

Carbon Dioxide Replaces Mineral Acid to Reduce pH

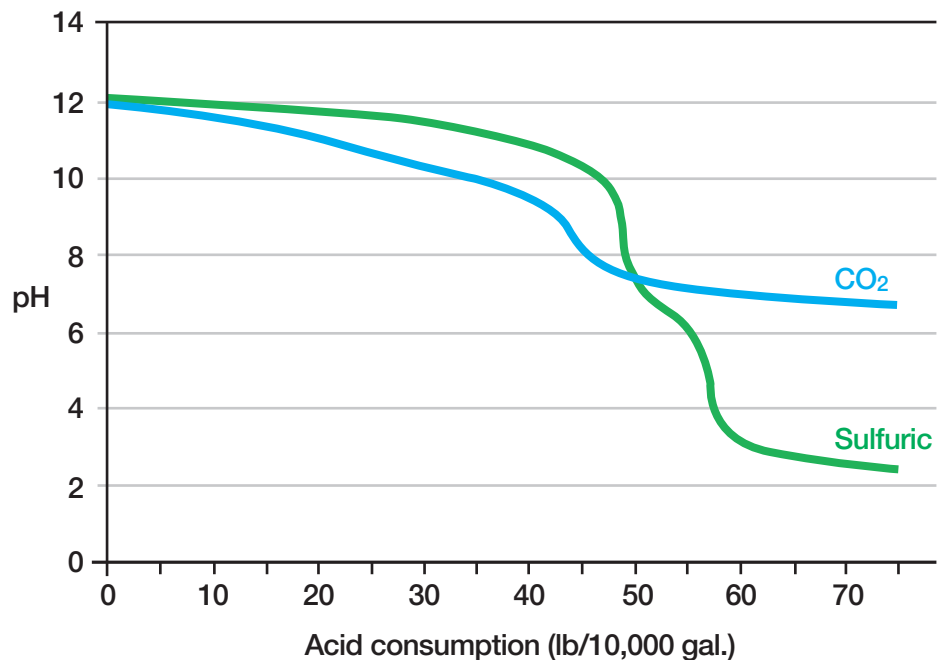
The replacement of mineral acid with carbon dioxide (CO₂) offers an effective, reliable, self-buffering and economical way to control pH. When CO₂ is dissolved in water, it goes through a series of chemical reactions as shown below.



Initially, dissolved CO₂ 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.

Typical Titration with CO₂ vs. H₂SO₄



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 CO₂ pH-Neutralization Systems

Praxair 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.

Praxair typically supplies

- Liquid CO₂ storage tanks
- Liquid CO₂ vaporizers
- Automated CO₂ pressure and flow control panels
- CO₂ dissolution equipment

Dissolution equipment is typically installed in tanks or pressurized water pipelines. Selection and design of the CO₂ 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 Praxair's CO₂ injection systems are built from durable components, such as stainless steel, to provide lasting reliability. All components, from liquid CO₂ storage to CO₂-dissolution



liquid CO₂ storage to CO₂-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
- Aluminum and alumina
- Steel
- Cement

Main uses of carbon dioxide for water treatment include:

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

Superior Systems

Praxair provides everything you need for superior CO₂ water treatment systems including:

Engineering

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

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

Praxair, the largest supplier of CO₂ 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.

Praxair has a network of strategically located liquid CO₂ supply plants, depots and sales offices available to serve all your needs. Praxair also maintains a large fleet of tanker trucks and railcars, allowing quick delivery of CO₂ 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.

Contact **Praxair** at **1-800-PRAXAIR** or via the web at **www.praxair.com/wastewater**.



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