus water system has one component only.

- **Similarly Sulphur system** has four phases: rhombic sulphur, monoclinic sulphur liquid sulphur and sulphur vapour and the composition of all these phases is expressed by one chemical individual sulphur. Therefore Sulphur system is one component system. Thus, all the phases in one component system is expressed by only one chemical individual.

- **A saturated solution of NaCl** in contact with excess solid NaCl has two phases. The composition of both the phases can be expressed in terms of two chemical individual NaCl and water. Hence a saturated solution of NaCl in water in contact with excess solid NaCl is a two component system.

Miscibility

Miscibility: refers to the ability of a liquid to completely dissolve in another liquid solution.

a distinct layer between two liquids will not form when you have a miscible solution. For example, Water and ethanol are miscible in all proportion.

- Mention examples for miscible liquids?

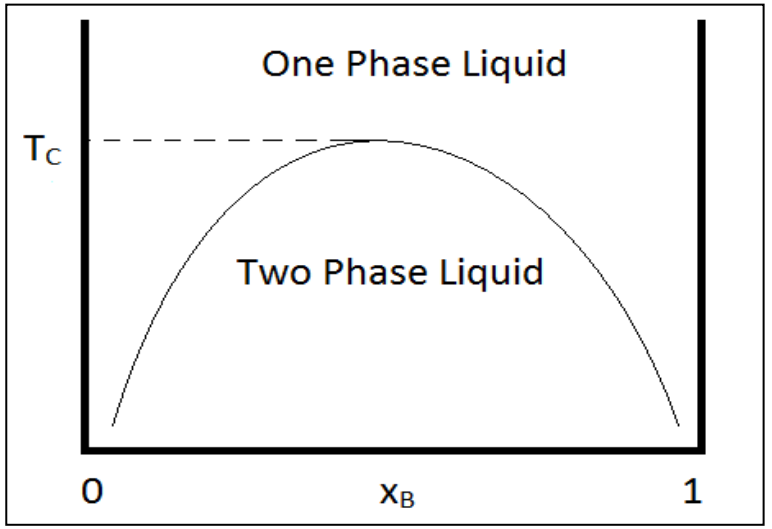
Immiscibility: When a distinct layer does form in a mixed solution, this is called immiscibility. For example, a type of immiscible liquid is oil and water. When mixed together, oil will essentially sit on top of water resulting in the formulation of a very noticeable layer. Another example, the water and mercury are completely immiscible regardless the amount of each.

- Mention examples for immiscible liquids?

Partial Miscibility: is when the substances only mix partially. When mixed, there are two layers formed each layer containing some of both liquids. for example, phenol and water.

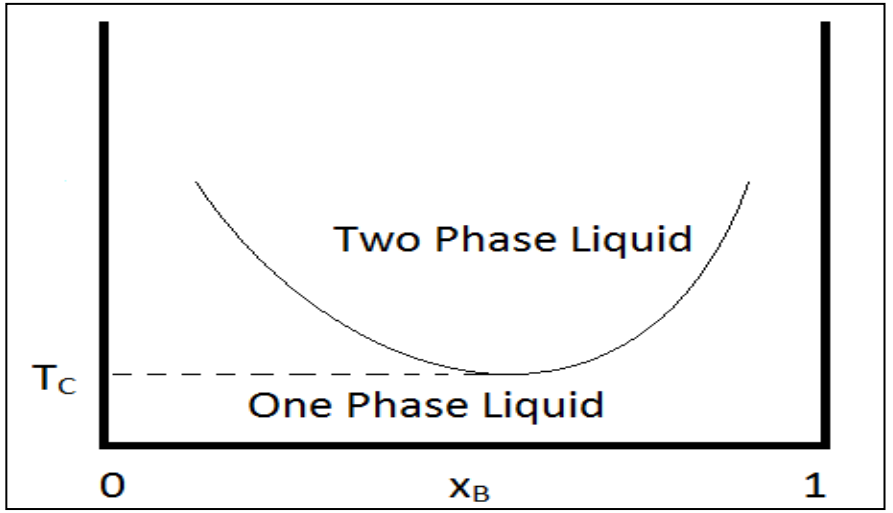
Partial Miscibility of phenol and water

- The solubility of partially miscible liquids are influenced by temperature and concentration. In a system such as phenol and water, the mutual solubility of the two conjugate phases increase with temperature until reaching the critical solution temperature, where a homogeneous or one phase liquid is formed.

