Bioc. Chem. 331Lab **Exp. date:**sep 20, 2021

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Experiment No: 1

Experiment title: Acetate Buffers.

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Objective:

The objective of this experiment is to recognize the best buffer by adding different volumes of acids and bases to different tubes and conducting their pH, and comparing them to their theoretical values. After, adding an acid (HCl) then recognizing the best buffer.

Materials:

1. Sodium acetate (0.1 M)

2. Acetic acid (0.1 M)

3. Hydrochloric acid (0.1 M)

4. pH meters

5. pipette

6. distilled water

Experimental Procedure:

1) sodium acetate and the acetic acid solution we're mixed as in the following table.
2) 6 different solutions of sodium acetate and acetic acid were prepared.
3) the pH of each solution was measured with a pH meter
4) 2ml of 0.1 M HCl was added to each mixture

5) The pH of the mixtures was measured again.

Data:

table 1 volumes, experimental pH, theoretical pH, and %error of test tubes.

	Volume acid(ml)	Volume base(ml)	Total volume(ml)	Experimental pH	Theoretical pH	%error
Tube1	16	2	18	3.73	3.85	3.22%
Tube2	12	6	18	4.32	4.45	3.01%
Tube3	8	10	18	4.65	4.86	4.50%
Tube4	4	14	18	5.15	5.31	3.11%
Tube5	0	18	18	-	-	-
Tube6	-	-	18	7.54	7	0.7%

Table 2 the effect of 2ml HCl on the solutions.

	Ph after adding 2ml HCl	Delta pH
Tube1	2.75	0.98
Tube2	3.45	0.89
Tube3	4.02	0.63
Tube4	4.74	0.41
Tube5	5.36	2.07
Tube6	2.97	4.57

Discussion & Comments:

The point of the experiment maintained in this lab report is the recognition of a buffer. In this experiment different ratios of acids and bases were added to 4 different tubes. Also, one tube with strictly a base (sodium acetate) and another with distilled water. So, in total 6 test tubes.

Buffers are used to maintain a solution's pH. Hence resisting the loss of H+ ions. Buffers usually consist of salt and acid. The stronger the acid, the higher the dissociation. However, buffers do have a limit, and that is the buffer capacity.

The buffer capacity refers to how much acid or base may be added to a given volume of buffer solution before the pH changes considerably, generally by one unit. The quantity of weak acid and its conjugate base in a buffer mixture determines buffer capacity. (1)

diving into the experiment above, the first thing to be mentioned is the acids and bases used. We used 0.1M sodium acetate and 0.1M acetic acid for the different ratios of the different tubes of the experiment.

The tubes, as shown in Table 1, all have a low percentage of error, except tube 5, of which the error was not calculated. These errors could be due to impurities. tube 5 was not calculated because there was no acid added.

table 2 shows the pH of the solutions after adding 2ml HCl. tube 4 is proven to be the best buffer, and here’s why. Acetic acid is considered a weak acid, therefore it will not be completely ionized upon its addition to a solution. However, sodium acid is a strong base and will be completely ionized, making for a better buffer. looking at tube 4 in comparison to the other tubes, it has the highest ratio of base to acid. (7:2). Now, this might hold up confusion upon how isn't tube 5 is the strongest buffer since it's purely a strong base. The answer to that is obviously because buffers consist of both acids and bases.

Now, for tube 6, water. water is a horrible buffer because it is self-ionizing. Self-ionization produces extremely little quantities of acid and base in water, therefore the reverse occurs. Any significant quantity of acid or base will throw the equilibrium off. Because there isn't enough acid and base in any given volume of water to make a difference when more acid or base is introduced, water is a poor buffer. (2)

conclusion:

In conclusion, a good buffer depends on either a strong acid or base that could fully dissociate upon ionization. There's no way a buffer could be strictly an acid or a base, it has to be a mixture of both. Water is not a suitable buffer because its pH is drastically changed upon the addition of either an acid or a base. therefore, defeating the whole purpose of a buffer; the stability of pH.

appendix:

• Average experimental pH = (sum of values / the amount of trials)

*(3.5 + 3.95 + 3.78 + 3.7) / 4 = 3.73

• theoretical pH:

pH = pKa + log ([A-] / [HA])

4.76+log 0.125 =4.76+(-0.90) =3.85

• Error % = ((Exp – Theo) / Exp) × 100%

Exp – Theo/ (Exp × 100%) 3.85-3.73/3.73 x100% =3.22%

• delta pH after adding HCl:

exp pH before - exp pH after = delta pH

Questions:

From your results, explain why some solutions are better buffers than others?

Some solutions were better buffers because they contained more of the strong base sodium acetate. if noticed, in table 2, the delta decreases as the amount of base in the sample increases.

Can you explain what the purpose of tube number 6 is?

tube 6 shows that distilled water is a horrible buffer. This proves that buffers only work with the presence of enough acid or base. water is neutral however, it's neither acidic nor basic.

references:

(1) *14.6 Buffers - Chemistry 2e | OpenStax*. (2021, July 26). Openstax.Org.

https://openstax.org/books/chemistry-2e/pages/14-6-buffers

(2) *Buffering*. (2021, September 27). Amrclearninghouse.Org.

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