Two component systems containing liquid phases

2nd stage/ First semester-Lab.2

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Introduction

***Two-component systems containing liquid phases*:-** are classified based on how well the two liquids mix together.

A phase:- is a uniform, distinct part of a system separated by boundaries.

A component:- is a chemical substance used to make 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.

The Phase Rule

To understand the effect of intensive variables, such as temperature, pressure, or concentration, on **the equilibrium** between phases as well as between chemical constituents.

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:

$$F = C - P + 2$$

Miscibility

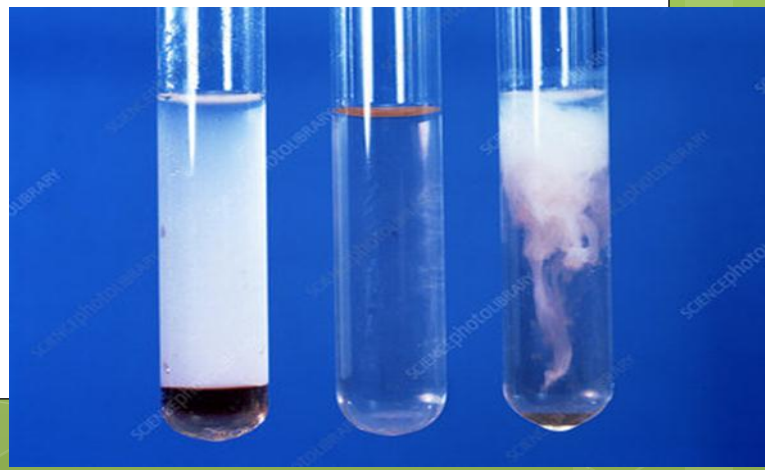
refers to the ability of a liquid to completely dissolve in another liquid solution. For example, Water and ethanol are miscible in all proportion.

oil and water

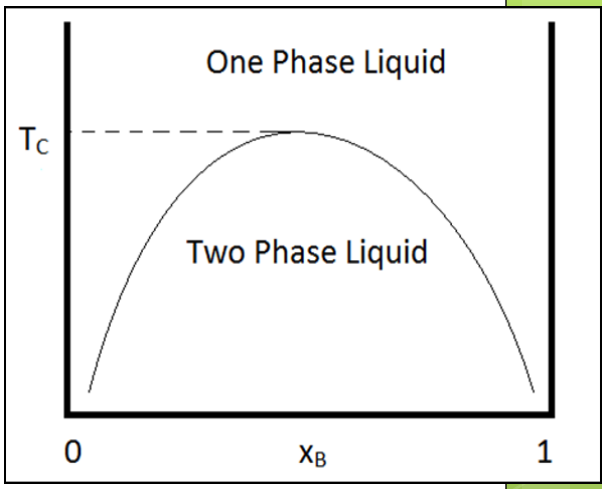
water and mercury

(examples for immiscible liquides)

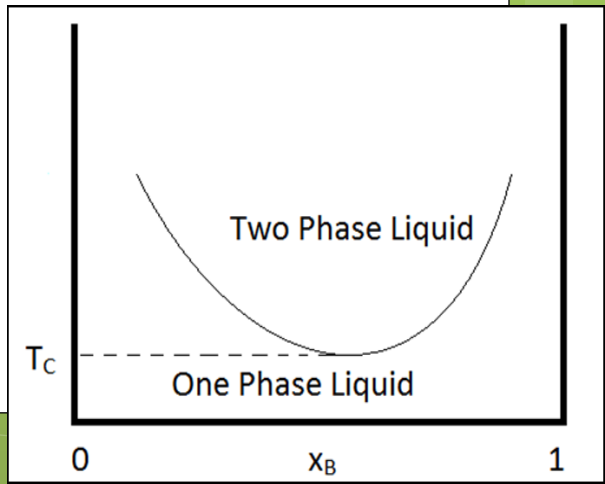
Partial Miscibility: is when the substances only ***mix partially***.(partially miscible liquids are influenced by temperature and concentration).



