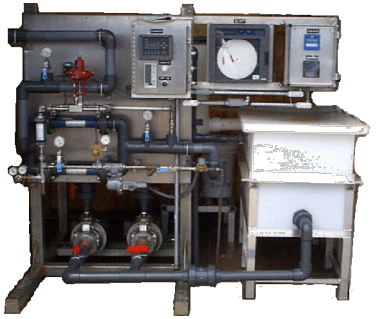
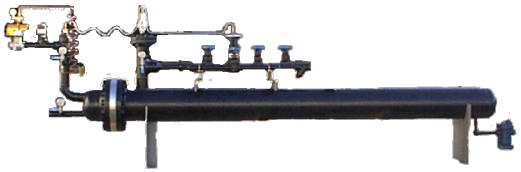
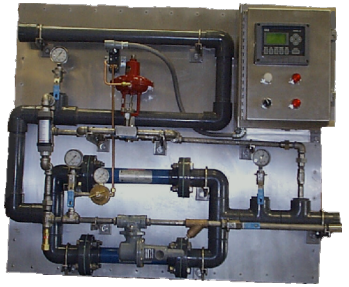
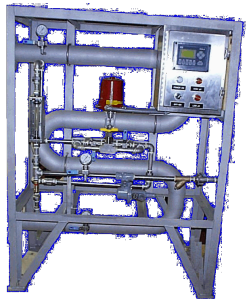
CO_2 Injection Methods and Equipment for pH Control

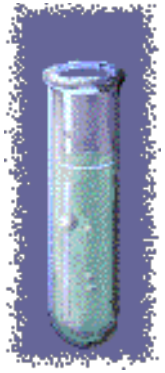








What is CO_2?
How is it Made?



- Carbon Dioxide is a gas at normal atmospheric temperature and pressure. It is a colorless, odorless gas that is about 1.5 times more dense than air. It dissolves in water to form carbonic acid; H_2CO_3. Carbon dioxide gas is formed from the combination of two elements: carbon and oxygen.

- CO_2 is produced from the combustion of coal or hydrocarbons, the fermentation of alcohols, the production of anhydrous ammonia, by-product of other chemical processes, occur naturally in deep CO_2 wells and the breathing of humans and animals. Found in small proportions in the atmosphere, it is assimilated by plants which in turn produce oxygen.

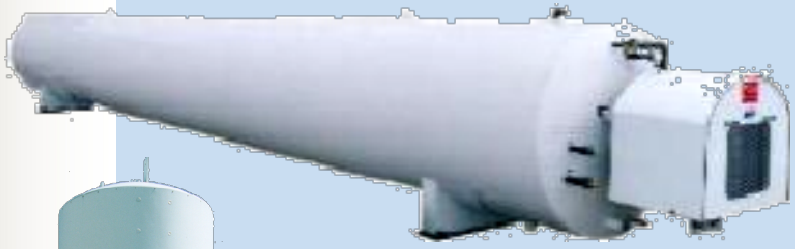
Why Do We Adjust pH?

- Stabilize Water Chemistry.
- Corrosion Control.
- Discharge Wastewater (Permit).
- To reduce or prevent Carbonate Scaling.
- To enhance a chemical reaction or process
  - Polymers, Chlorine, Lime, Filtration, Contaminant removal

Carbon Dioxide pH Control Equipment

- CO_2 Storage
- Vaporizer
- Vapor Heater
- Pressure Regulator
- CO_2 / H_2CO_3 Feed Panel
- Diffuser

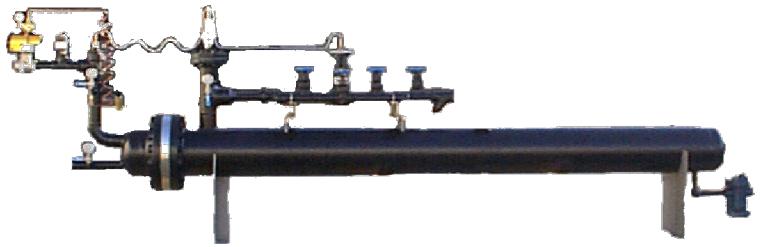
CO_2 Bulk Storage

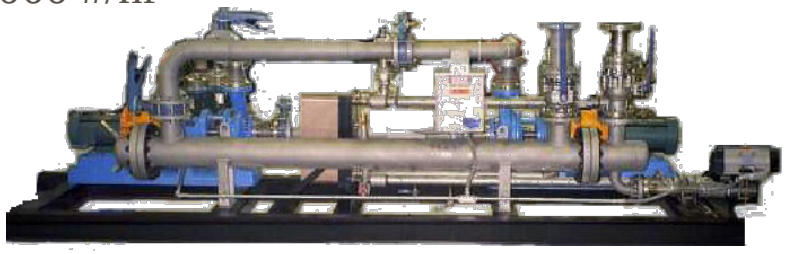


- E-Style Series
  - 3.75 Tons – 120 Tons Capacity
- C-Style Series
  - 3.75 Tons – 60 Tons Capacity
- V-Style Series
  - 6 Tons – 75 Tons Capacity

