EWCE 332: Environmental Engineering Sessional

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Experiment 01: Determination of pH in Water

What is pH?

- The term pH refers to the measure of hydrogen ion concentration in a solution and is defined as the negative log of H+ ion concentration in water and wastewater.

  $pH = -\log\{H+\}$

- Water dissociates to form a hydrogen ion (H+) and a hydroxyl ion (OH-) according to the following equation:

  $\{H2O\} = \{H+\} + \{OH-\}$

- At equilibrium,

$$K_W = \frac{[H^+][OH^-]}{\{H_2O\}}$$

- Since the concentration of water is extremely large (approximately 55.5 mol/L) and is diminished very little by the slight degree of ionization, may be considered as a constant and its activity is taken as 1.0. So,
- Kw = {H+} + {OH-}

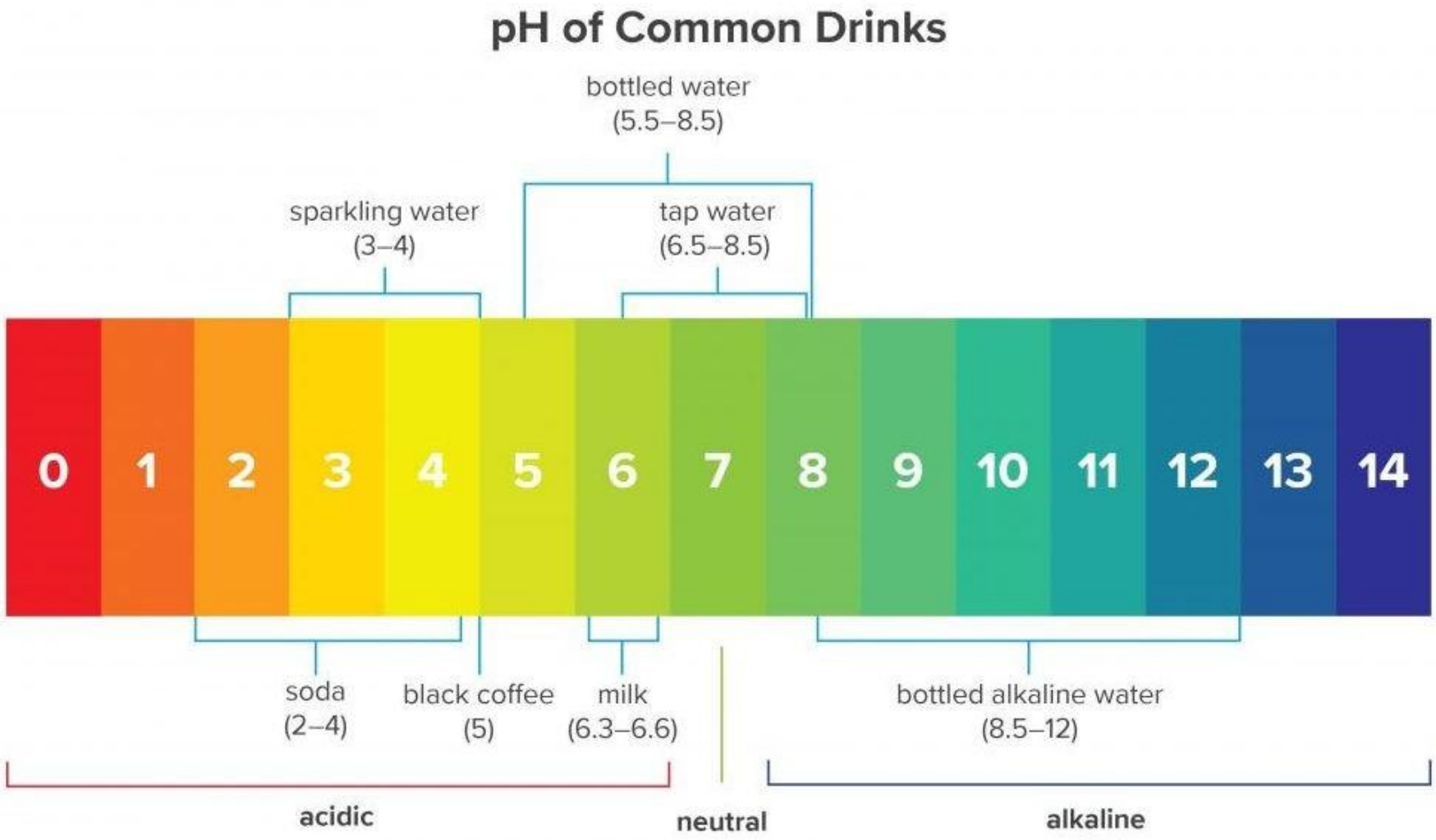
Where, Kw = Equilibrium Constant

- Concentration of water is extremely large (approximately 55.5 mol/L) may be considered as a constant

