

# Water Quality 101

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## Common Water Quality Sampling Parameters and Analytical Procedures

- Water temperature
- Salinity
- Conductivity
- pH
- Light attenuation
- Secchi depth
- Dissolved oxygen
- BOD<sub>5</sub> and BOD<sub>20</sub>
- Turbidity
- Total suspended solids
- Fecal Coliform bacteria/Enterococcus
- Chlorophyll *a*
- Nutrients
  - ◇ Total Nitrogen
  - ◇ Nitrate/Nitrite
  - ◇ Ammonia
  - ◇ Total Phosphorous
  - ◇ Orthophosphate
  - ◇ TKN - Total Kjeldahl Nitrogen = ammonia + organic nitrogen
  - ◇ Silicate
- Heavy metals – water column
  - ◇ aluminum
  - ◇ arsenic
  - ◇ cadmium
  - ◇ chromium
  - ◇ copper
  - ◇ iron
  - ◇ lead
  - ◇ mercury
  - ◇ nickel
  - ◇ zinc

## **Dissolved Oxygen**

- All animals require oxygen
- Aquatic animals use gills to obtain Oxygen gas (O<sub>2</sub>) that is dissolved in water
- measure as parts per million (ppm) or mg/liter
- Warm water holds less oxygen than cold water. During summer, oxygen levels often become low and fish may have difficulty breathing, a condition called hypoxia (1-5 ppm DO). Some animals, like catfish are tolerant of low oxygen levels
- Low dissolved oxygen problems are exacerbated when organic materials enter a water body. As bacteria consume this material they also use oxygen and may deplete oxygen, a condition called anoxia (0 ppm DO)

## **Biochemical Oxygen Demand (BOD)**

- A measure of the demand (usually by bacteria or chemical reactions) for dissolved oxygen in water
- Put water from the river in a bottle, measure the oxygen, seal the bottle, let it sit for either 5 or 20 days, measure the oxygen to determine how much was used
- Measure as BOD<sub>5</sub> or BOD<sub>20</sub> in mg/liter

## **Turbidity**

- A measure of the particles suspended in water
- sediment, plankton, detritus
- Instrument (Nephelometer) shines a light into the water and measures the amount of light which is reflected at a 90 degree angle
- Measure as NTU, nephelometric units

## **Total Suspended Solids**

- A measure of suspended particles in water, similar to turbidity
- Filter volume of water and weigh
- Measure as mg/liter

## **Fecal Coliform Bacteria/Enterococcus**

- Bacteria that exist in the digestive tract of mammals and birds
- Indicates presence of human or animal sewage which may contain pathogens
- Used to close shellfishing and prohibit human contact
- Measure as colony forming units (cfu)/volume of water

## **Salinity**

- A measure of chloride ions in the water.
- Chloride ions may be from sodium chloride, potassium chloride, magnesium chloride
- Units include ppt (parts per thousand) or PSU (practical salinity units). PPT is the chemical ratio and is measured with a refractometer. PSU is calculated from a

measured Conductivity value. Most new electrical meters use this method.

- Salinity Regimes –

freshwater	0-0.5	lakes, rivers and streams
Oligohaline	0.5-5	estuaries
Mesohaline	5-18	estuaries
Polyhaline	18-30	estuaries
Euhaline	30+	ocean

### **Conductivity**

- A measure of the electrical conductivity of water. More sensitive than salinity ranging from 0 in purified water, 50-200 in surface freshwaters and around 55,000 in the ocean.
- Measured in siemens (S)
- Influenced by all dissolved constituents in water

### **pH**

- A measure of the Hydrogen ions
- No units
- Scale is 1-14, acidic to basic

### **Light Attenuation**

- Measures the attenuation of light through the water column
- Influenced by dissolved and suspended compounds
- Important to plants and algae
- Reported as a “k” value (use a formula to derive)

### **Secchi Depth**

- Use a Secchi disk (round, flat, painted half black, half white)
- Lower till cannot see, this is Secchi depth
- Used in a calculation to get “k” value as in light attenuation

### **Chlorophyll *a***

- Chlorophyll *a*, a plant pigment used in photosynthesis, gives plants green color
- Can measure to get idea of the amount of plant or algae material is in water
- Measured in parts per billion

**Nutrients** – Term “nutrients” applied here because of the use of these compounds as important growth factors by algae and aquatic vegetation.

### **Total Nitrogen**

- Measure of the total amount of nitrogen atoms in the water sample
- Typically reported as ppm or mg/l

- Nitrate + Ammonium + Organic Nitrogen = TN

### **Nitrate/Nitrite**

- $\text{NO}_3/\text{NO}_2$  (predominantly Nitrate, usually referred to as Nitrate)
- An important plant nutrient
- Levels above 10 mg/l in drinking water can cause health problems in infants
- Sources include human and animal waste and fertilizers

### **Ammonia**

- Measure of  $\text{NH}_3$  ions in solution
- Derived from the breakdown of organic nitrogen compounds
- Can be very toxic at high levels (>

### **Organic Nitrogen**

- proteins, peptides, amino acids, nucleic acids, urea

### **TKN (Total Kjeldahl Nitrogen)**

- ammonia + organic nitrogen = TKN

### **Total Phosphorus**

- Compounds containing Phosphorus atoms
- Two principle components are organic phosphorus and Orthophosphate ( $\text{PO}_4$ )

### **Organic Phosphorus**

- Any Phosphorus atoms bound up in biologically derived compounds

### **Orthophosphate**

- Prevalent in commercial crop fertilizers and sewage
- Chemical formula is  $\text{PO}_4$

*\* The cycling of nitrogen and phosphorus in aquatic ecosystems is very complicated. Further study should be pursued in order to understand the complexities of how these compounds change due to various biological, physical and chemical factors in the aquatic environment.*

**Heavy Metals- This term is used for a number of**

# ALGAE

*What are algae?*

- Distinguished from other chlorophyllous plants because of their reproductive mechanisms
- Non-vascular
- Aquatic and subaerial (i.e. exposed to the atmosphere)
- May be suspended (phytoplankton) or attached (benthic)
- Microscopic to 10 feet tall (kelp)

*Major algal groups-*

Blue-green algae  
Green algae  
Stoneworts  
Euglenoids  
Brown algae

Diatoms  
Dinoflagellates  
Cryptomonads  
Red algae

*Toxic algae-*

Dinoflagellates and Blue-green algae  
Produce and exude toxins and cellular tissue is toxic

*Pfiesteria*

A toxic dinoflagellate with many forms, implicated in many fish fish kills.