Buffer Solutions

Created: Friday, 30 September 2011 09:27 | Published: Friday, 30 September 2011 09:27 | Written by Super User | Print

Introduction

Image not readable or empty
images/stories/buffer%20solutions_01.jpg

buffer solutions_01 Preservation of the solutions of particular pH is generally difficult as when they are kept open absorb atmospheric carbon dioxide and alters the pH. If they are kept in closed glass bottles, they react with the alkaline impurities present in the bottle and again alter the pH of the solution.

Image not readable or empty
images/stories/buffer%20solutions_02.gif

buffer solutions_02 Buffer Solutions

A buffer solution is defined as the solution that resists changes in its pH value even when small amount of the acid or the base are added to it.

Types of Buffer Solution

There are two types of buffer solutions. These are:

(i) **Solution containing single substances**: The solution of the salt of a weak acid and weak base, e.g., ammonium acetate (CH_3 $COONH_4$) acts as a buffer.

(ii) **Solution containing mixtures:** These are mixtures of acid or base with salts.

Acidic buffer: It is the solution of a mixture of weak acid and a salt of this weak acid and a strong base.
Example: $CH_3COOH + CH_3COONa$.

Basic buffer: It is a solution of a mixture of a weak base with the salt of this weak base with a strong acid.

Buffer Action

The property by virtue of which a buffer solution resists any change in its pH value even on adding a small amount of the acid or base to it is called buffer action.

Buffer Action of Ammonium Acetate

Ammonium acetate like all other salts is almost completely dissociated in the aqueous solutions as follows:

CH_3COONH_4? $CH_3COO^- + NH_4^+$

Thus in solutions, there is excess of CH_3COO^- ions and NH_4^+ ions. On adding

few drops of HCl to this solution the H_3O+ ions produced combine with CH_3COO^- and gives CH_3COOH

$CH_3COO- + H_3O^+ ? CH_3COOH + H_2O$

Since concentration of H_3O^+ ions does not change practically, the pH of the solution remain almost constant.

Similarly when a few drops of base like NaOH are added to the above solution, the OH^- ions given by the base combine with NH_4^+ ions.

$NH_4^+ + OH^- ? NH_4OH$

Thus OH^- ion concentration and hence H_3O^+ ion concentration remains almost constant.

Buffer Action of Acidic Buffer

In the acidic buffer containing CH_3COOH and CH_3COONa, acetic acid dissociates to a small extent whereas sodium acetate is almost completely dissociated in the aqueous solution as follows:

$CH_3COOH + H_2O ? CH_3COO- + H_3O+$ ....(I)

$CH_3COONa ? CH_3COO- + Na^+$

By common ion effect the ionisation of CH_3COOH is further suppressed.

Thus in the solution, there are excess of acetate (CH_3COO^-) and small amount of H_3O^+ ions.

When a few drops of acid are added H_3O^+ ions given by acid combine with CH_3COO^- ions to form weakly ionised molecules of CH_3COOH.

$CH_3COO^- + H_3O^+ ? CH_3COOH + H_2O$

Similarly on addition of few drops of base

OH^- ions combine with H_3O^+ ions already present to form weakly ionised molecules of H_2O.

$H_3O^+ + OH^- ? H_2O$

As the H_3O^+ ions are used up, the equilibrium (I) shifts to right as a result more CH_3COOH dissociate. So the H_3O^+ ion concentration as well as pH of the solution does not change.

Henderson- Hasselbalch Equation

pH of an acidic or a basic buffer **is calculated from Henderson - Hasselbalch equation**.

For acidic buffers, pH = pK_a + log [salt]/[acid]

For basic Buffers, pOH = pK_a + log [salt]/[base]

Dilution of a buffer solution does not affect its pH, but pH of a buffer changes with temperature.

Buffer Capacity

buffer solutions_06
Image not readable or empty
images/stories/buffer%20solutions_06.gif

Uses of Buffer solution

(i) Buffer solutions are used in colorimetry to determine pH of unknown solutions.

(iv) Buffer solutions are used for fermentation of alcohols, tanning of leather, electroplating, manufacture of sugar, paper manufacturing etc.

(vi) Human blood consists of a buffer system of carbonic acid + sodium bicarbonate. It maintains the constant pH (7.4) of blood in human body.

How does human blood maintain its buffer?

Try to answer. Still need help? Want to know more about it? Click here to schedule live help from a certified tutor!

About eAge Tutoring:

Reference Links

- http://en.wikipedia.org/wiki/Buffer_solution
- http://www.chem.purdue.edu/gchelp/howtosolveit/equilibrium/buffers.htm
- http://www.sparknotes.com/chemistry/acidsbases/buffers/section1.html
- http://www.chemguide.co.uk/physical/acidbaseeqia/buffers.html