

pH & Alkalinity

A Quick Review

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What is pH? pH, one of the most common analyses in soil and water testing, is the standard measure of how acidic or alkaline a solution is. It is measured on a scale from 0 – 14. pH of 7 is neutral, pH less than 7 is acidic, and pH greater than 7 is basic. The closer pH gets to 1, the more acidic. The closer pH gets to 14, the more basic. Acids and bases are two Extremes, like hot and cold. Mixing acids and bases together can even out the extreme effects, much like mixing hot and cold water to even out water temperature. The pH scale is logarithmic, which means that a unit decrease in pH equals a tenfold increase in acidity. For instance, tomato juice (pH 4) is ten times more acidic than black coffee (pH 5). Hydrogen (H⁺) ions (ions are atoms or groups of atoms with negative or positive charge) control acidity levels. pH measures the concentration of H⁺ and hydroxide (OH⁻) ions which make up water (H₂O): H⁺ + OH⁻ = H₂O When the two ions are in equal concentration, the water is neutral, whereas the water is acidic if H⁺ > OH⁻ and basic when OH⁻ > H⁺.

MORE ACIDIC NEUTRAL MORE BASIC

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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What affects pH? Some variables that influence pH include: Bedrock (the solid rock underlying surface soils) of a location. Areas with limestone bedrock generally have higher pH waters (more basic). Acid rain (atmospheric deposition). The presence of acid rain can lower the pH in lakes making them more acidic. For more information on acid rain, please visit the U.S. Environmental Protection Agency (U.S. E.P.A.) web site at [http://epa.gov/airmarkets/acid_rain/Water use](http://epa.gov/airmarkets/acid_rain/Water_use). Municipal water suppliers often raise the pH of drinking water to prevent corrosion of pipes. Carbon dioxide (CO₂). pH fluctuates throughout the day in a lake or pond largely in response to changing CO₂ levels. CO₂ dissolved in water forms a mild acid. When CO₂ is high; pH falls (more acidic). In the morning, CO₂ levels are high as a result of respiration that occurred in the pond overnight. As sun rises, plants and algae begin photosynthesis thereby consuming CO₂ and causing the pH to rise (more basic) as the day progresses. Algae blooms can significantly increase this effect. How is pH measured? pH can be measured electronically or visually. There are three main methods routinely used in water quality monitoring: 1. Laboratory quality pH meter and electrode 2. pH “pocket pals” and multi-parameter probes 3. Color comparators / pH strips. The pH meter and electrode, generally restricted to laboratory analysis of field collected samples, offers the highest degree of accuracy and precision. This pH meter-electrode measures the electric potential which is a function of the H⁺ activity in water samples. Calibration is completed with two buffer solutions. The latter two methods can be easily used in the field. pH “pocket pals” and multi-parameter probes are electronic

hand-held testers that are dipped directly into the water body and provide digital readout of pH. Pocket pals are typically calibrated with one buffer. With color comparators, you add a reagent to the water sample that colors the sample for a visual comparison. pH strips are dipped into water samples and then change color according to the pH. The intensity of the color is proportional to the pH in the sample and colors are compared on a chart.

What is Alkalinity? Alkalinity is the buffering capacity of a water body. It measures the ability of water bodies to neutralize acids and bases thereby maintaining a fairly stable pH. Water that is a good buffer contains compounds, such as bicarbonates, carbonates, and hydroxides, which combine with H⁺ ions from the water thereby raising the pH (more basic) of the water. Without this buffering capacity, any acid added to a lake would immediately change its pH. What affects alkalinity? Alkalinity comes from rocks and soils, salts, certain plant activities and certain industrial wastewater discharges (detergents and soap based products are alkaline). If an area's geology contains large quantities of calcium carbonate (CaCO₃, limestone), water bodies tend to be more alkaline. Granite bedrock is deficient in alkaline materials to buffer acidic inputs. Addition of lime as a soil amendment to decrease acidity in home lawns can runoff into surfacewaters and increase alkalinity. How is alkalinity measured? Alkalinity, reported as mg/L CaCO₃, is measured as the amount of acid (e.g., sulfuric acid) needed to bring the water sample to a pH of 4.2. At this pH, all the alkaline compounds of the sample are “used up.” Laboratory technicians use a burette (a graduated glass tube with a small opening at its base and stopcock for delivering measured quantities of liquid) to dispense the sulfuric acid drop by drop into the water sample while continuously monitoring the change in pH with a pH meter and electrode or pH “pocket pal.”

Ok, class is over for the day, back to work til next time. 💧