CO_2 Vaporizers

- Variety of Vaporizers
  - Electric Pressure Build
    - 245 #/hr – 2150 #/hr
  - Direct to Process
    - 375 #/hr – 2250 #/hr
  - Steam
    - 500 #/hr – 18,000 #/hr
  - Water
    - 500 #/hr – 20,000 #/hr

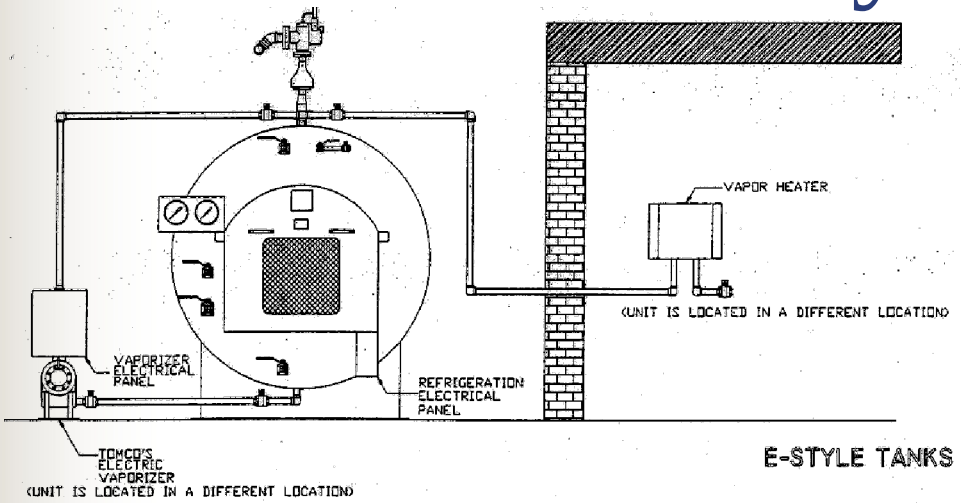




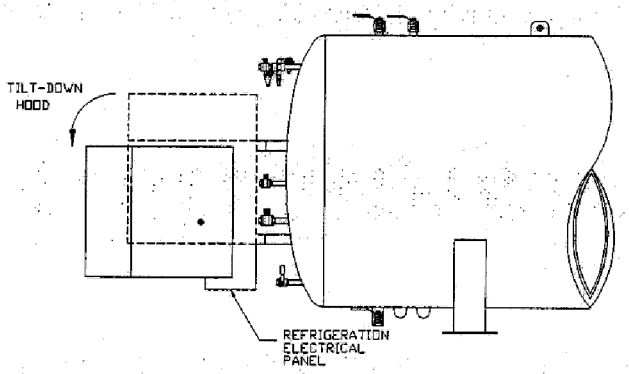
CO_2 Vapor Heaters

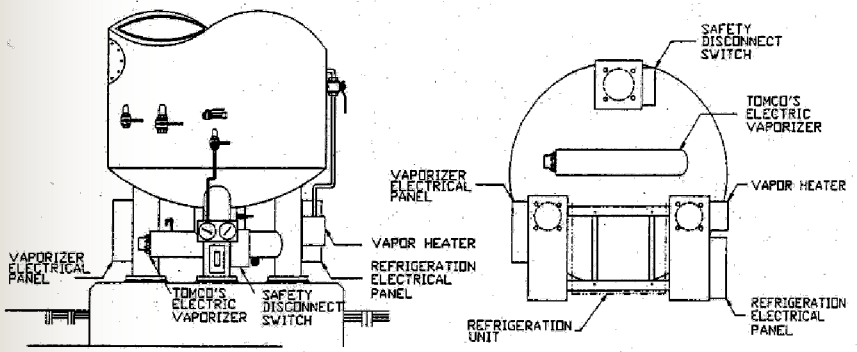
- Electric
  - 720 #/hr to 1440 #/hr (Wall)
  - 2000 to 6000 #/hr (Floor)
- Steam
  - 500 #/hr to 6,000 #/hr

