Experiment 2: Purifying Chemicals by Distillation

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CH1321-A07

Lab Performed: January 25th, 2018

Procedure:

See laboratory manual page 25 to 27

Observations:

- The 50:50 mixture of 2- propanol and 1- butanol is clear
- The mixture had a strong chemical odour

Simple Distillation:

- Temperature first increased slowly, then very quickly
- The dripping was very quick at first, then slowed down as the volume approached 23 ml

Fractional Distillation:

- The glass column is packed with metal sponge
- The temperature was slow to rise at first
- The dripping in fractional distillation was much slower in comparison to simple distillation
- Dripping in the opposite direction (into the flask) occurred throughout the distillation
- There was a temperature vs volume plateau at the end (last few ml's)

Data:

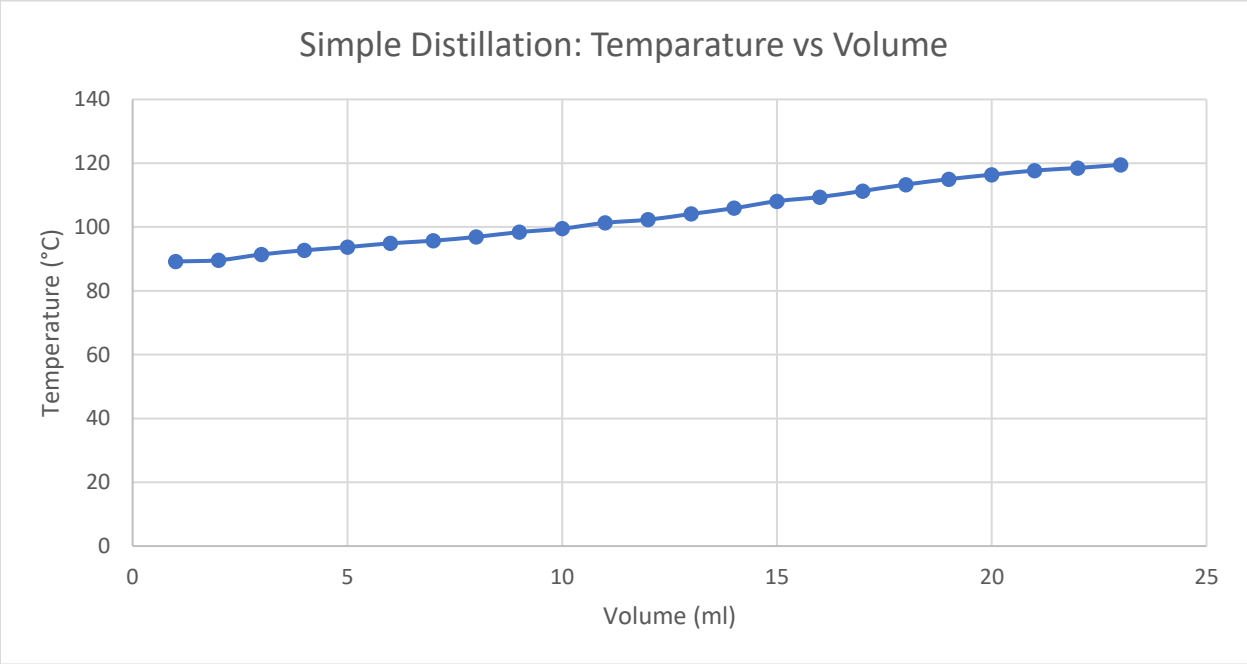
Simple:

Volume (ml)	Temperature (°C)
1	89.2
2	89.6
3	91.4
4	92.7
5	93.7
6	94.9
7	95.7
8	96.9
9	98.4
10	99.5
11	101.3
12	102.3
13	104.1
14	105.9
15	108.1
16	109.4
17	111.3
18	113.3
19	115.0
20	116.4
21	117.7
22	118.5
23	119.5

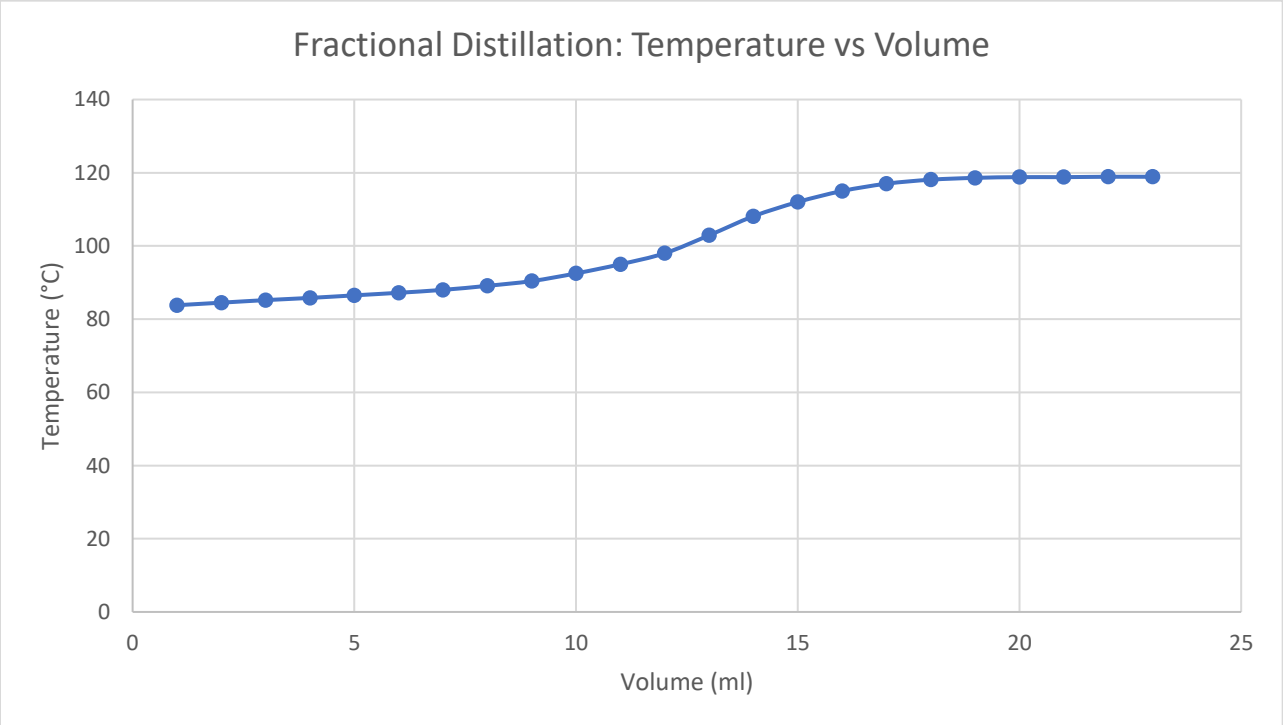
Fractional Distillation:

