Chemistry Experiment
Partition Coefficient

Aim
To determination of the Partition Coefficient of Ethanoic Acid between Water and 2-Methylpropan-1-ol

Introduction
If a solute is added to two immiscible solvents, A and B. in contact with each other, the solute distributes itself between the two and an equilibrium is set up between the solute molecules in solvent A and the solute molecules in solvent B. The ratio of the concentration of the solute in the two solvents is

$$K = \frac{\text{Concentration of solute in solvent A}}{\text{Concentration of solute in solvent B}}$$

where K is known as the partition coefficient or distribution coefficient.

Chemicals
2-Methylpropan-1-ol (density = 0.805 gdm^{-3}), 0.2 M ethanoic acid, 0.1 M NaOH, phenolphthalein indicator

Apparatus
100 cm^3 separating funnel, titration apparatus, 10.0 cm^3 pipette, 50 cm^3 measuring cylinder, thermometer, Stoppers, Boiling tubes Waste bottle with lid.

Procedure

1. Record the room temperature.

2. Using suitable apparatus, pour 25 cm^3 of the given aqueous ethanoic acid and 25 cm^3 of 2-methylpropan-1-ol into a 100 cm^3 separating funnel. Stopper the funnel and shake vigorously for 1 to 2 minutes. (Release pressure in the funnel by occasionally opening the tap.)

3. Separate approximately 20 cm^3 of each layer and collect them in TWO Boiling tubes with stoppers. (Discard the fraction near the junction of the two layers and collect the wastes in waste bottle.)

4. Pipette 10.0 cm^3 of the aqueous layer into a conical flask and titrate it with 0.1 M sodium hydroxide solution using phenolphthalein.

5. Using another pipette, deliver 10.0 cm^3 of the alcohol layer into a conical flask and titrate it with 0.1 M sodium hydroxide solution.

6. Repeat steps (2) to (5) with another separating funnel using either one of the following volumes:

   (a) 35 cm^3 Or aqueous ethanoic acid and 25 cm^3 of 2-methylpropan-1-ol,
   (b) 45 cm^3 of aqueous ethanoic acid and 25 cm^3 of 2-methylpropan-1-ol.

7. For each experiment, calculate the ratio of the concentration of ethanoic acid in the aqueous layer to that in the 2-methylpropan-1-of layer.

   Comment on your results.

Results

Room temperature: °C

Volume of 2-methylpropan-1-ol: cm^3

Volume of 0.2 M ethanoic acid / cm^3	Volume of 0.1 M NaOH titre for aqueous layer / cm^3	Volume of 0.1 M NaOH titre for alcohol layer / cm^3	Partition coefficient, K

Discussion

1. Why is shaking necessary in step (2)?

2. Would you expect the partition coefficient to vary with temperature? Explain briefly.

3. Explain why the amounts of aqueous ethanoic acid and 2-methylpropan-1-ol placed in the funnel need not be measured out accurately, whereas the volumes of the aqueous and alcohol solution used in the titration must be known as accurately as possible.

4. What assumptions are made in the above experiment? Based on experimental evidence, are these assumptions valid? Explain your answer.

5. Why is it more efficient to extract a solute with two 25 cm^3 portions of solvent rather than with a single 50 cm^3 extraction?

6. Give two applications of the partition law.

END