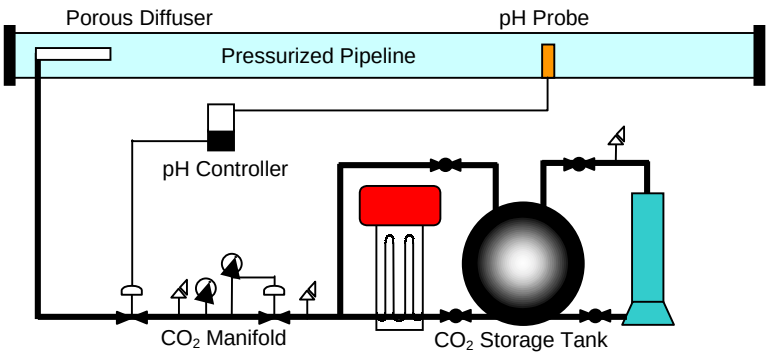
Carbon Dioxide for pH Control

Environmentally Safe CO_2 Technology
for pH Reduction of Alkaline Water

Carbon Dioxide Versus Mineral Acids

For a number of years, sulfuric acid was used in water treatment facilities to control alkalinity. It's a product that works, but it also has may potential problems. Sulfuric acid can be difficult to apply and control. It is potentially dangerous to store and handle. Safety showers have to be installed and readily available to operating personnel who must wear special clothing for their protection.

The extremely corrosive acid requires special material for equipment and piping. Maintenance of the system demands frequent component repairs and replacement. Carbon dioxide on the other hand is safe to handle, easy to apply, efficient and ecologically safe.



When pH control is critical to your process or effluent quality, CO_2 can be a most viable alternative.

The Chemistry

Carbon dioxide is a gas, which once dissolved into water produces as weak acid: carbonic acid. This substance reacts immediately with alkalis such as caustic soda, sodium carbonate and dissolved lime, turning them into neutral carbonates and bicarbonate salts.

$$CO_2 + H_2O \longrightarrow H_2CO_3$$
$$H_2CO_3 + 2NaOH \longrightarrow Na_2CO_3 + 2H_2O$$
$$H_2CO_3 + Na_2CO_3 \longrightarrow 2NaHCO_3$$

Carbonic acid is a mild acid present in water as ions H^+ and HCO_3^-, which are highly reactive. They will immediately react with ions responsible for alkalinity of water.

PH Control System

CO_2 is introduced into the high pH water by means of a diffuser, which is typically installed in an existing pressurized pipe or at the bottom of a basin. Small CO_2 bubbles are then released by the diffusers into the high pH water. A pH probe is installed downstream of the gas injection point, thus measuring pH in the water after absorption and CO_2 reaction. An in-line CO_2 pH control installation is depicted in this document.

A pH control manifold is used to modulate gas flow automatically and achieve high efficiency and reliability with little supervision from plant personnel. The CO_2 pH control technology can be customized to suit your control needs. Existing pH control instruments may be retained when sulfuric acid is replaces with carbon dioxide.

Model Of Supply

For small requirements carbon dioxide is supplied with liquid cylinders. Larger volumes will be delivered by truck and stored on site into a bulk CO_2 storage tank. The CO_2 storage tank is typically supplied, installed and maintained by the supplier of the gas.

Typically CO_2 is stored in pressurized vessels up to 300 psig and thus do not require feed or transfer pumps to supply the process.

Benefits of CO_2 pH Control

Safe-to-use: carbon dioxide in the absence of water is inert and non-corrosive. It does not require mechanical transfer or handling equipment. It becomes active only when dissolved in water. CO_2 leaks dissipate safely into the atmosphere, leaving no residue to be neutralized. Furthermore, carbon dioxide does not corrode metal equipment. No special alloy or plastic distribution piping is required for the CO_2 system.

Accuracy of Regulation: CO_2 is better than strong acids for controlling pH because it forms a mild but highly reactive acid which minimizes risks of overt acidification and rapidly responds to any variations of the incoming pH or water flowrate. Over or under treatment with mineral acids will often result in a pH, which rapidly deviates from the compliance range.

Low Maintenance System: Systems are generally engineered to be pressure driven. With a minimum number of moving parts, this system offers continuous trouble free operation. Moreover, trained technicians can be rapidly dispatched to service the bulk CO_2 tank in the unlikely event of a problem.

Flexibility: With a turndown ratio in control of the CO_2 injection rate exceeding 10:1, the pH control system will efficiently and rapidly respond to any fluctuation of flowrate or incoming pH.

Safe for the Environment: There is no secondary pollution introduced into the treated water by salts such as chlorides (from HCl) or Sulfates (from (H_2SO_4). The introduction of CO_2 will contribute to the chemical equilibrium of water by forming neutral carbonates and bicarbonates.

Comparative Neutralization Curves of an Industrial Effluent