Experiment 2 Title:
Purifying Chemicals by Distillation

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Section:
Chem 1321 Z02

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Procedure:

As outlined in the lab manual ("Experiment 2: Purifying Chemicals by Distillation", Dr. Rashmi Venkateswaran, 2020, pg. 1-8).

Observation:

The solution used for this lab was transparent and odorless. As the the millimeters of the distilled solution were being added in the graduated cylinder the temperature continued rising, but the two variables were not increasing systematically to one another.

When observing the simple distillation graph at the beginning it seemed to be having a linear shape however later as time passed a curvature was formed as the temperature was reaching 40 ℃ and the distillation was about to reach the ending ending.

When observing the fractional distillation graph in its middle section is remarkable a drop that then continues rising until the distillation reaches its end point.

During the experiment the relative speeds of reaction were relatively constant throughout each distillation.

Tables:

Table 1: Simple Distillation

mL of distilled solution	Temperature in Celsius
1	28
2	30
3	33
4	35
5	36
6	36

7	36
8	37
9	37
10	37
11	37
12	38
13	38
14	38
15	39
16	39
17	39
18	40
19	40
20	40

Table 2: Fractional Distillation

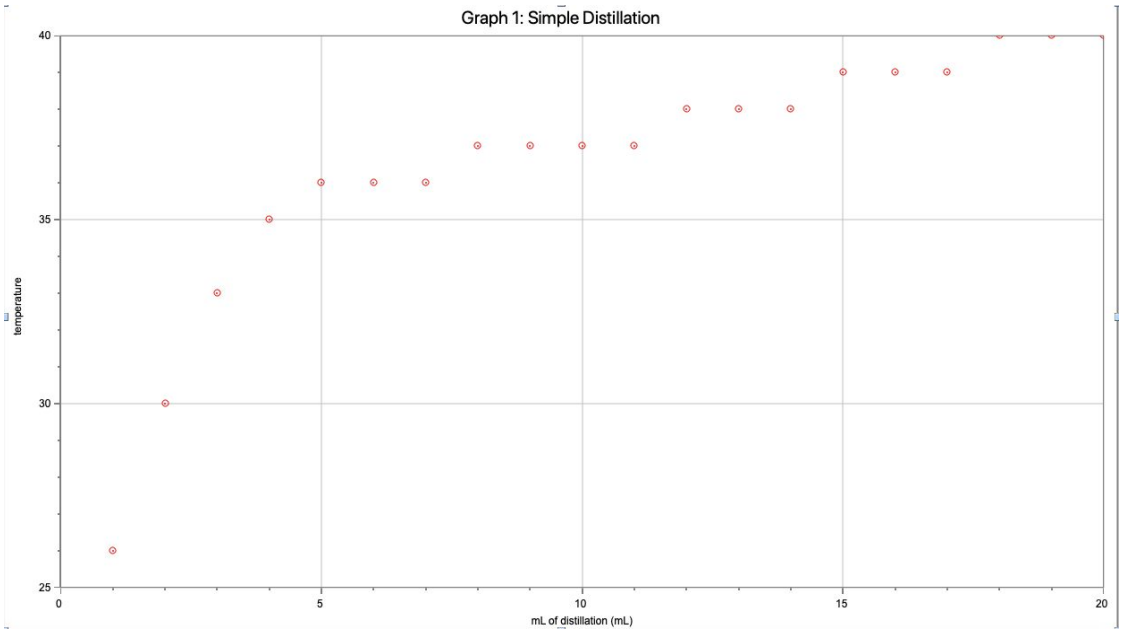
**data used from other group*

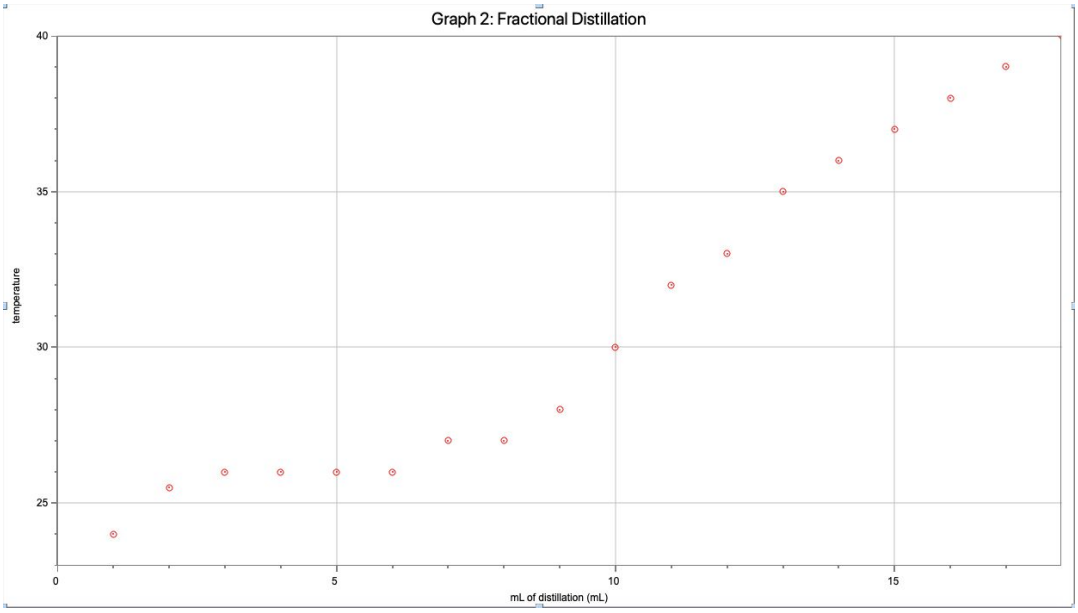
mL of distilled solution	Temperature in Celsius
1	24
2	25.5
3	26
4	26
5	26
6	26

7	27

8	27
9	28
10	30
11	32
12	33
13	35
14	36
15	37
16	38
17	39
18	40

Graphs:





Discussion:

Distillation is a technique used to separate the different components of a solution boiling a given solution until vapour is released, this is then condensed using a tube with cold water flowing through it. During a distillation the solution goes from a liquid state into a gaseous state before turning liquid state again.

A simple distillation and a fractional distillation were performed during this experiment resulting in different outcomes. The fractional distillation is a lot more effective thanks to the fractional column between the boiling flask and condenser, this column allows the solution to vapour and condenses multiple times allowing the different components to be separated better. Distillation is favoured when the difference in boiling point of the solution used is less than 100 °C.

The simple distillation results in having a higher boiling point than the fractional. By the change in boiling points obtained during the experiment it is possible to determine components of the final product obtained in each distillation. In the simple distillation the the component that has a lower boiling point will be more present in the graduated cylinder because it will get

condensed first, as the simple distillation progresses the change in composition of the vapour increases as well. The *graph 1* represent the curve observed during the distillation, which can be described as an increasing curve, this representation is the result in a small difference in boiling points

The fractional distillation usually the component of the solution that gets separated first is the one with low boiling point followed by the one with higher boiling point which explains the sudden increase in temperature. The *graph 2* shows the moment from low boiling component to high boiling point component as an inflection and sudden increase. The greater the difference in boiling point the greater the inflection component of the graph.

To increase the efficiency of the separation of the solution it can be considered increasing the surface area of the column so that the vapour has greater space to condensate, varying the speed of distillation.

The thermometer misplaced and the graduated cylinder not completely straight as well as the distillator not being well sealed from the surrounding environment are some of the sources of error that could have occured in the laboratory.

Conclusion:

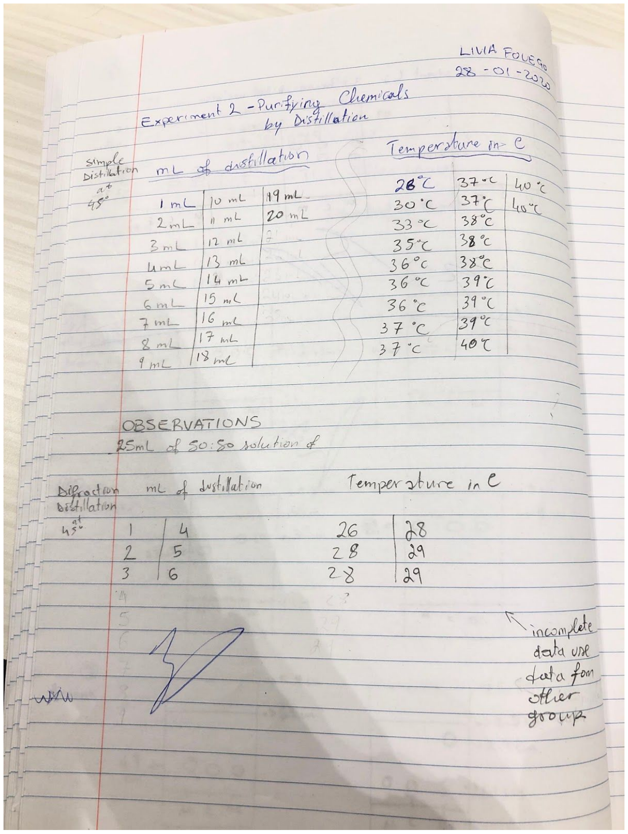
In conclusion, the simple distillation illustrates a solution turning into gas then liquid without modifications, which is later pictured in the smoot curve obtained. The fractional distillation illustrates two different components of a solution being separated and the graph shows the difference in boiling points through its curves. The purpose of the laboratory was to observe the different distillation techniques and analyze how distillation separates compounds of a solution.

References:

- https://uottawa.brightspace.com/d2l/le/content/136888/viewContent/2570720/View

Appendices:

Raw Data



LIVIA FOLEGO
28-01-2020

Experiment 2 - Purifying Chemicals by Distillation

Simple Distillation at 45°

mL of distillation			Temperature in C		
1 mL	10 mL	19 mL	28°C	37°C	40°C
2 mL	11 mL	20 mL	30°C	37°C	40°C
3 mL	12 mL		33°C	38°C	
4 mL	13 mL		35°C	38°C	
5 mL	14 mL		36°C	38°C	
6 mL	15 mL		36°C	39°C	
7 mL	16 mL		36°C	39°C	
8 mL	17 mL		37°C	39°C	
9 mL	18 mL		37°C	40°C	

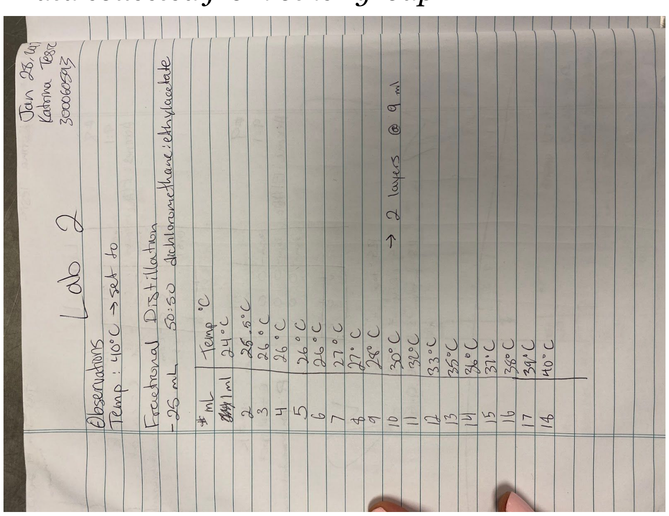
OBSERVATIONS
25mL of 50:50 solution of

Diffraction Distillation at 45°

mL of distillation		Temperature in C	
1	4	26	28
2	5	28	29
3	6	28	29

incomplete data use data from other group

Data collected from other group



Jan 28, 2020
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Lab 2

Observations
Temp: 40°C → set to
Fractional Distillation
~25 mL 50:50 dichloromethane:ethylacetate

# mL	Temp °C
1 ml	24°C
2	25.6°C
3	26°C
4	26°C
5	26°C
6	26°C
7	27°C
8	27°C
9	28°C
10	30°C → 2 layers @ 9 ml
11	32°C
12	33°C
13	35°C
14	36°C
15	37°C
16	38°C
17	39°C
18	40°C

Questions:

1. Yes It is possible to separate a mixture of ethanol and toluene through distillation. Considering the difference in boiling points of each molecule we can say that the distillation will not be very efficient because their difference is less then 100 degree celsius.

2. In a fractionating column its important to maintain a uniform temperature gradient in order to have constant and comparable variables. Changing the temperature will change the rate of speed at which the compound will be diluted, resulting in a different slope in the graph. Maintaining a stable and constant temperature range will also prevent the fractionating column from flooding. It is important therefore to have constants rate for both compounds to be separated effectively.

3. At the given temperature of 39.6 degrees celsius the pressure of dichloromethane is 1 atm, because pure liquids have equal applied pressure and vapour pressure at the boiling point. In most cases the atmospheric and applied pressure coincide.

4. As the atmospheric pressure increases so does the boiling point because in pure liquids the values are equal, therefore increasing one has a direct effect on the value of the other.

5. To ensure a correct cooling of the vapour its important to have the water come from the bottom hole. Assuming the water comes from the top it could not interact with the vapour, missing it and not cooling it down appropriately, disrupting the distillating cycle in course.

6. $P_{TOT}=(PA)+(PB)$

   $=(PA^{o})(NA)+(PB^{o})(NB)$

   $=[350mm\ Hg(4/5)]+[140mm\ Hg(1/5)]$

   $=308mm\ Hg$

The total vapour pressure of the mixture given is 308mm Hg.