EXPERIMENT 5:

Distillation

Abstract

The objectives of this experiment were to obtain an unknown solution by simple distillation and to separate acetone-water by fractional distillation. The results that was determined after simple distillation was the name of the unknown which was acetone. By performing fractional distillation acetone and water were successfully separated. The temperature per mL was collected for each distillation performed and a chart and table were made for both. In conclusion, acetone was determined to be the unknown used in the simple distillation and acetone- water was separated successfully by fractional distillation.

Introduction

Distillation is the chief technique used to separate and purify liquids. In this process, a liquid in one vessel is vaporized, and the vapor is subsequently condensed in another vessel. There are four types of distillation: simple, fractional, steam, and vacuum distillation.

Simple Distillation

As the liquid is heated, its vapor rises and comes into contact with the thermometer. The vapor then passes through a water-cooled condenser, where it cools, reliquifies, and drips into a collecting flask. For a pure liquid compound, the boiling point read on the thermometer will remain constant throughout the distillation. During the distillation of an ideal mixture of two liquids, the lower-boiling component will vaporize first at a constant temperature (its boiling point). The higher-boiling component will follow when its boiling point is reached. Mixtures of liquids with boiling points within 30°C or less of each other are not easily separated by simple distillation. In these cases fractional distillation is a much more efficient technique.

Fractional Distillation

A fractioning column is placed between the distilling flask and the connecting adaptor to promote an efficient separation of components that have small differences in boiling point. Inert packing material in the column, such as glass beads, glass wool, steel wool, or cooper wire, continuously subjects the upward-moving mixture to many vaporization-condensation cycles. As the vapor rises in the column, it cools and condenses. The condensate runs down the column until it is reheated and vaporized again. Each time the condensate is vaporized, the vapor becomes richer in the component with the lower boiling point. Each cycle, therefore, represents a simple distillation, and the process continues until only vapor of the lower boiling point component reaches the thermometer and the condenser. The result is that the mixture undergoes many simple distillations in one operation.

Experimental

Simple distillation

For the simple distillation of the unknown solvent, a simple distillation apparatus was set up using a 50mL round-bottom flask. 30mL of a solution was added and a few boiling chips and then heated. The distillate was collected in a round-bottomed flask and the constant temperature at which the main fraction of the distillate was collected was recorded. The solvent was identified by comparing the constant temperature with the BP of the compounds provided.

For the simple distillation of a two-liquid mixture, a simple distillation was performed just like above using 30mL of a 50:50 acetone-water mixture. A 10mL graduated cylinder was used to collect the distillate and the temperature for every 1mL of distillate was collected. Once the 10mL mark was reached, the vacuum adaptor was rotated upwards, the first 10mL of the distillate was discarded, and the distillation process was continued. The heating was discontinued once the temperature reached 100°C. The various temperatures were plotted on the y-axis of a

line graph while the number of milliliters collected was plotted on the x-axis. The points were connected to produce a smooth curve.