General Tank Layout

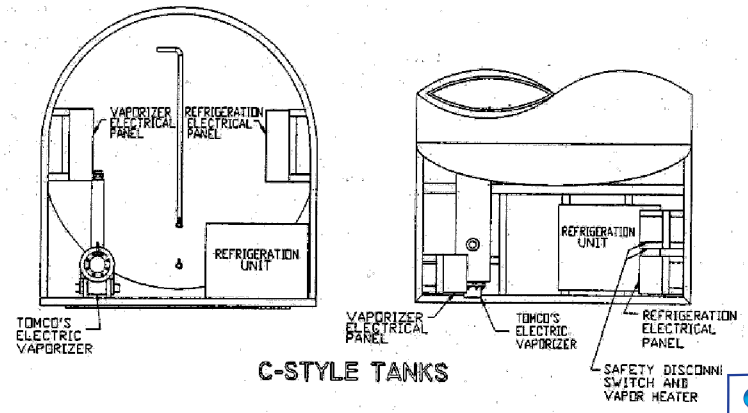


E-STYLE TANKS





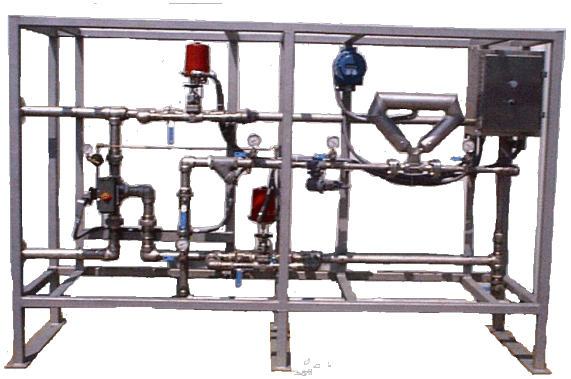
VERTICAL-STYLE TANKS

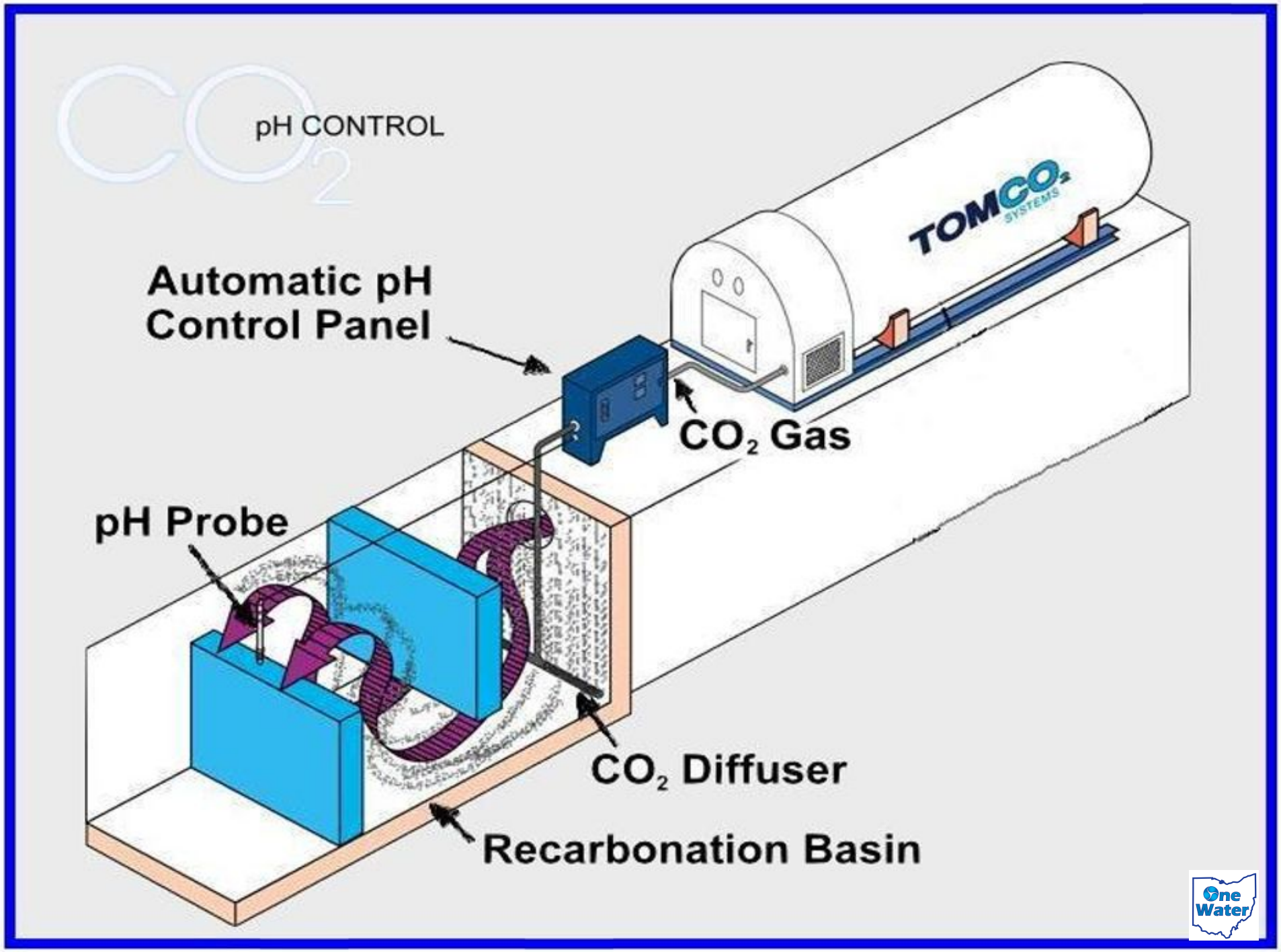


C-STYLE TANKS

CO_2 Feed Equipment

- CO_2 Gas Feed
  - 60% - 85% efficiency of the carbon dioxide
  - Needs deep contact or holding basins.
  - Able to reduce the pH to 7.0
- Carbonic Acid (PSF)
  - Minimum 95% efficiency of the carbon dioxide
  - Able to reduce the pH to 5.5 – 6.0
  - Can be injected in a pipe, basin, tank or shallow channel.
  - Eliminates the need for deep contact or holding basins.