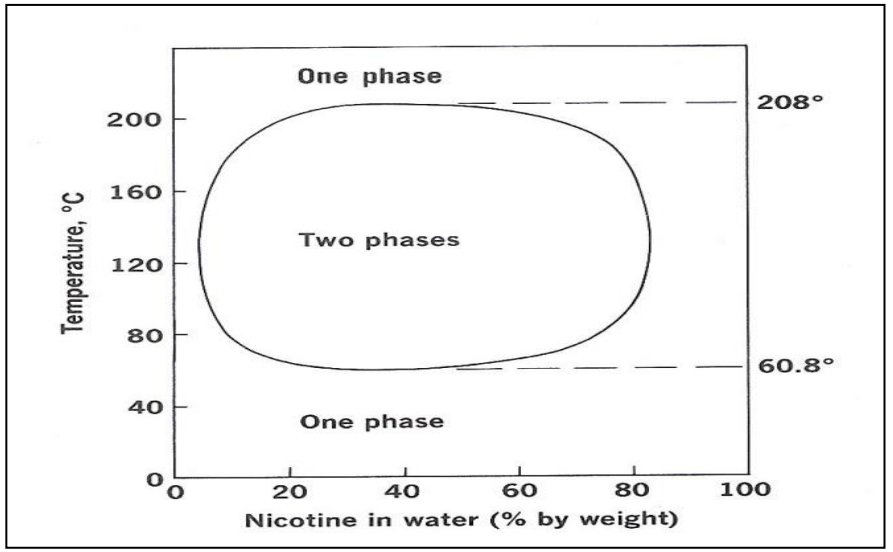


Critical solution temperature

- The solubility of some liquid pairs, such as Triethanolamine and water can increase as the temperature is lowered, and the system will exhibit a lower critical temperature, below which the two liquids are soluble in all proportions and above which two separate layers form.



- Another type, involving a few mixtures such as nicotine and water, shows both an upper and a lower critical temperature with an intermediate temperature region in which the two liquids are only partially miscible.



Conclusion

Miscibility of liquids:

1. **Miscible liquids**

For example: Ethanol and water

(Two components and one phase)

2. **Immiscible liquids**

For example: Oil and water

(Two components and two phase)