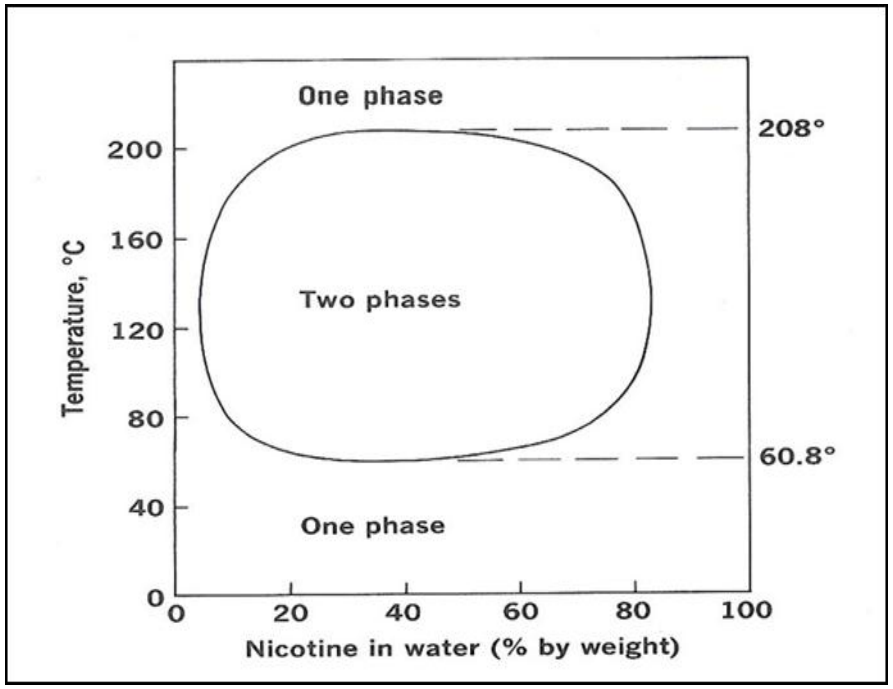
In a system such as phenol and water, the mutual solubility of the two conjugate phases increase with temperature until reaching the *critical solution temperature, where a homogeneous or one phase liquid is formed.*



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.



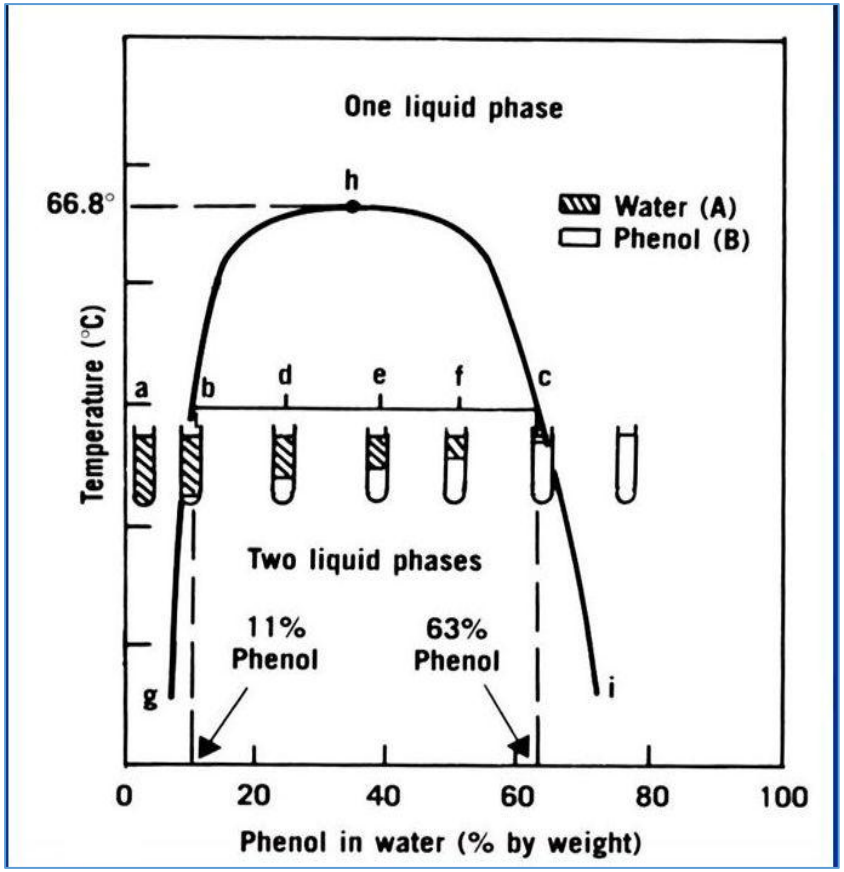
Effect of temp. and conc. on phenol and water system

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:

Concentration

Temperature



Experimental part

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

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).