

WATER TREATMENT

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WATER QUALITY PARAMETERS (Measurement Units)

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Introduction

- The water quality parameters can be divided into three categories:-
 - Physical parameter
 - Chemical parameter
 - Biological parameter

Physical Parameters

- Solids
- Turbidity
- Color
- Absorption/Transmittance
- Taste and Odor
- Temperature
- Conductivity

Chemical Parameters

- pH
- Alkalinity
- Hardness
- Organic constituents
- Inorganic constituents
 - Non-metallic
 - Metallic
- Disinfection by-products

Biological Parameters

- Pathogenic organisms
 - Bacteria
 - Viruses
 - Protozoa
 - Cyanobacteria
- Indicator organisms
 - Coliform bacteria
 - Enterococcus
 - Coliphage
 - Other fecal indicator organisms
 - Heterotrophic bacteria

Introduction

- Water quality (WQ) parameters are used as a gauge to develop good potable drinking water, where the quality of a tested water is illustrated **QUALITATIVELY** and **QUANTITATIVELY**.

Measurement Units (Concentrations)

- Concentrations are normally used to quantitatively measure physical or chemical parameters
- Two types of measurement units are employed:
 - Liquids:
Mass/Volume (e.g. mg/L, $\mu\text{g/L}$, mol/L or Molarity (M))
 - Solids:
Mass/Mass units (e.g. g/g, mg/kg, $\mu\text{g/kg}$)

Measurement Units

(Unit conversion)

- Conversion mg/L → parts per million (ppm)

$$1 \frac{\text{mg}}{\text{L}} = \frac{1 \text{ mg}}{1000 \text{ g solution}} = \frac{1 \text{ mg}}{10^6 \text{ mg solution}} = 1 \text{ ppm}$$

- What is the unit for:
 - Parts per billion (ppb)?
 - Parts per trillion (ppt)?

Measurement Units (Equivalents per liter)

- Equivalents per liter (eq/L) or milliequivalents per liter (meq/L)
 - Used for measurement which involves the combination of several different elements
 - Three cases use eq/L:
 - a. salt ions: one equivalent is one mole of electric charge (without regard to sign)
 - b. oxidation-reduction reactions: one equivalent is one mole of electrons (e^-)
 - c. Acids & bases: one equivalent is one mole of H^+

Measurement Units (Equivalents per liter)

- Converting mg/L to meq/L
 - Based on equation

$$\frac{\text{meq}}{\text{L}} = \text{concentration} \left(\frac{\text{mg}}{\text{L}} \right) \times \frac{1}{\text{Equivalent weight}}$$

where

$$\text{Equivalent weight} = \frac{\text{Atomic or Molecular Weight}}{|\text{Valence}|}$$

Measurement Units (Equivalents per liter)

- To convert mg/L \rightarrow meq/L, 3 steps conversion involved:-



Measurement Units (Equivalents per liter)

Example:

Convert 1.8 g/L of phosphate ion (PO_4^{3-}) into meq/L.
(MW PO_4^{3-} = 94.973 g)

$$1.8 \frac{\text{g}}{\text{L}} \times \frac{1 \text{ mol of } \text{PO}_4^{3-}}{94.973 \text{ g}} = 0.019 \frac{\text{mol}}{\text{L}}$$



$$0.019 \frac{\text{mol}}{\text{L}} \times \frac{3 \text{ equivalents}}{1 \text{ mol of } \text{PO}_4^{3-}} = 0.0569 \frac{\text{eq}}{\text{L}}$$



$$0.0569 \frac{\text{eq}}{\text{L}} \times \frac{1000 \text{ meq}}{1 \text{ eq}} = 56.9 \text{ meq/L}$$

Measurement Units (Equivalents per liter)

Practice (Let's do it the reverse way!)

Convert 4 meq/mL of calcium chloride dihydrate into g/L
($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$: MW = 147)

Ans: 294 g/L

Measurement Units (Interconversion)

- Species concentrations represented by a single element
- Only applicable for species that can be interconverted chemically or biologically
- Example: Nitrogen, phosphorus, sulfur

Measurement Units (Interconversion)

Example:

A water sample contains 1.4 mg NO_2^- -N/L.

a. What is the concentration of nitrite ion in the water sample?

Ans: 4.6 mg NO_2^- /L

a. If all nitrite ion is converted to nitrate, calculate the concentration of nitrate ion in the water sample

Ans: 6.2 mg NO_3^- /L

References

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