Fish and Fisheries Lab, ZOOA-DSE(B)-6-2-P

Assessment of pH:

What is pH of Water?

- pH of water is a measure of amount of hydrogen ions that is present in the water.
- It determines if the water is alkaline or acidic in nature. pH stands for potential of hydrogen.
- As per the World Health Organization (WHO), value of pH for the water is 6.5 to 8.5. pH can be calculated mathematically as:

pH = -log [H]=1/log[H]

This scale was developed by the scientist Sorenson in the year 1909. The below reaction implies that the water shows that the number of H+ and OH- ions are equal in amount experimentally. It has also been proved that the product of both the concentration is equal to a constant 'K'. The value of this constant found to be between 10 and 14.

$H_2O \rightarrow H^+ + OH^-$

For acids, the pH value is between 1 to 7. Alkaline will have pH value from 7 to 14.

Determination of pH of Water:

There are two methods involved in the determination of pH value of water. They are:

A.Colorimetric Method

B.Electrometric Method

In environmental engineering experiments, every stage of water treatment is dependent on the pH value of the water. For example, the coagulation, disinfection, control of corrosion, acid-base neutralization and water precipitation.

A. Colorimetric Method for pH of Water:

Take the pH standard solution and the water that is to be tested. Take the colorimetric paper. Dip this paper on the water sample. The obtained color is computed from the standard table and the respective pH value is recorded. This pH Value will conclude whether the sample of water is acidic or alkaline.

Fig.1. Standard pH Chart

B.Electrometric Method for pH of water:

One of the most widely accepted method for the hydrogen ion determination (pH) is the electrometric method. This method is highly accurate and used in laboratory work and by researchers. The accuracy of the pH value is 0.1 to 0.0001.

Fig.1. Determination of pH of water by pH meter

Apparatus for pH Determination:

The apparatus required for the determination of water pH are:

- pH meter that is suitable for field as well as laboratory analysis. These can have either one or two electrodes.
- Distilled Water

- Standard Buffer solutions with pH of 4, 7 and 10. The solutions of known standards can be used.
- Thermometer that can read 77±18oC to the nearest value of 0.1 degree Celsius
- Glass stirring rod
- Minimum capacity scale to read up to 1.1 lb

Procedure for pH Determination:

The procedure of determination of pH of water involves the following steps:

A. The water sample is properly mixed and stirred using a glass rod.
B. By using a watch glass, sample of water equal to 40ml (5ml more or less) is added to the beaker.
C. The temperature of the water is allowed to stabilize by placing the sample stand for 1 hour.
D. In between this time stirring can be done. After 1 hour, the temperature of the water is measured and this temperature is adjusted in the pH meter.
E. Hence the pH meter shows temperature similar to that of the sample.
F. All these adjustment to the apparatus must be performed and fixed before the test is conducted.

G. There are some pH meters with automatic temperature controls.

H. In such cases, the instructions provided by the manufacturer have to be followed.

I. The standard solutions are used to standardize the pH meter.

J. Here also the temperature is adjusted as mentioned above procedure.

K. Next, into the water sample, the electrodes are inserted.

L. The beaker is turned and adjusted so that there is good contact between the electrodes and the water.

M. Before starting the reading, the electrodes have to be placed in the solution for more than 30 seconds.

N. This time period is required for the proper stabilizing of the meter to have proper reading.

O. In pH meter that have an automatic reading system, a signal will be provided to tell that the meter is stabilized.

P. Once the reading is shown, it must be read to the nearest tenth of the whole number.

Remark:

If the value shows to 100th place then it has to be rounded off. The tenth-place digit is left if the 100th place is less than 5. For values greater than 5 after decimal, it is rounded to 1 unit. If the 100th place is equal to 5, the nearest even number is taken as rounded value.

Maintenance of apparatus:

The apparatus must be maintained after each use. The electrodes used are washed thoroughly with distilled water. If there is any form of film around the electrodes, it has to be cleared. Wiping of the electrodes must be avoided as this will result in polarization which will result in slow response of the experiment.

Precautions and Tips:

- The pH meter can be standardized by measuring the 7-pH buffer solution or any other solution of standard pH. Sometimes, the manufacturer of the pH meter may suggest other methods of standardizing, which too have to be followed.
- The electrodes have to be inserted into the water so that it does not touch the bottom of the beaker. Bottom contact with damage may cause damage to the electrodes.

- ❖ Any cause of slow response due to the polarization can be solved by washing the electrodes thoroughly.
- ❖ Periodic check has to be conducted to check the electrodes
- ❖ During the electrode storage, they have to be kept moist. And also follow the instructions of the manufacturer.

Importance of Water Quality in Aquaculture:

- ➢ Fish perform all their bodily functions in water. Because fish are totally dependent upon water to breathe, feed and grow, excrete wastes, maintain a salt balance, and reproduce, understanding the physical and chemical qualities of water is critical to successful aquaculture. To a great extent water determines the success or failure of an aquaculture operation.
- ➢ Very high (greater than 9.5) or very low (less than 4.5) pH values are unsuitable for most aquatic organisms.
- ➢ Young fish and immature stages of aquatic insects are extremely sensitive to pH levels below 5 and may die at these low pH values.

- High pH levels (9-14) can harm fish by denaturing cellular membranes.
- Changes in pH can also affect aquatic life indirectly by altering other aspects of water chemistry.
- Low pH levels accelerate the release of metals from rocks or sediments in the stream. These metals can affect a fish's metabolism and the fish's ability to take water in.

High pH Levels Effect:

At high pH (>9) most ammonium in water is converted to toxic ammonia (NH3) which can kill fish. Moreover, cyanobacterial toxins can also significantly influence fish populations.

NOTE:

One critical parameter is pH, Not only for the health of the fish, but for the bacteria have that cleaned up the water as well as nitrifiers that remove excess nutrients.

pH is important in aquaculture as a measure of the acidity of the water or soil. Fish cannot survive in waters below pH 4 and above pH 11 for long periods. The optimum pH for fish is between 6.5 and 9. Fish will grow poorly and

reproduction will be affected at consistently higher or lower pH levels.

The effects of pH on warm-water pond fish

pH	Effect on fish
4	Acid death point
4 to 5	No reproduction
4 to 6.5	Slow growth
6.5 to 9	Desirable ranges for fish reproduction
9 to 10	Slow growth
≥ 11	Alkaline death point