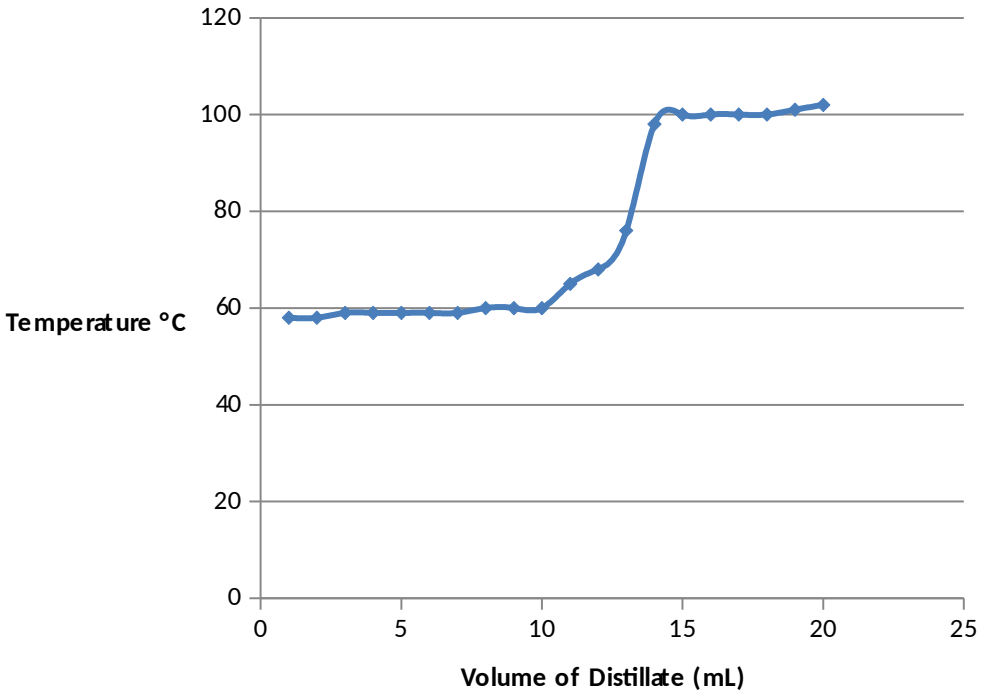
Fractional Distillation

To start off the fractional distillation, a 50mL round bottomed flask was clamped on a ring stand, and a 30mL of a fresh 50:50 acetone-water mixture was placed in the flask through a funnel. The fractional distillation apparatus was assembled. The fractionating column was packed with glass beads. The fractionating column was wrapped with aluminum foil as an insulating material. The mixture was distilled slowly and the temperature for every 1mL collected was recorded. The heating was discontinued once the temperature reached 100°C. The temperature was plotted on the y-axis and the number of milliliters distilled on the x-axis of the graph paper provided. The points were connected to produce a smooth curve. The graphs were then compared between the simple distillation and the fractional distillation of the acetone-water mixture.

Results and Discussion

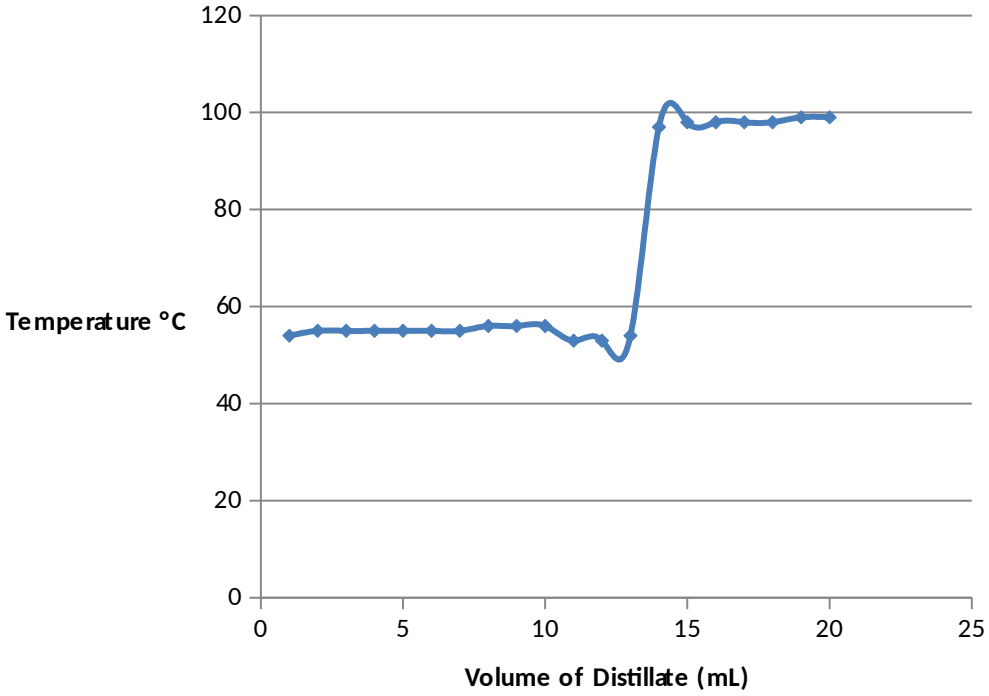
SIMPLE DISTILLATION OF 50:50 ACETONE/ WATER SOLUTION

Volume (mL)	Temp (°C)
1	58
2	58
3	59
4	59
5	59
6	59
7	59
8	60
9	60
10	60
11	65
12	68
13	76
14	98
15	100
16	100
17	100
18	100
19	101
20	102


120
100
80
60
40
20
0
Temperature °C
0
5
10
15
20
25
Volume of Distillate (mL)

FRACTIONAL DISTILLATION OF 50:50 ACETONE/ WATER SOLUTION

Volume (mL)	Temp (°C)
1	54
2	55
3	55
4	55
5	55
6	55
7	55
8	56
9	56
10	56
11	53
12	53
13	54
14	97
15	98
16	98
17	98
18	98
19	99
20	99



Just as explained in the experimental section, the temperature was recorded for every 1mL and 20mL were collected all together. The charts and line graphs were recorded for both the simple distillation and the fractional distillation. The volume was recorded on the x-axis and the temperature was recorded on the y-axis. According to the line graph of the fractional distillation and the BP of the provided compounds, the unknown was determined to be acetone because the BP of acetone is 58°C.

Conclusion

In conclusion, acetone was determined to be the unknown used in the simple distillation according to the BP of acetone and the temperatures recorded on the graph and chart. Acetone-water was separated successfully by fractional distillation according to the temperatures of each mL collected.

References

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