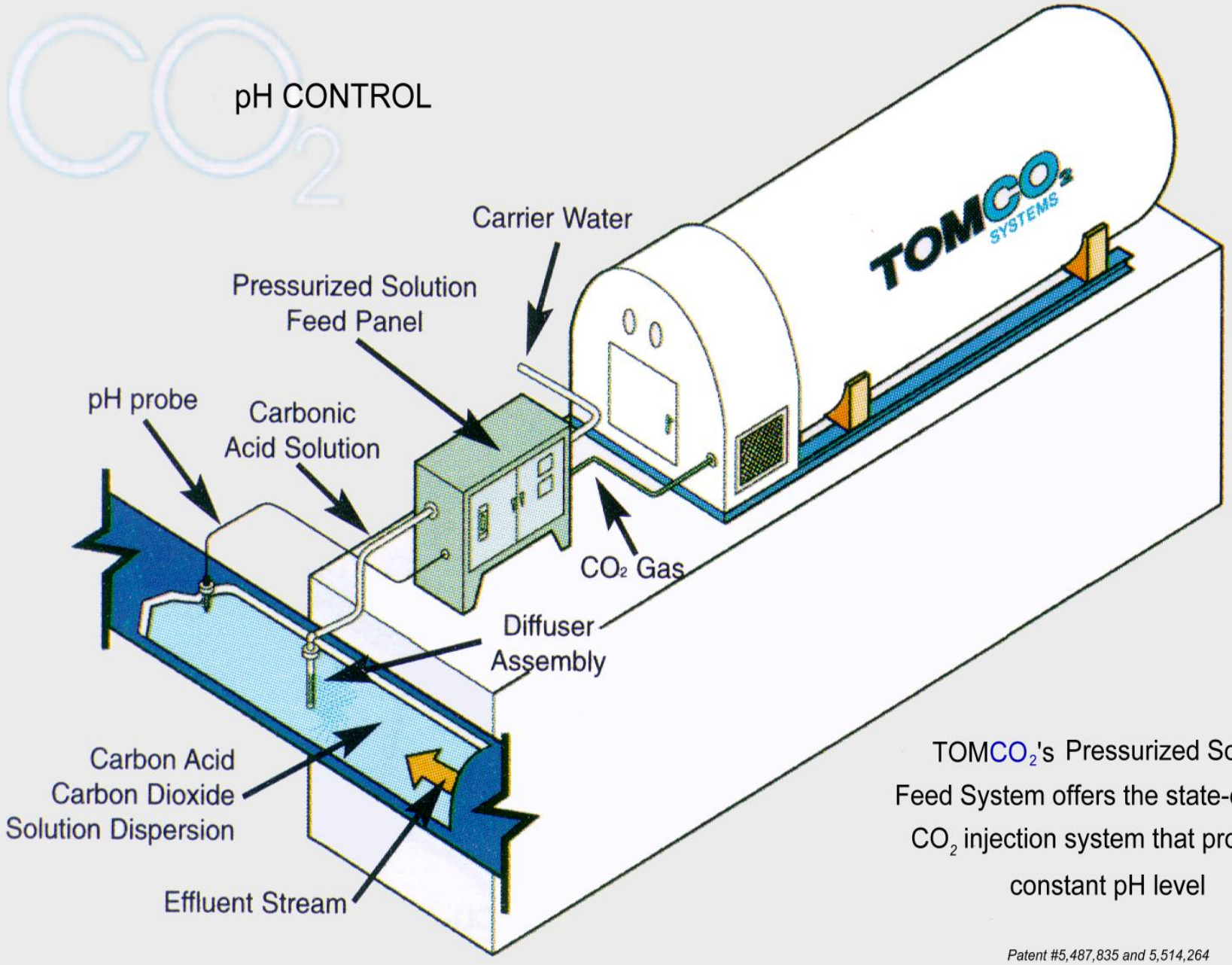



pH CONTROL
Automatic pH Control Panel
TOMCO2 SYSTEMS
CO2 Gas
pH Probe
CO2 Diffuser
Recarbonation Basin

CO_2 Gas Injection

- **Gas (CO_2) + Liquid (water) reaction takes time**
- **Requires tremendous surface area (fine bubbles)**
- **Interference of other gases; i.e. air**
- **Requires mixer or baffles to hold the gas down in the water**
- **Lower efficiencies due to gas bubbles at the surface**

pH CONTROL



