

Experiment 2: Purifying Chemicals by Distillation
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Protocol:

As described in the lab manual (Dr. R. Venkaterswaran, "Experiment 2: Purifying Chemicals by Distillation," Organic Chemistry Laboratory Manual, 2017 , Experiment 2 pg. 20-26).

Modifications include:

A 50 ml distillation flask was used in replacement to a 100 ml distillation flask.

Recorded the temperature on the thermometer after each 1 mL portion of distillate is collected.

During both distillation, the end point was near 22 ml of distillate instead of 25 ml.

Observations:

Tables

Table 1.0: Temperature values recorded after the collection of each milliliter of solution.

Simple Distillation	
Volume (mL)	Temperature (°C)
1	88.7
2	90.6
3	91.4
4	91.9
5	93.2
6	94.2
7	95.7
8	97.1
9	97.8
10	98.5
11	100.8
12	103.2
13	105.9
14	111.1
15	112.4
16	115.4
17	117.2
18	117.7
19	118.1
20	118.2

21	117.4
22	105.5

Table 1.1: Temperature values recorded after the collection of each milliliter of solution.

Fractional Distillation	
Volume (mL)	Temperature (°C)
1	80.8
2	81
3	80.9
4	81.6
5	81.7
6	81.8
7	82
8	82.3
9	83.5
10	87.1
11	92.2
12	96.2
13	108.4
14	115.4
15	117.2
16	117.7
17	118.1
18	118.2
19	117.3
20	117.4
21	117.4
22	117.2

Graphs:

Figure 1.0: Temperature of the distilled vapor measured after the collection of each milliliter of solution using fractional distillation.

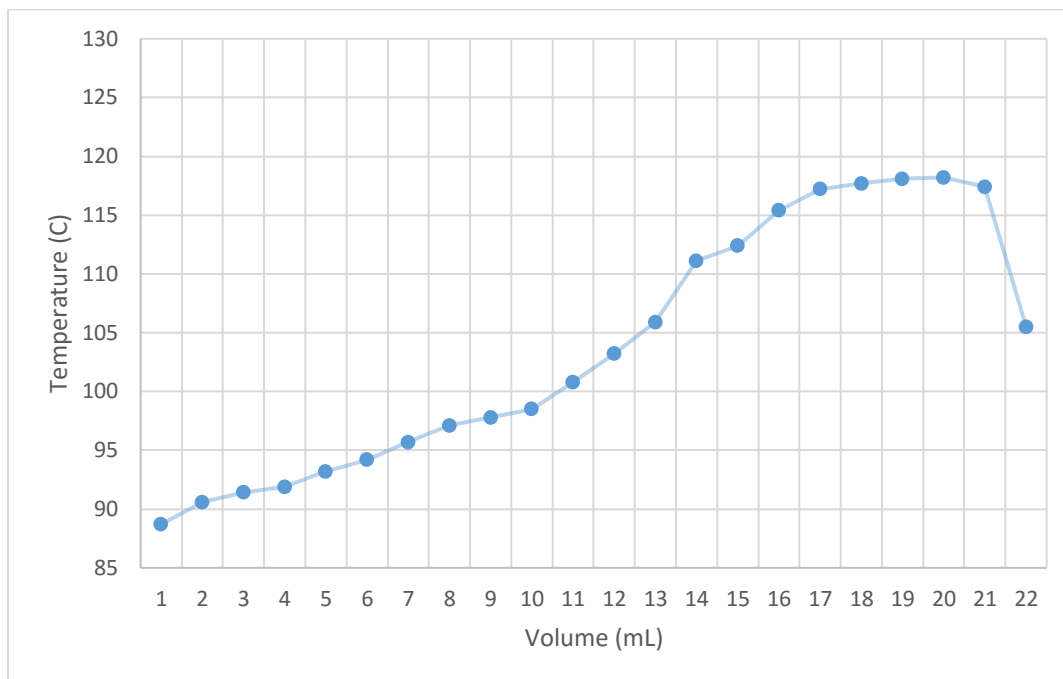
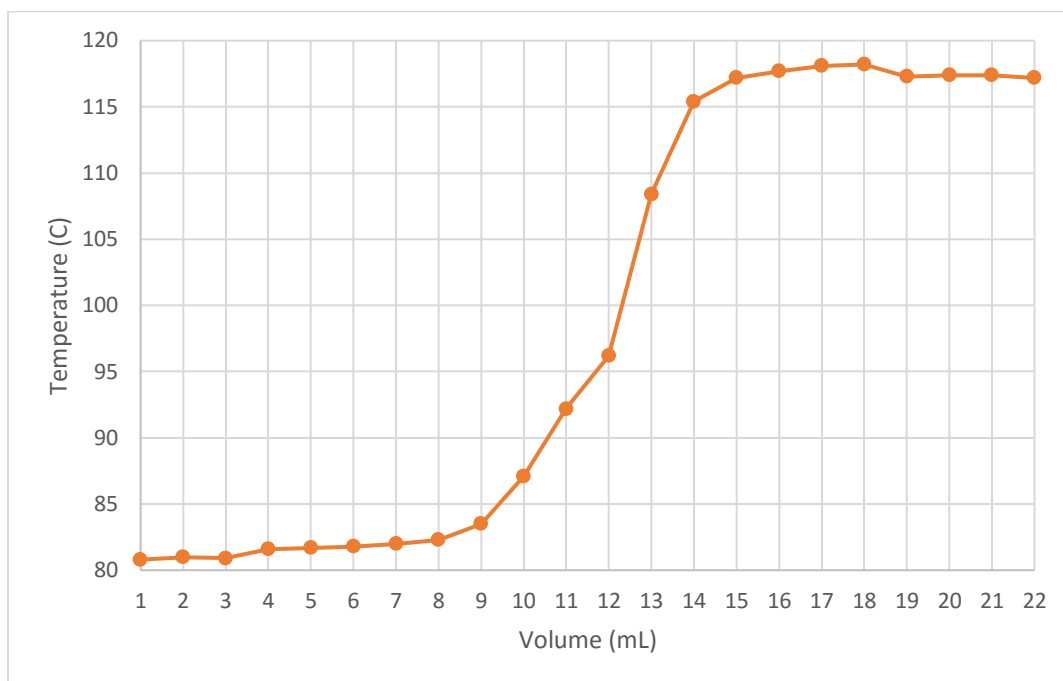


