

Acidity

For water, wastewater and seawater

Digital Titration Method

Acidity is the quantitative expression of water's capacity to neutralize a strong base to a designated pH and an indicator of how corrosive water is. Acidity can be caused by weak organic acids, such as acetic and tannic acids, and strong mineral acids including sulfuric and hydrochloric acids; however, the most common source of acidity in unpolluted water is carbon dioxide in the form of carbonic acid.

Acidity is classified by the pH value of a titration end point. Acidity caused by mineral acids exhibits a pH below 4.5. Salts of certain metals, particularly those with trivalent iron and aluminum, may hydrolyze in water and also contribute to acidity.

Standard Methods for the Examination of Water and Wastewater (Standard Methods) recommends titration with sodium hydroxide to an end point pH of 3.7 to determine mineral acidity. Titrate to pH 8.3 to determine total acidity.

Acidity is commonly determined using methyl orange as a color indicator of the pH end point. Because methyl orange undergoes a color change from red to orange at a pH of 3.7, the results of the titration are termed Methyl Orange Acidity. Hach procedures for acidity use bromphenol blue indicator instead of methyl orange because the methyl orange color change is difficult to detect. The bromphenol blue indicator gives a sharp end point change from yellow to blue-violet.

Total acidity includes acidity caused by mineral acids, weak organic acids, and carbon dioxide (in the form of carbonic acid). Acidity determined by titrating to a phenolphthalein end point pH of 8.3 corresponds to the neutralization of carbonic acid to bicarbonate. Because carbon dioxide is the major cause of acidity in natural waters, in most cases the phenolphthalein acidity is equal to the total acidity. Acidity tests can be performed using a pH meter to detect the end points; however, methyl orange acidity and phenolphthalein acidity are the terms used to describe the results. Results of the acidity tests are reported in mg/L CaCO₃.

Table 1 Chemical reactions

Methyl orange acidity	Phenolphthalein acidity
$2\text{NaOH} + \text{H}_2\text{SO}_4 \zeta \text{Na}_2\text{SO}_4$	$\text{NaOH} + \text{H}_2\text{CO}_3 \zeta \text{NaHCO}_3 + \text{H}_2\text{O}$
$\text{NaOH} + \text{HCl} \zeta \text{NaCl} + \text{H}_2\text{O}$	$\text{NaOH} + \text{HC}_2\text{H}_3\text{O}_2 \zeta \text{NaC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$

Reactions of indicator Phenolphthalein

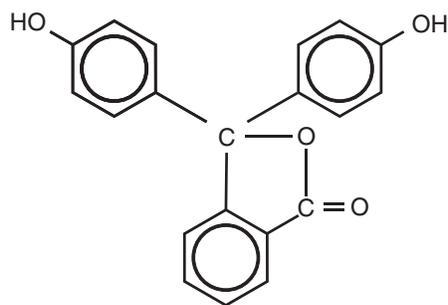


Figure 1 Colorless—pH < 8.3

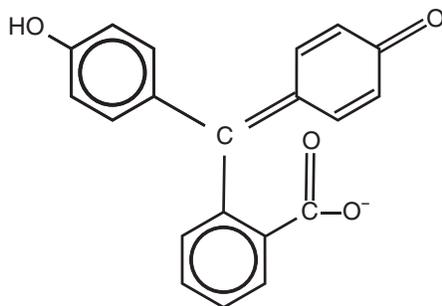


Figure 2 Pink—pH > 8.3

Reactions of indicator Bromphenol blue*

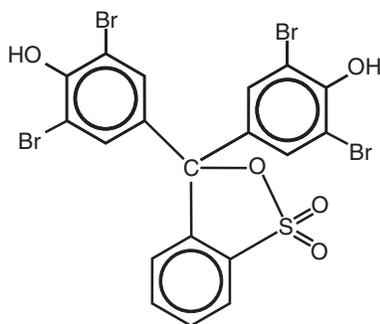


Figure 3 Yellow=pH 3

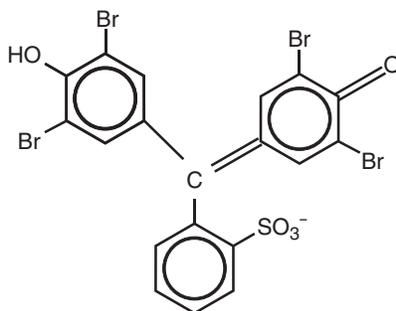


Figure 4 Blue-violet=pH 4.6

* 3',3'',5',5'', -Tetrabromophenolsulfonephthalein