Physicochemical Analysis of Water

Temperature

(1) Introduction

Turbid water absorbs more sunlight and hence the temperature of water increases. The water temperature usually affects phytoplankton photosynthetic enzyme activity and primary productivity.

(2) Apparatus

Alcohol or mercury thermometer with 110 ºC as maximum graduation.

(3) Procedure

 Record the surface temperature by holding the thermometer upright in the surface.
 Rerecord the water temperature immersing the bulb of the thermometer in it. See that the bulb is completely immersed in water.
 Observe the mercury or alcohol column and note down the reading in Celsius when the reading becomes constant.

(4) Precautions

 Do not expose the bulb of the thermometer to direct source of heat or sunlight while taking the reading.
 It is important to take temperature reading at the same time of the day and season, if the readings have to be composed over a period.
 Take minimum and maximum temperature and mention it in your record if temperature is measured over a period of time i.e. Day, Month, etc.

Light penetration/ Turbidity

The Secchi disk is a popular limnological instrument for determining the clarity of water. The standard Secchi disk is a 20-cm-diameter disk with alternate black and white quadrants. It is attached to a calibrated line and fitted with a weight so it will sink rapidly. Secchi disk visibility usually is reported in centimetres, and in natural waters, the value may vary from a few centimetres to several meters.

The passage of light through a column of water is described by the equation:

$$\textbf{Light at depth } z = \textbf{Incident light} \times e^{-kz}$$

Where e = base of the natural logarithm (2.303),

k = the extinction coefficient, and z = depth in meters.

It has been shown that the extinction coefficient is related closely to Secchi disk visibility in meters:

$$k = \frac{1.7}{\text{Secchi disk visibility}}$$

Limnologists are interested in light penetration because light is needed for photosynthesis. The greater the Secchi disk visibility, the deeper plant growth can occur in a water body. Generally, there is enough light for plant growth down to about twice the Secchi disk visibility. Thus, twice the Secchi disk visibility is a rough estimate of the depth of the photic zone in lakes, ponds, and other water bodies.

Guidelines for use

- The disk should be slowly lowered until it just disappears from view and raised until it just reappears. The average of the two measurements should be used as the Secchi disk visibility.

- The measurement should be made on clear or partly cloudy days when the sun is not obscured by clouds.
- The reading should be taken with the sun behind the observer.
- The observer's face should be within 25-50 cm of the water surface while making the reading.
- The observer should not wear sunglasses while making the measurement.

Application

Secchi disk visibility can be used in aquaculture to determine whether light conditions are suitable for the growth of underwater weeds on pond bottoms. It is excellent for this purpose because Secchi disk visibility is correlated strongly with turbidity.

Water turbidity

Plankton often are the major source of turbidity in pond water, but particles of mineral soils and suspended non-living organic matter also create turbidity. Thus, a small Secchi disk visibility means a water mass is turbid but does not necessarily indicate there is a heavy plankton bloom.

Plankton usually give water a green, yellow, blue-green, or brown colour. Suspended mineral particles impart a colour similar to that of surface soil in the area – usually brown, yellow, or red. Thus, plankton and non-living particles sometimes give water similar colours. However, when viewed in a clear glass held in bright light, particles of non-living matter are smaller than those of plankton and more regular in shape.

Most water is turbid because of a mixture of mineral particles, organic matter, and plankton. The relationship between Secchi disk visibility and measures of plankton abundance, such as chlorophyll a concentration, is not as strong as its relationship to turbidity.

Water from a particular source used to fill an aquaculture pond has a certain level of turbidity. In some ponds, the water may be very clear, while in others it may be noticeably turbid. The addition of nutrients in aquaculture usually stimulates plankton abundance and causes turbidity to increase with a corresponding decrease in Secchi disk visibility below the background level.

Secchi Disk Reading (cm)	Comments
Less than 20 cm	Pond too turbid. If pond is turbid with phytoplankton, there are likely to be problems with low dissolved oxygen concentrations in the early morning. When turbidity is from suspended soil particles, productivity will be low.
20-30 cm	Turbidity becoming excessive.
30-45 cm	If turbidity is from phytoplankton, pond is in good condition.
45-60 cm	Phytoplankton becoming scarce.
More than 60 cm	Water is too clear. Inadequate productivity

Table 1. Interpretation of Secchi disk visibility.

Comment: If observation of the water suggests the declining turbidity is caused by a diminishing plankton bloom, fertilizer may be applied to encourage more phytoplankton. Following a successful fertilizer application, Secchi disk visibility would be expected to decline in response to greater plankton abundance.

Determination of pH

The pH gives a scale of available hydrogen ion concentration in water. If free H+ ions are more than OH^- ions, the water will be acidic, or otherwise alkaline. The most chemically pure water at 22°C is partly dissociated into H^+ and OH^- ions. This quantity is exactly 10^{-14} g molecules of dissociated H^+ and OH^- ions. Therefore, the H^+ ions are 10^{-7}. This value is expressed in terms of negative logarithm of the total H^+ ion concentration. Hence, pH = 7 indicates neutral water, below this scale is acidic and above alkaline.

Measurement Procedure

pH of water can be accurately measured using pH meter of different makes. Most of the pH meters come with following accessories/chemicals:

1. Digital pH meter with electrode.
2. Two sets of buffer solutions, mostly of pH 4.0 and 9.2.

Operation procedures:

1. Switch on the pH meter and allow some time for stabilization.
2. Wash the electrode with distilled water and connect to electrode holder of the pH meter.
3. Dip the electrode in buffer solution of pH 4.0 and move the temperature knob to specified buffer temperature. Adjust the set buffer knob until it reads 4.0.
4. Turn to selector switch 0.
5. Wash the electrode with distilled water and dip in buffer pH solution 9.2.
6. Adjust the set buffer knob until it reads 9.2.
7. Turn selector switch to 0.
8. Wash the electrode with distilled water.
9. Read the pH of the sample by dipping the electrode into the sample. Fix the temperature knob to the temperature of the sample.
10. Wait for some time and note the reading. Take three readings and note the average value.

Caution

Prolonged dipping of electrode into the sample may cause variation in reading. Now a day, portable pH meters are available which are handy and does not require any buffer setting before use.