Water Quality: Definition, Characteristics, and Perspectives
Total Dissolved solids

The material remaining in the water after filtration for the suspended solid analysis is considered to be dissolved solids.

• **Source**
  - Results from the solvent action of water on solids, liquids, and gases.
  - Inorganic dissolved solids; minerals, metals, gases.
  - Organic; decay products of vegetation, organic chemicals and gases.
**Impacts**

- Produce tastes, colors, and odor,
- Some chemicals are toxic or carcinogenic,
- Some dissolved solids may combine to form a compound of more dangerous than the original materials,
- Not all dissolved solids are undesirable.

**Measurement**

- See sec. 2-2 Suspended Solids
- By measuring the electrical conductivity of the water, Conductivity measures the ability of water to conduct an electrical current.
• Conductivity is a good way to determine the ionic strength of water because the ability of water to conduct a current is proportional to the number of ions in the water.
• Freshwater generally has low conductivity measured in microSiemens (μS).
• Marine systems have much higher conductivity measured in milliSiemens (mS) which can easily be converted to salinity.
• Humans and other terrestrial animals require fresh water for survival as do plants and animals normally found in freshwater.

**Use**

• **TDS** parameter is important in the analysis of water and wastewater to know more about the composition of the solids in water.
Ion Balance

The dissolved solids content of natural water is classified to:

- **Major constituents** ... (1-1000mg/L)
  
  - sodium (Na\(^+\)), calcium (Ca\(^{2+}\)), magnesium (Mg\(^{2+}\)), bicarbonate (HCO\(_3^-\)), sulfate (SO\(_4^{2-}\)), chloride (Cl\(^-\))
  
  - Called **common ions**, 
  
  - Measured individually and summed on an equivalent basis to represent the approximate **TDS**, 
  
  - The sum of anions must equal the sum of cations (as a check)

- **Secondary constituents** .... ....(0.01-10mg/L).
  
  Iron, potassium, carbonate, nitrate, fluoride, boron, silica
Testing for ion balance

- The results of common ions for a sample of water are shown below,
- If 10% error in the balance is acceptable, should the analysis be considered complete?

- Sodium (Na⁺) = 98mg/L,
- Calcium (Ca²⁺) = 55mg/L,
- Magnesium (Mg²⁺) = 18mg/L,
- Bicarbonate (HCO₃⁻) = 250mg/L,
- Sulfate (SO₄²⁻) = 60mg/L,
- Chloride (Cl⁻) = 89mg/L
<table>
<thead>
<tr>
<th>Ion</th>
<th>Concentration (mg/L)</th>
<th>Equiv, (mg/mequiv)</th>
<th>Equiv conc, (mequiv/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Na&lt;sup&gt;+&lt;/sup&gt;)</td>
<td>98</td>
<td>23/1</td>
<td>4.26</td>
</tr>
<tr>
<td>(Ca&lt;sup&gt;2+&lt;/sup&gt;)</td>
<td>55</td>
<td>40/2</td>
<td>2.75</td>
</tr>
<tr>
<td>(Mg&lt;sup&gt;2+&lt;/sup&gt;)</td>
<td>18</td>
<td>24.3/2</td>
<td>1.48</td>
</tr>
<tr>
<td>(HCO&lt;sub&gt;3&lt;/sub&gt;⁻)</td>
<td>250</td>
<td>61/1</td>
<td>4.1</td>
</tr>
<tr>
<td>(SO&lt;sub&gt;4&lt;/sub&gt;²⁻)</td>
<td>60</td>
<td>96/2</td>
<td>1.25</td>
</tr>
<tr>
<td>(Cl⁻)</td>
<td>89</td>
<td>35.5/1</td>
<td>2.51</td>
</tr>
</tbody>
</table>

**Total: 8.49**
Calculate the percent of error

\[
\text{percent of error} = \frac{(8.49 - 7.86) \times 100}{7.86} = 8\% < 10\% \quad \text{.... Accept analysis}
\]

Bar diagram