

16.4 Buffering Capacity of Alka-Seltzer™

Subjects: Acids/Bases, buffers

Description: The buffering capacity of Alka-Seltzer is examined.

Materials:

- 1 l distilled water
- 4 250 mL beakers
- 2 150 mL beakers (for holding HCl and NaOH)
- Alka-Seltzer™ packet
- Disposable pipets
- Universal indicator‡
- 0.1 M Hydrochloric acid (HCl)‡
- 0.1 M Sodium Hydroxide (NaOH)‡

‡HCl and NaOH are located in the cabinets under the hood.

Universal indicator is located in the flammables cabinet.

Pre-class Preparation:

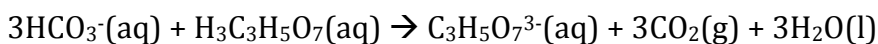
1. Label the four 250 mL beakers A-D.
2. Add 200 mL DI water to all four beakers.
3. Add the same amount of Universal indicator to each beaker so that they are roughly the same color.
2. Label the two 150 mL beakers with HCl and NaOH
3. Pour samples of HCl and NaOH into the two 150 mL beakers.

Procedure:

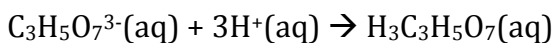
1. Add one Alka-Seltzer tablet to beaker B and the other Alka-Seltzer tablet to beaker D. Note the colors of the solutions.
2. Add acid drop wise using the disposable pipets to beaker A. Note the number of drops it takes to lower the pH.
3. Repeat with beaker B. Note it takes more acid to change the pH.
4. Repeat steps 2 and 4 with beakers C and D, adding NaOH until the pH increases.

Discussion:

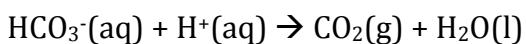
An Alka-Seltzer tablet contains 1.9 grams (0.022 mol) of sodium bicarbonate and 1.0 gram (0.005 mol) of citric acid. When the tablet is placed in water, the citric acid reacts with the sodium bicarbonate, producing sodium citrate in solution and releasing carbon dioxide gas.



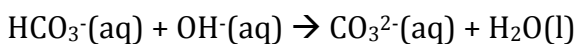
Sodium citrate behaves like an antacid, because citrate is the anion of a weak acid. It neutralizes excess acid by forming citric acid:



The excess sodium bicarbonate also acts as an antacid, liberating CO_2 :



Excess bicarbonate also neutralizes hydroxide ions, helping the solution to resist a change in pH.



Alka-Seltzer now also contains aspirin, which is a weak acid. How does this affect the buffering capacity?

Disposal: The solutions can be flushed down the drain with water.

References:

1. B.Z. Shakhashiri; *Chemical Demonstrations: A Handbook for Teachers of Chemistry*; Wisconsin; Volume 3; 1989; p. 186-187
2. N. Friedman; *J. Chem Education*; 52:605 (1975)