

pH

Water (H₂O) contains both hydrogen (H⁺) and hydroxyl (OH⁻) ions. The pH of water is a measurement of the concentration of H⁺ ions, using a scale that ranges from 0 to 14. A pH of 7 is considered "neutral", since concentrations of H⁺ and OH⁻ ions are equal. Liquids or substances with pH measurements below 7 are considered "acidic", and contain more H⁺ ions than OH⁻ ions. Those with pH measurements above 7 are considered "basic" or "alkaline," and contain more OH⁻ ions than H⁺ ions. For every one unit change in pH, there is approximately a ten-fold change in acidity or alkalinity. Therefore, a pH of 4 is 10 times more acidic than a pH of 5. Similarly, a pH of 9 is 10 times more alkaline than a pH of 8 and 100 times more alkaline than a pH of 7. Pure deionized water is neutral, with a pH of 7.

Natural water usually has a pH between 6.5 and 8.5. While there are natural variations in pH, many pH variations are due to human influences. Fossil fuel combustion products, especially automobile and coal-fired power plant emissions, contain nitrogen oxides and sulfur dioxide, which are converted to nitric acid and sulfuric acid in the atmosphere. When these acids combine with moisture in the atmosphere, they fall to earth as acid rain or acid snow. In some parts of the United States, especially the Northeast, acid rain has resulted in lakes and streams becoming acidic, resulting in conditions which are harmful to aquatic life. The problems associated with acid rain are lessened if limestone is present, since it is alkaline and neutralizes the acidity of the water.

Most aquatic plants and animals are adapted to a specific pH range, and natural populations may be harmed by water that is too acidic or alkaline. Immature stages of aquatic insects and young fish are extremely sensitive to pH values below 5. Even microorganisms which live in the bottom sediment and decompose organic debris cannot live in conditions which are too acidic. In very acidic waters, metals which are normally bound to organic matter and sediment are released into the water. Many of these metals can be toxic to fish and humans. Below a pH of about 4.5, all fish die.

Water Quality Standards for pH

Rule 53 of the Michigan Water Quality Standards (Part 4 of Act 451) states that the hydrogen ion concentration expressed as pH shall be maintained within the range of 6.5 to 9.0 in all waters of the state.

Effluent Limitations for pH in NPDES Permits

Wastewater treatment plants and most industrial facilities which discharge to waters of the state are required to monitor for pH on a frequent basis. Limits are usually 6.5 as a daily minimum and 9.0 as a daily maximum. Limits for pH are not necessary for all permits, such as discharges of clear noncontact cooling water, which are expected to have pH levels between 6.5 and 9.0 without treatment.