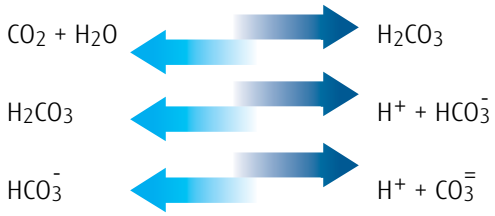
Carbon Dioxide Replaces Mineral Acid to Reduce pH

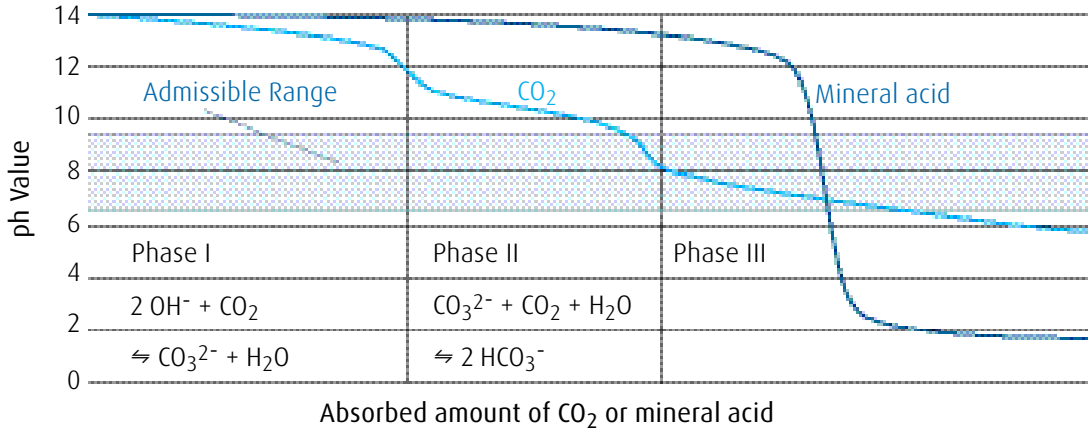
The replacement of mineral acid with carbon dioxide (CO_2) offers an effective, reliable, self-buffering and economical way to control pH. When CO_2 is dissolved in water, it goes through a series of chemical reactions as shown below.



Initially, dissolved CO_2 forms carbonic acid, which subsequently dissociates into bicarbonate, carbonate and hydrogen ions, at levels that depend upon pH. The hydrogen ions in turn reduce the pH.

Carbon dioxide typically does not overshoot pH. By using carbon dioxide, the carbonate buffer strength and alkalinity are maintained. With mineral acids the alkalinity is destroyed. The importance of this difference is that carbon dioxide decreases the pH evenly. With mineral acids, the pH change is sudden and dramatic. As shown in the chart, with carbon dioxide the pH drops almost linearly to pH 7, after which the pH change is minimal. However, with mineral acid, the pH change is minimal during the initial part of the titration and then suddenly drops to about pH 3. The result of this difference is that with carbon dioxide, the pH rarely drops below 7 even without automated control, whereas with mineral acid, even a slight excess can drop the water to acidic levels of pH 3 or less.

Neutralization of sodium hydroxide solution with CO_2 and with mineral acid.



Advantages of Carbon Dioxide

- → Does not overshoot pH, even with excess acid addition
- → Reduces risk of equipment corrosion
- → Eliminates the need for storage and handling of hazardous mineral acids
- → Cost-competitive with mineral acid
- → Food grade, non-toxic

Custom-Engineered CO_2 pH-Neutralization system

Linde has over 20 years of experience in the design, installation, and startup of custom-engineered systems to meet pH control needs in a variety of settings. This experience includes both liquid and gaseous CO2 delivery systems that utilize a wide range of dissolution techniques.

Linde supplies

- → Liquid CO_2 storage tanks
- → Liquid CO_2 vaporizers
- → Automated CO_2 pressure and flow control panels
- → CO_2 dissolution equipment

Dissolution equipment is typically installed in tanks or pressurized water pipelines. Selection and design of the CO_2 dissolution equipment, such as spargers and diffusers, is based upon the specific requirements of each installation.

This ensures that every treatment system provides a safer, more efficient, and economical pH neutralization. All of Linde's CO_2 injection systems are built from durable materials, such as stainless steel, to provide lasting reliability. All components, from liquid CO_2 storage to CO_2 dissolution. liquid CO_2 storage to CO_2-dissolution systems, are designed for long service life with minimal maintenance and operator attention.

A Broad Range of Control Applications

Carbon dioxide is utilized for pH control in many industries including:

- → Food
- → Textile
- → Pulp and paper
- → Chemical
- → Petroleum
- → Municipal facilities

Main uses of carbon dioxide for water treatment include:

- → Effluent water treatment
- → Process water pH control
- → Drinking water re-carbonation

Superior Systems

Linde provides everything you need for superior CO_2 water treatment systems including:

Engineering

- → Determination of requirements
- → Custom injection and control design
- → Start-up and optimization

Installation Services

- → Bulk tank installation
- → Piping systems
- → Field service representatives

Product Supply

- → Strategic worldwide placement of production plants
- → Nationwide network of supply depots
- → Dependable fleet of delivery vehicles

One Source for All Your Needs

Linde, the largest supplier of CO_2 in North and South America has the resources, experience, technical know-how and supply network to meet today's requirements for pH control. Each regional office has a staff that includes application engineers and service personnel to ensure that every installation meets the specific requirements of your application and provide ongoing support.

In addition, our R&D facility near Chicago provides technical application support that ensures the highest quality product and state-of-the-art technical backup. Linde has a network of strategically located liquid CO_2 supply plants, depots and sales offices available to serve all your needs. Linde also maintains a large fleet of tanker trucks and railcars, allowing quick delivery of CO_2 wherever it is needed. Our storage vessels are manufactured to the highest quality standards, using the latest construction technology for long life, minimum maintenance, energy savings, automatic operation, safety and reliability.

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