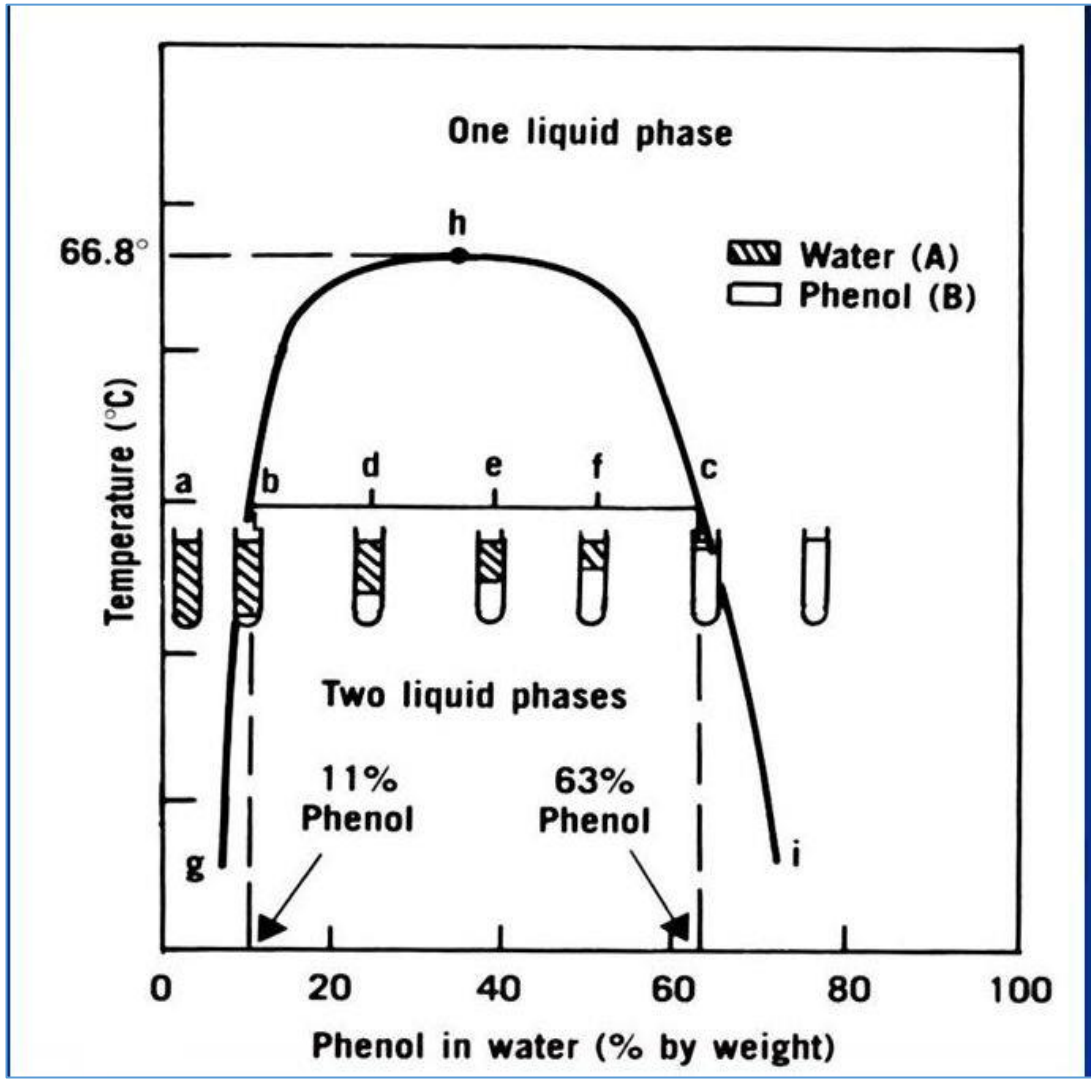
3. **Partially miscible liquids**

For example: phenol and water

(Two components and two phase or one phase)

Effect of temperature and concentration on phenol and water system

- Phenol and water is an example for two component systems.
- Phenol and water are partially miscible with one another in limited proportions and their miscibility affected by two factors:
  1. **Concentration**
  2. **Temperature**



The experiment

Title:

- Two components system containing liquid phases

Aim:

- To study the effect of concentration and temperature on the miscibility of phenol in water.

Materials and equipment:

- Phenol
- Distilled Water
- Test tube
- Thermometer

Procedure

1. Prepare the following percent w/w phenol /water (10gm total weight): 2%, 7%, 9%, 11%, 20%, 40%, 55%, 63%, 70%, 75%. e.g. 2%: 0.2g phenol + 9.8g water.
2. Place 0.2g of phenol in a test tube. 9.8g of water is added to the phenol and gently shacked.
3. Determine which of the prepared concentrations is 2 phases or one phase.
4. Put test tube in a fixed temperature in water bath (25 C) and keep it for 10 minutes at that temperature.
5. Take the test tubes out and before their temperature has change record which one has two phases and which has one phase.
6. Repeat the work at higher temperature using the following temp. 40 C, 50 C, and 70 C.
7. Mention the upper consulate temperature.

Results:

Flask NO.	Phenol (w/w) (%)	water (w/w) (%)	Phenol (w/w) (g)	water (w/w) (g)	Phases NO.				Temperature
					25 ^{0}C	40 ^{0}C	50 ^{0}C	70 ^{0}C	
1	2%	98%							
2	7%	93%							
3	9%	91%							
4	11%	89%							
5	20%	80%							
6	40%	60%							
7	55%	45%							
8	63%	37%							
9	70%	30%							
10	75%	25%							

Thank You