Salts, Acidity and Alkalinity

By Peter S. Cartwright, PE, CWS-VI

The basic chemistry fundamentals presented every month is not intended to be a comprehensive chemistry course, but rather basic instruction on chemistry as it relates to water and water treatment. It is hoped that your interest will be piqued and induce you to want to learn more. The desired outcome is that it will help you become a more effective and valuable water treatment professional. Please get back to us with any questions or concerns; we welcome your input!

Salts are chemical compounds composed of soluble components that become electrically charged when in solution. These charged components are collectively known as ions.

Those ions with positive charges (+) are called cations, and those with negative charges (-) are called anions. When acids and bases (substances that release hydroxide ions into the water and will also produce a pH in water above 7) combine, salts are formed.

$$\underset{\text{(acid)}}{HCl} + \underset{\text{(base)}}{NaOH} \rightarrow \underset{}{H_2O} + \underset{}{NaCl}$$

$$H^+ + OH^- + Na^+ + Cl^- \rightarrow H_2O + NaCl$$

Acidity and alkalinity

Acidity is the measure of dissolved solids that are acidic in nature (pH < 7). Acidic waters contain several traits.

They have a sour taste (like fruit juice and vinegar) and they turn Litmus paper red when tested. They also can be corrosive and tend to dissolve many metals.

A very complex subject, alkalinity is the quantitative capacity of water to neutralize an acid. Alkalinity is not the same as pH, because water does not necessarily have a high pH in order to have high alkalinity.

Alkalinity factors

Principal contributors to alkalinity in water supplies include the bicarbonate ion (HCO_3^-) and the carbonate ion (CO_3^{2-}), the latter being common with natural waters in limestone areas. Alkalinity is also associated with high pH solutions (bases) and is most uncommon as hydroxide (OH^-), except in municipal waters softened by soda-lime process.

Alkaline waters have a soda taste and can cause drying of the skin. They tend to oxidize metals and turn Litmus paper blue.

LSI

The Langelier Saturation Index (LSI) is a calculated number used to predict the calcium carbonate ($CaCO_3$) stability of a water supply. It determines whether this water will precipitate, dissolve, or be in equilibrium with calcium carbonate.

LSI = pH – pH 8

Where: pH = actual pH of the water

pH 8 = pH at which water having the same alkalinity and calcium content is just saturated with calcium carbonate.

Some common chemicals with low solubility in water include: red rust ferric iron (Fe_2O_3), calcium carbonate scale ($CaCO_3$) and calcium sulfate ($CaSO_4$).

About the author

♦ *Peter S. Cartwright, CWS-VI, President of Cartwright Consulting Company of Minneapolis, Minnesota, is a registered Professional Engineer. He has been in the water treatment industry since 1974, has authored over 125 articles, presented over 125 lectures in conferences around the world and has been awarded three patents. Cartwright has chaired several WQA committees and task forces and has received the organization's Award of Merit. A member of WC&P Technical Review Committee since 1996, his expertise includes high-technology separation processes such as RO, UF, MF, UF electrodialysis, deionization, carbon adsorption, ozonation and distillation. Cartwright is also Technical Consultant to the Canadian Water Quality Association. He can be reached by phone (952) 854-4911; fax (952) 854-6964; email pscartwright@msn.com or on his website, www.cartwright-consulting.com.*