$$K_W = \{H^+\}\{OH^-\}$$

- pure water at 25 °C, $K_W = 10^{-7} \times 10^{-7} = 10^{-14}$
- water at 25°C dissociates to yield 10^{-7}mol/L of hydrogen ion (H^+) and 10^{-7}mol/L of hydroxyl ion (OH^-).
- pH of deionized water is equal to 7

- pH < 7: acidic
- pH > 7: basic
- pH = 7: neutral


pH of Common Drinks
bottled water
(5.5–8.5)
sparkling water
(3–4)
tap water
(6.5–8.5)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
soda
(2–4)
black coffee
(5)
milk
(6.3–6.6)
bottled alkaline water
(8.5–12)
acidic
neutral
alkaline

Environmental Significance of pH

- pH is crucial in biological wastewater treatment.
- Anaerobic treatment fails below pH 5.
- Aerobic treatment is affected if pH is out of the 5–10 range.
- Affects chemical reactions like coagulation, disinfection, etc.
- pH influences taste, corrosion, and chlorine effectiveness.

Guideline and Principle

- According to Bangladesh Environment Conservation Rules (2023), the drinking water standard for pH ranges from 6.5 to 8.5
- pH measured using a glass electrode system
- Potential difference across the electrode membrane gives pH

Apparatus and Reagents

- Apparatus:
  - pH meter
  - Beaker

- Reagent:
  - Buffer solutions of known pH

Sample Handling and Precautions

- Analyze samples as soon as possible.
- Note the temperature during analysis.
- Clean and calibrate the electrode properly.

Procedure

1. Calibrate pH meter with buffer solutions.
2. Stir sample in beaker using magnetic stirrer.
3. Insert electrode and record stable pH reading.
4. Clean electrode with distilled water after use.

Data Table:

Experiment No:
Experiment Name:
Id:
Group No:
Date:

Data Table:

Sample No	Source of Sample	Temperature of Sample (^{0}C)	p^H

Result:

Assignment Questions:

1. Explain why pH is important in water and wastewater treatment.
2. Define pH in terms of [H+] and [OH-].
3. How much does [H+] decrease if pH increases by 1 unit?
4. At 25^0C, the hydroxyl ion concentration $[OH^-]$ of a solution is $10^{-5.7}$. Determine the p^H of the solution.

Experiment 02: Determination of Color of Water

Introduction

- Pure water should not have color.
- Color arises from metallic ions, organics, and industrial waste.
- 'True color': from dissolved/colloidal substances.
- 'Apparent color': from dissolved/colloidal substances, also includes suspended matter.
- Color value depends on pH — record pH with color.

Environmental Significance of Color

- The presence of color in water is not always harmful to human.
- Aesthetically, people do not prefer to use water with color.
- Disinfection by chlorination of water containing natural organics (which produces color) results in the formation of tri-halomethanes (chloroform and chlorinated organics), leading to problems.

Guideline:

- According to the Bangladesh Environment Preservation Act (1997), the drinking water standard for color is 15 Pt-Co units.

Method:

- The color of water will be measured by the spectrophotometric method.

Apparatus and Reagents

- Apparatus:
  - Color Disk
  - Filtration setup (paper, funnel, beaker, holder)
  - Spectrophotometer

- Reagent:
  - Standard Potassium Chloro-platinate Solution

Data Table:

Experiment No:
Experiment Name:
Id:
Group No:
Date:

Data Table:

Sample No	Source of Sample	Temperature of Sample (^{0}C)	Color

Result:

Assignment Questions:

1. Discuss the environmental significance of color.
2. Discuss briefly the causes of color in water. Define true color and apparent color. Why is true color more important than apparent color?
3. Write down the methods that are commonly used for removing color from water and wastewater.

Structure of the Report:

- Experiment No
- Name of the Experiment
- Objective
- Reagent & Apparatus Used
- Brief test procedure
- Calculation (if any)
- Test Result: (Include Date, Location, Temp)
- Discussion