

LIQUID-VAPOR EQUILIBRIUM

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- ABSTRACT:

A boiling point phase diagram is constructed for the ethyl acetate-cyclohexane system using a refluxing system to determine the boiling temperature of a series of mixtures. The composition of the liquid and vapor phases are determined by the use of a refractometer.

- TEXT REFERENCE:

"Experiments in Physical Chemistry", Garland et al. Eighth Ed., McGraw-Hill, 2009, pp 207-215.

- OTHER REFERENCES:

- GENERAL DESCRIPTION AND THEORY:

A number of homogeneous liquid mixtures do not obey Raoult's law and as a result the phase diagrams depart from that expected for an ideal solution. Some of these solutions will depart sufficiently from ideal solution behavior that a maximum or minimum is formed in the boiling point diagram. This boiling point phase diagram may be determined by finding the boiling temperature of each mixture and the composition of the both the liquid and vapor phases. A plot of these points will generate the phase diagram.

- EQUIPMENT:

Cottrell refluxing system, refractometer, pipets, syringes, pipet bulbs.

- PROGRAMS:

- CHEMICALS:

Ethyl acetate and cyclohexane.

- DIAGRAMS:

- LABORATORY PROCEDURE:

The laboratory procedure is performed similar to the procedure described in the text, except that we will use cyclohexane and ethyl acetate as the reagents. Start with 50 mL of cyclohexane, determine the composition (residue and distillate) at the boiling point, then add 10 mL ethyl acetate. Repeat this procedure until a total of 50 mL of ethyl acetate have been added. Discard the resulting mixture, and repeat the procedure, this time starting with 50 mL of ethyl acetate and adding aliquots of cyclohexane. It is necessary to ensure that the thermometer bulb is well washed by the boiling liquid. The refractive index is determined as a function of composition by making up about 4 small solutions of accurately known composition (weighed amounts of ethyl acetate and cyclohexane) and finding their refractive indices. The calibration curve drawn from these values will enable you to determine the composition of the vapor and liquid phases in the boiling point apparatus. A Cottrell apparatus is used instead of the apparatus described in the text and this equipment allows one to get a sample of the vapor by means of a small pocket in the condenser. The general procedure is to bring the system to a boil at a constant temperature. When the mixture is boiling and a steady stream of condensate is dripping from the thermometer bulb, the condenser is rotated 180 degrees to allow a small amount of vapor to condense in the pocket. Then a Pasteur pipette is used to remove this condensate and transfer it to a refractometer in order to determine the refractive index. The liquid may be sampled by using a small volumetric pipette. It would be wise to store all samples in labelled vials so that they may be remeasured if necessary.

- CALCULATIONS:

The calculations are performed as described in the text.

- LITERATURE VALUES: