PURIFYING CHEMICALS BY DISTILLATION

Experiment 2

By Deborah O. Akpoguma

8536373

CHM1321 Section D7

February 4th, 2016

INTRODUCTION

Distillation is a chemical process that is used in the separation of miscible liquids based on their relative boiling points. It is also used in the purification of chemicals. There are two kinds of distillation, simple and fractional. In simple distillation, the liquid is heated until it vaporizes. The vapour then enters the condenser and is cooled down by water circulating through the outer part of the condenser. The water re-condenses the vapour and the liquid is collected and referred to as the distillate. Simple distillation is effective when the difference in boiling points of the components of the liquid is large or if the liquid is made up of mostly one component. When a mixture has components that do not have a large difference in boiling points, fractional distillation is a more effective way to separate the mixture . The apparatus for fractional distillation is similar to that of simple distillation but a fractionating column is introduced between the distilling flask and the condenser. The fractionating column contains an inert material to give it a maximum surface area for vapour to condense on, this increases separation efficiency.

OBSERVATIONS AND RESULTS

50: 50 Mixture of 2-propanol and 1-Butanol: Clear liquid.

Simple Distillation, TABLE 1

Volume	Temperature
2	46
4	47
6	48
8	48
10	50
12	51
14	52
16	54
18	57
20	59
22	61

Volume	Temperature
24	64
25	65

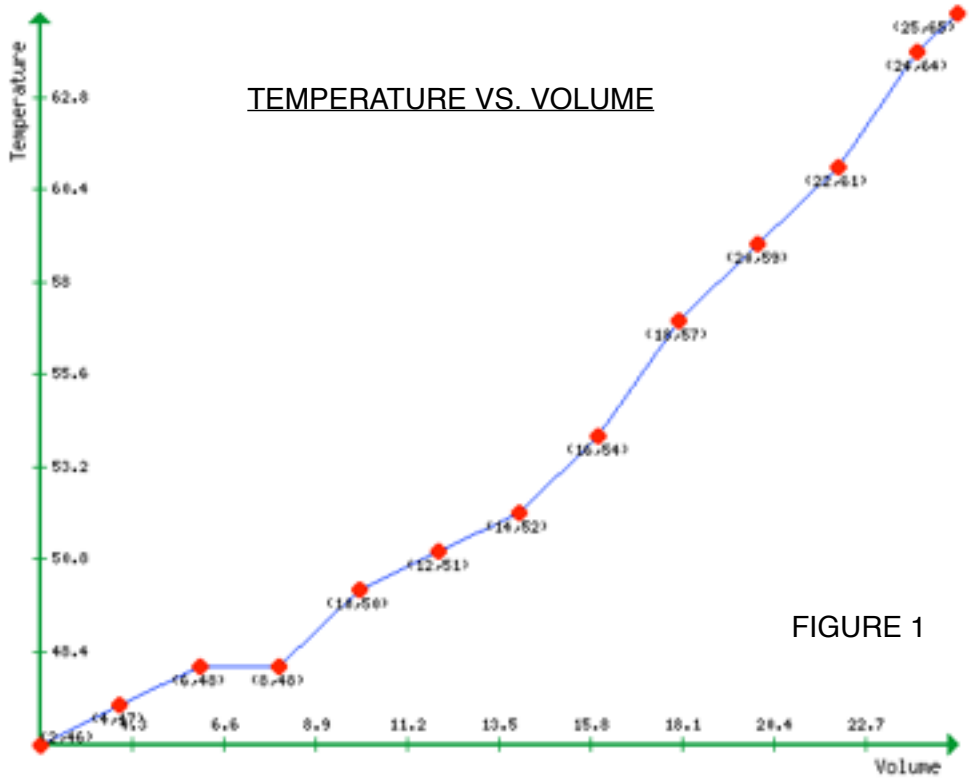


FIGURE 1

Fractional Distillation , TABLE 2

Volume	Temperature
2	40
4	41
6	41
8	41
10	41
12	41
14	41
16	40

Volume	Temperature
18	40
20	37
22	43
24	46
26	54
28	61
30	66
32	71
34	72
36	71
38	68
40	68

TEMPERATURE VS. VOLUME

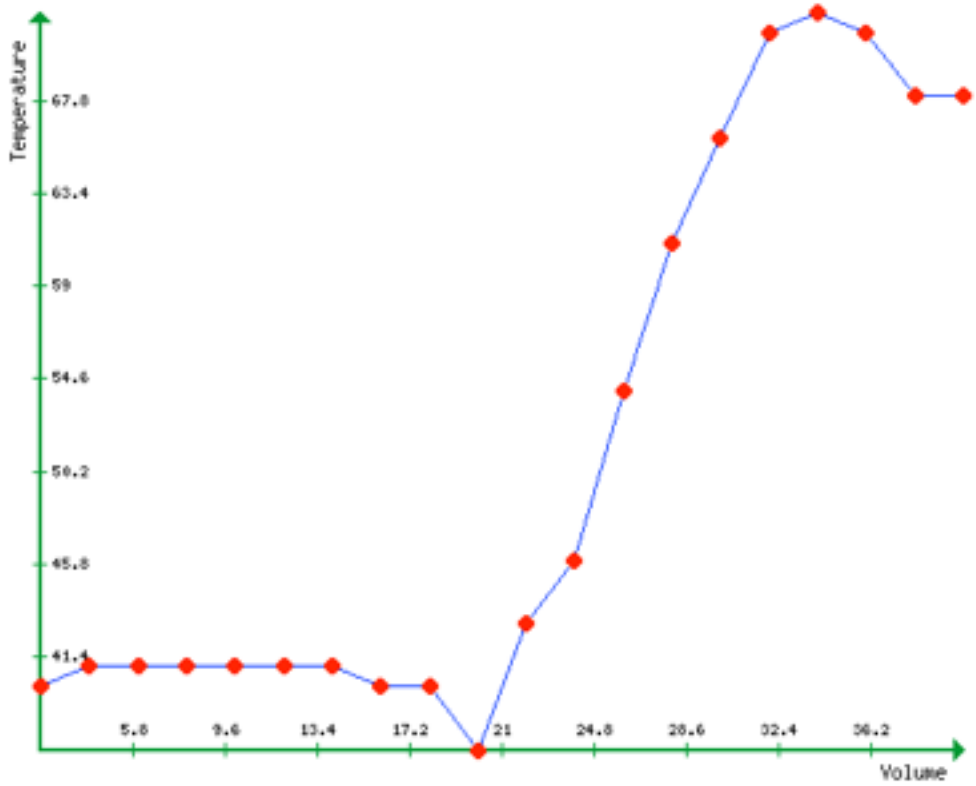


FIGURE 2

DISCUSSION

The simple distillation curve theoretically is supposed to increase steadily and it does. In figure 1, the temperature is constantly increasing and there is never a point that the temperatures are uniform. The curve in figure 1 is increasing because while the liquid was being heated the composition of vapour varied, there was never a point where the vapour was enriched with one component. It fluctuated through out the distillation. In figure 2, however there are two sections of the curve where temperature seems to be fairly stable. This is due to the presence of a fractionating column. As distillation went on, theoretical plates ensured that the vapour was enriched with 2-Propanol as it has the lower boiling point and the liquid in the distilling flask was enriched with 1-Butanol. The temperature remained constant as 2-Propanol was being distilled, it increased and then remained fairly constant as 1-Butanol was being distilled. Theoretically, on the curve, the sections where a component is being distilled should be constant. However, Distillation is a difficult process, it requires a lot of skill which makes it hard to obtain accurate results.

QUESTIONS

-Explain why you must have liquid flowing back through the fractionating column in order to get separation of the components during a fractional distillation.

When the liquid condensates back into the distilling flask, it maintains specific temperature within the flask. By doing this, the distillate is rich in a specific component and not a mixture of components.

- Fractionating columns normally work better if they are insulated in order to maintain a smooth temperature gradient in the column. Why is it important to maintain a uniform temperature gradient in the fractionating column?

A uniform temperature gradient is maintained in the column to increase the efficiency of the separation and also to prevent the column from flooding.

The boiling point of benzene is 81°C. What is the the vapour pressure of benzene at this temperature?

The vapour pressure of benzene at this temperature is 760mmHg.

- What does an increase in atmospheric pressure have on the the boiling point of a liquid ?

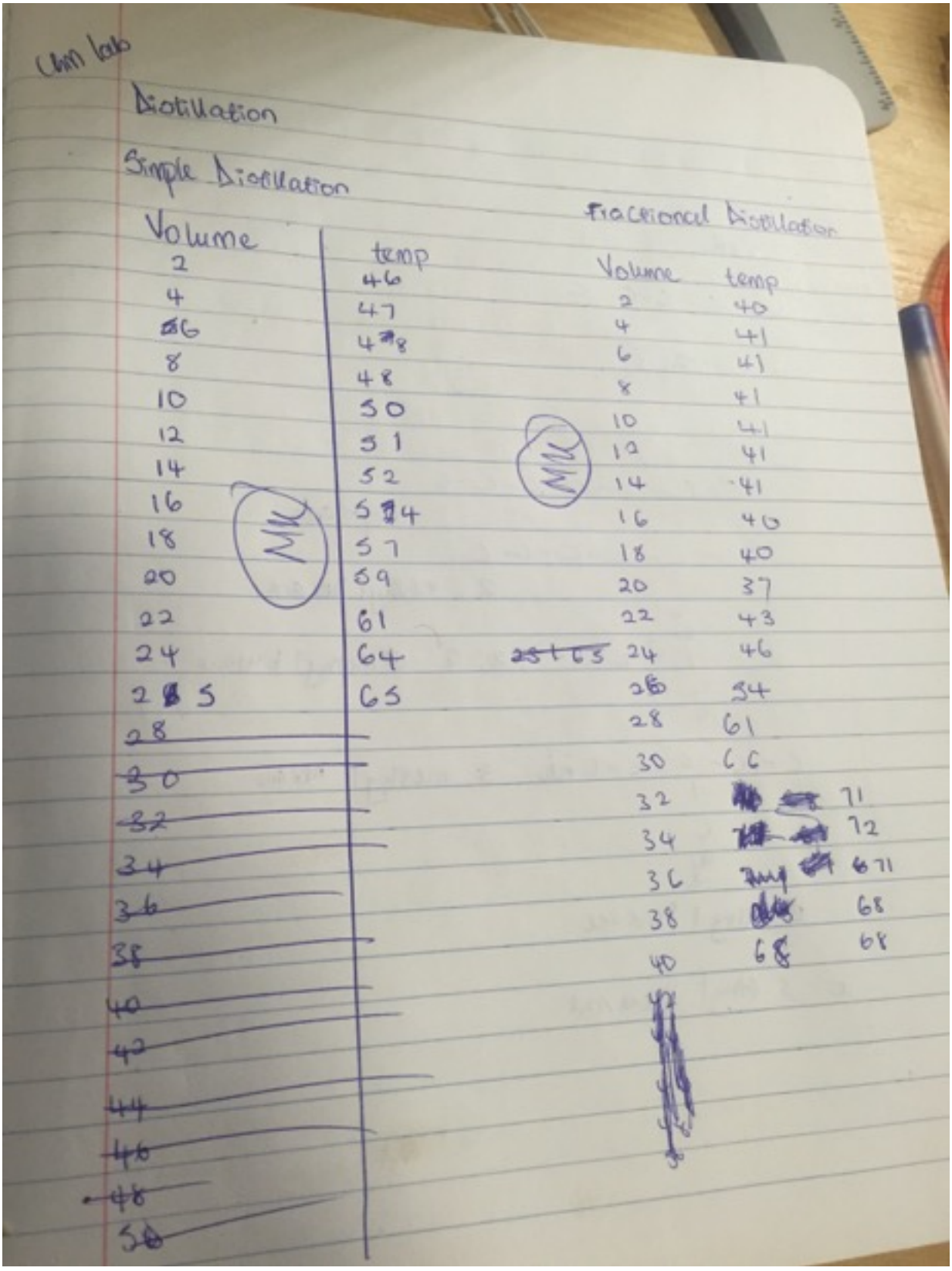
For a liquid to boil the vapour pressure of the liquid has to be equal to the pressure applied to it that is, atmospheric pressure. An increase in atmospheric pressure of a liquid would increase the boiling point of the liquid.

- Why is it important to have cooling water enter the bottom of the condenser and not the top?

When water enters through the top, it doesn't run through the volume of the condenser and this reduces the efficiency of the condenser.

- Compound A has a vapour pressure of 350mmHg at 95°C whereas compound B has a vapour pressure of 150mmHg at the same temperature. If A and B are miscible, what is the vapour pressure of 3:1 mixture of A and B at 95°C?

Using Raoult's law (Pa°).(Na)+ (Pb°).(Nb), the vapour pressure of the mixture at 95°C will be 300mmHg.



Chem lab

Distillation

Simple Distillation

Volume	temp
2	46
4	47
~~6~~	4~~8~~
8	48
10	50
12	51
14	52
16	5~~8~~4
18	57
20	59
22	61
24	64
2~~8~~5	65
~~28~~	
~~30~~	
~~32~~	
~~34~~	
~~36~~	
~~38~~	
~~40~~	
~~42~~	
~~44~~	
~~46~~	
~~48~~	
~~50~~	

Fractional Distillation

Volume	temp
2	40
4	41
6	41
8	41
10	41
12	41
14	41
16	40
18	40
20	37
22	43
~~25 65~~ 24	46
26	54
28	61
30	66
32	~~68~~ ~~68~~ 71
34	~~71~~ ~~71~~ 72
36	~~71~~ ~~71~~ 71
38	~~68~~ 68
40	68 68