SEM-IV (Honours) Dr. Debranjan Ghosh

Physical Pharmacy Practical

Associate Professor SEM-4 (Hons) course code: CC-8 physical chemistry - III (Force)

Saturday, 1 June 2013

Practical 2: Phase Diagram- Mutual Solubility Curve for Phenol and Water

OBJECTIVE

To determine the solubility of 2 partially miscible liquids properties by using phenol in water

INTRODUCTION

A few liquids are miscible with each other in all proportions while others have miscibility under certain proportions only. A typical example for this is phenol and water. Under certain temperature and concentration of phenol and water, the phenol and water maybe in 1 phase condition or maybe being separated into 2 different phases. Generally, both liquids become more soluble with rising temperature until the critical solution temperature or consolute point is attained, and above that point, the liquids will turn into only 1 phase. At any temperature below the critical solution temperature, the composition for the 2 layers of liquids in equilibrium state is constant and does not depend on the relative amount of these 2 phases. The mutual solubility for a pair of partially miscible liquids in general is extremely influenced by the presence of a third component.

APPARATUS AND MATERIALS

Phenol, water, thermometer, boiling tube rack, boiling tubes, pipette

PROCEDURES

1. Mixture of phenol and water in boiling tubes was prepared in the way that phenol was added in water in various percentages from 8%, 11%, 20%, 50%, 60%, 63% and 80%.
2. The total amount of 2 liquids in the boiling tubes was fixed to be 30ml and the boiling tubes were labeled accordingly from A to G.
3. Then, the boiling tube A was heated in hot water and the mixture was stirred.
4. The temperature at which the turbid liquid became clear was recorded.
5. The boiling tube A was then been cooled gradually and the temperature at which the liquids became turbid again forming 2 separated layers was recorded. Then, boiling tube A was heated again and the average temperature for heating and cooling was recorded.
6. Finally, steps 3-5 were repeated for boiling tubes B to G.
7. A graph of temperature at complete miscibility against phenol composition in the different mixtures was plotted.

RESULTS:

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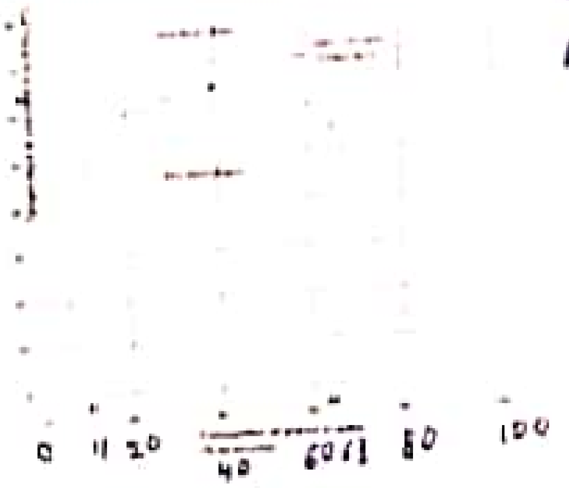
Percent of phenol	vol of phenol (ml)	vol of water (ml)	The temp. Turbid (°C) Liq form clear	Temp at which the beaker turbid
8	2.4	27.6	80	59
11	3.3	26.7	64	60
20	6.0	24	68	65
50	15.0	15.0	67	60
60	18.9	11.1	70	—
80	24	6	—	

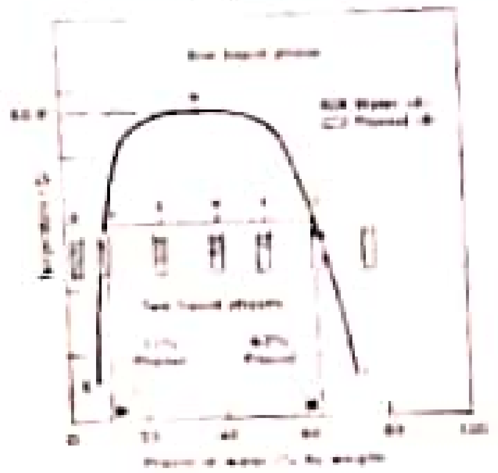
Graph temperature versus percentage of phenol in water



DISCUSSION

Phenol and water system is one of the examples of two-component system containing liquid phase. Phenol is partial miscible with water. An important feature of phase diagrams is that all systems prepared on a tie line, at equilibrium, will separate into phases of constant composition. These phases are termed conjugate phases.

A graph temperature versus percentage of phenol in water is plotted. The curve of the graph shows the limits of the temperature and concentration within which two liquid phases exist in equilibrium. The region outside this curve contains systems having but one liquid phase.



Starting at the point a, equivalent to a system containing 100% water (pure water) at 50°C, the addition of known increments of phenol to a fixed weight of water, the whole being maintained

at 50°C, will result in the formation of a single liquid phase until the point b is reached, at which a minute amount of a second phase appears.

As we prepare mixtures containing increasing quantities of phenol, that is, as we proceed across the diagram from point b to point c, we form systems in which the amount of the phenol-rich phase continually increases. At the same time, the amount of the water-rich phases decreases. Once the total concentration of phenol exceeds 63%, at 50°C, a single phenol-rich liquid phase is formed. The maximum temperature at which the two-phase region exists is termed the critical temperature.

The graph obtain for this system is a phase diagram with two components containing liquid phase condensed system. According to phase rule, F=2-1+2, thus the degree of freedom for this system is 3. This show that 3 intensive variable must be fixed in order to describe the system completely. As the pressure is fixed, F reduces to 2, and it is necessary to fix both temperature and concentration to define the system.

CONCLUSION

Through this experiment, we were able to determine the phase diagram of phenol and water. Besides, we also determine that the critical solution temperature for mixtures between phenol and water is around 67°C.

REFERENCES

1. Physicochemical Principles of Pharmacy 4Th edition, Alexander T Florence and David Attwood, Pharmaceutical Press

2. Physical Chemistry 2nd Ed. Pergamum, E.A. Moelwyn-Hughes New York

3. Martin's Physical Pharmacy and Pharmaceutical Sciences, 5th edition, Patrick J. Sinko, Lippincott Williams and Wilkins

Physical Pharmacy at 04:13

2 comments:

anonymous 26 September 2015 at 08:10

hi, i just want to ask you, how do you plot the graph till it become so smooth as that? do you use excel ?

Reply