Volume (ml)	Temperature (°C)
1	83.8
2	84.5
3	85.2
4	85.8
5	86.5
6	87.2
7	88.0
8	89.1
9	90.4
10	92.5
11	95.0
12	98.0
13	102.9
14	108.1
15	112.0
16	115.0
17	117.0
18	118.1
19	118.6
20	118.8
21	118.8
22	118.9
23	118.9

Graph 1: Representation of data collected from simple distillation:



Graph 2: Representation of the data collected from fractional distillation



Discussion:

- During simple distillation, the 50:50 solution was brought to a boil, which produced vapour
- The vapor moved through the distillation head, where the temperature was recorded, and then through the condenser.
- As the vapor passed through the condenser, it cooled down due to the cold water flowing at the bottom
- The condensed vapour dripped down into a graduated cylinder, where the temperature was recorded for every 1 ml
- Both distillations were relatively slow, but fractional distillation was a little faster
- This is due to the metal sponge packed in the insulated glass column, which significantly increases the surface area
- The boiling point of 2-propanol is about 80 °C, meaning it made up most of the vapour up to temperature 118 °C (boiling point of 1-butanol)
- We know that 2-propanol condensed first since it has a much lower boiling point that 1-butanol
- The graph obtained for simple distillation consists of a somewhat linear and increasing curve
- The fractional distillation graph looks slightly S-shaped, as it tends to plateau near the end.
- We expect the curve to increase when the boiling point of a substance is reached
- This increase is not quite as visible in the simple distillation graph as it is in the fractional distillation graph
- This reflects how fractional distillation is more efficient at purifying and separating components of a solution, especially if they have close boiling points
- One source of error in this lab would be the possible loss of vapour during the distillation, which caused the solution collected in the graduated cylinder to be less than the distilled solution.

Questions:

1. We must have liquid flowing back into the fractioning column since it indicates that the temperature is gradually changing. If the temperature increased suddenly and significantly, it would cause flooding, which will prevent the proper separation of the solution
2. Maintaining a constant and uniform temperature is crucial in distillation. If the temperature changes suddenly, all the vapour will condense and drip backwards, preventing itself from entering the condenser and dripping into the graduated cylinder.
3. Atmospheric pressure

4. An increase in atmospheric pressure will result in an increase in boiling point
5. It is important that the water enters through the bottom due to the force of gravity. When it enters through the bottom, some of it shoots up to cover the top portion of the condenser while the rest fills the bottom. If it were to enter from the top, gravity would pull it down and the top portion won't be filled with water as a result.
6. P total = $P_A N_A + P_B N_B$
   = (350 mm Hg) (0.75) + (150mm Hg) (0.25)
   = 300 mm Hg

The vapour pressure is 300 mm Hg

Jan 25th 2018
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Experiment 2

Simple:

Volume : mL	Temp °C
1 mL	89.2
2 mL	89.6
3 mL	91.4
4 mL	92.7
5 mL	93.7
6 mL	94.9
7	95.7
8	96.9
9	98.4
10	99.5
11	101.3
12	102.3
13	104.1
14	105.9
15	108.1
16	109.4
17	111.3
18	113.3
19	115.0
20	116.4
21	117.7
22	118.5
23	119.5

Jahandar

Jan 25th 2018

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Fractional

~~Temp~~

Volume	Temp
1mL	83.8
2mL	84.5
3mL	85.2
4mL	85.8
5mL	86.5
6mL	87.2
7mL	88.0
8mL	89.1
9mL	90.4
10mL	92.5
11mL	95.6
12mL	98.0
13mL	102.9
14mL	108.1
15mL	112.0
16mL	115.6
17mL	117.0
18mL	118.1
19	118.6
20	118.8
21	118.8
22	118.9
23	118.9

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Observations:

Simple

- 50:50 mixture is clear
- Temp first increased slowly, then very quickly
- The dripping was a little slower near the very end.

Fractional:

- Enhance SA = more efficient distillation
- The glass column is packed with metal sponge
- Temp slow to increase at first
- much slower dripping (opposite direction)
- plateau @ end.