Figure 1.1: Temperature of distilled vapor measured after the collection of each milliliter of solution using fractional distillation.



Discussion:

Essentially, the focus of the lab was to demonstrate understanding of the two methods of distillation, simple and fractional. Figures 1.0 and 1.1 both show the two different forms of distillation. The graph for simple distillation projects a separation of the 50:50 mixture in which 2-propanol, with a boiling point of 82.6 °C, is separated first due to the boiling point of 1-butanol, 117.7°C. Thus, this indicates a higher concentration of 2-propanol in the receiving flask. There is a steady curve on the simple distillation, portraying a gradual increase and a purer result. The simple distillation approximately plateaued at 118.1 °C suggesting the end of the distillation. However, since the boiling points between 1-butanol and 2-propanol are very close in comparison ($T < 100$ apart), simple distillation is not best suited for the distillation of the given mixture. During fractional distillation, the temperature was very slow to rise, although, the aluminum foil helped escalate the temperature and speed up the process. It was very quick to start but maintained a relatively low temperature until the aluminum foil was wrapped around.

Possible sources of error include the lack of aluminum foil from the start of the experiment, resulting in inconsistency. The experiment was too slow, and the temperature would not rise enough to speed up the process. In the end the aluminum foil was very useful in terms of distillation and acted as a smooth insulator for the column. The experiment would have been more efficient if there was an increase in the diameter of the fractional column. This is due to the method “packing” needing to be adjusted to fit the rate of the distillation, however, just increasing the diameter of the column itself would not require any adjustment.

Raw Data

Experiment 2

50:50 2-propanol, 1-butanol

Part 1: Temperature	Part 2
88.2	80.8
90.6	81.0
91.4	80.4
91.9	81.6
93.2	81.7
94.2	81.8
95.7	82.0
97.1	82.3
97.8	83.5 + the first
98.5	87.1
100.8	92.2
103.2	96.2
105.4	108.4
111.1	115.4
112.4	117.2
115.4	117.7
117.2	116.1
117.7	118.2
118.1	117.3
118.2	117.4
117.4	117.4
105.5	117.1

Observation
→ bubbles in the tube present
→ at 86°C & water boiling but no distillation

