Experiment No.1
Measurement of PH, EC and TDS

PH
The pH of a solution is a measure of hydrogen (H+) ion concentration, which is, in turn, a measure of acidity. The intensity of Acidic and basic character of a solution is indicated by pH or hydrogen ion, at a given temperature.

\[ \text{H}_2\text{O} \leftrightarrow \text{H}^+ + \text{OH}^- \]

The equilibrium constant for this reaction, Kw is the product of H+ and OH concentrations and is equal to 10^-14. This relationship may be expressed as

\[ [\text{H}^+][\text{OH}^-] = K_w = 10^{-14} \]

Where [H+] and [OH-] are the concentrations of hydrogen and hydroxyl ions respectively.

\[ \text{pH} + \text{pOH} = \text{pK}_w \]

\[ (-\log_{10} a_{\text{H}^+}) + (-\log_{10} a_{\text{OH}^-}) = 14 \]

In a neutral solution the H+ concentration is 10^-7, so the pH is 7.

As the H+ concentration increases the pH decreases. For example, if the H+ concentration is the pH is 4, and the solution is acidic. In this solution, we see that the OH concentration is 10^{14}/10^4, or 10^{10}. Since 10^4 is much greater than 10^{10} the solution contains a large excess of H+ ions, confirming that it is indeed acidic.

Any solution where the H+ concentration is less than 10^-7 or the pH is greater than 7, would be basic. The pH range in dilute samples is from 0 (very acidic) to 14 (very alkaline), and in water samples is rarely below 4 or above 10.

The measurement of pH is now almost universally done using electronic pH meters.

The pH of an effluent or water sample is important in almost all phases of drinking water and wastewater treatment.

Procedure:

1. Calibrate the electrodes with two standard buffer solutions of pH.
2. Immerse the electrodes into the sample of water (whose pH is to be determined) and wait up to one minute for steady reading.
3. The reading is observed after the indicated value becomes constant.

Observations:

<table>
<thead>
<tr>
<th>Type of solution</th>
<th>PH Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>potable water</td>
<td></td>
</tr>
<tr>
<td>Tap water</td>
<td></td>
</tr>
<tr>
<td>Distilled water</td>
<td></td>
</tr>
</tbody>
</table>
**Electrical Conductivity:**

**Conductivity (K):**

Is a measure of ability of an aqueous solution carry an electric currents. This ability depends on the presence of ions and on the temperature of measurement.

**Conductance (G):** is defined as the reciprocal of resistance.

\[ G = \frac{1}{R} \]

The conductance of a solution, \( G \), is directly proportional to the electrode surface area, \( A \), cm\(^2\), and inversely proportional to the distance between the electrodes, \( L \), cm.

The constant of proportionality, \( k \), such that:

\[ G = k \left( \frac{A}{L} \right) \]

The units of \( k \) are 1/ohm-cm or mho per centimeter.

Conductivity is customarily reported in micromhos per centimeter (\( \mu \)mho/cm).

In the International System of Units (SI) the reciprocal of the ohm is the siemens (S) and conductivity is reported as millisiemens per meter (mS/m); 1 mS/m = 10 \( \mu \)mhos/cm and 1 \( \mu \)S/cm = 1 \( \mu \)mho/cm

**Procedure:**

1. Calibrate the EC meter by standard solutions of electrical conductivity.
2. Immerse the electrodes into the sample of water (whose conductivity is to be determined) and wait up to one minute for steady reading.
3. The reading is observed after the indicated value becomes constant.

**Observations:**

<table>
<thead>
<tr>
<th>Type of solution</th>
<th>EC (( \mu )S/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>potable water</td>
<td></td>
</tr>
<tr>
<td>Tap water</td>
<td></td>
</tr>
<tr>
<td>Distilled water</td>
<td></td>
</tr>
</tbody>
</table>
**Total dissolved solids (TDS)**

Solids refer to matter suspended or dissolved in water or wastewater. Solids may affect water or effluent quality adversely in a number of ways. Waters with high dissolved solids generally are of inferior palatability and may induce an unfavorable physiological reaction in the transient consumer. For these reasons, a limit of 500 mg dissolved solids/L is desirable for drinking waters.

**Total solids**: is the material residue left in the vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature.

**Total solids** = total suspended solids + total dissolved solids

**Total suspended solids**: the portion of total solids retained by a filter of 2µm.

**Total dissolved solids**: the portion that passes through the filter of 2µm or smaller.

**Factors affecting separation of suspended from dissolved solids**:  
1. The pore size.  
2. Porosity  
3. Thickness of the filter  
4. Particle size.  
5. Amount of material deposited on the filter.

**Total solids** = Fixed solids + Volatile solids

**Fixed solids**: is the residue of total, suspended, or dissolved solids after heating to dryness for a specified time at a specified temperature.

**Volatile solids**: is the weight loss on ignition. It includes losses due to decomposition or volatilization of some mineral salts.

**The theoretical relations between TDS and EC**

\[
\text{TDS (mg/L)} = 0.6 \times \text{EC (µS/cm)}
\]