TOMCO_2's Pressurized Solution Feed System offers the state-of-the-art CO_2 injection system that provides a constant pH level

Patent #5,487,835 and 5,514,264

Carbonic Acid Injection (PSF)

- **CO_2 pre-reacted to form Carbonic Acid**
- **Liquid / Liquid (Carbonic Acid / Water) Reaction**
- **Immediate reaction (Requires less time)**
- **Close to 100% efficiency**
- **Higher pressure improves CO_2 solubility**
- **More effective pH control**
- **Faster reaction time reduces scale potential.**

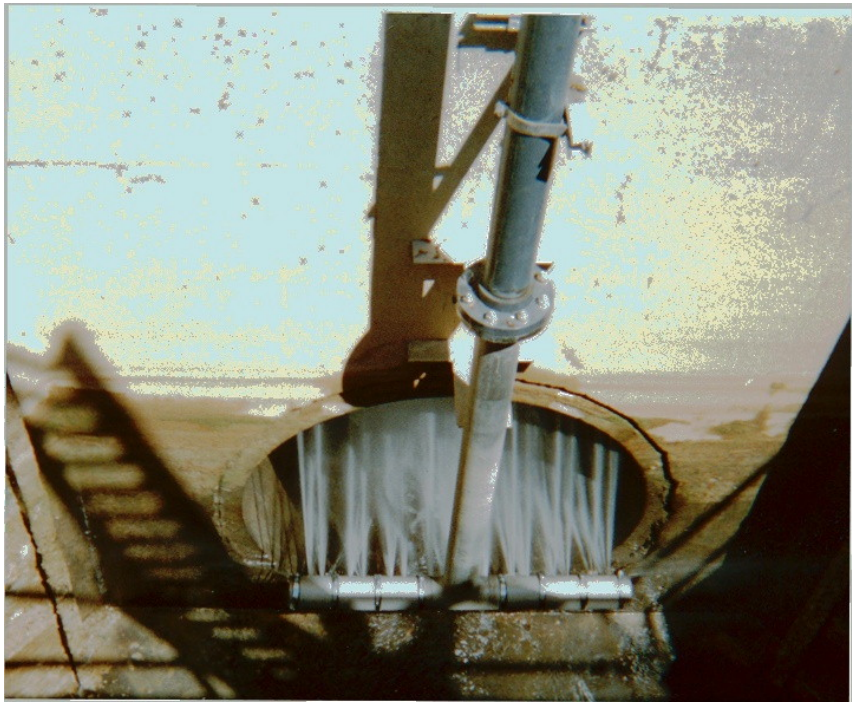
CO_2 Diffusers

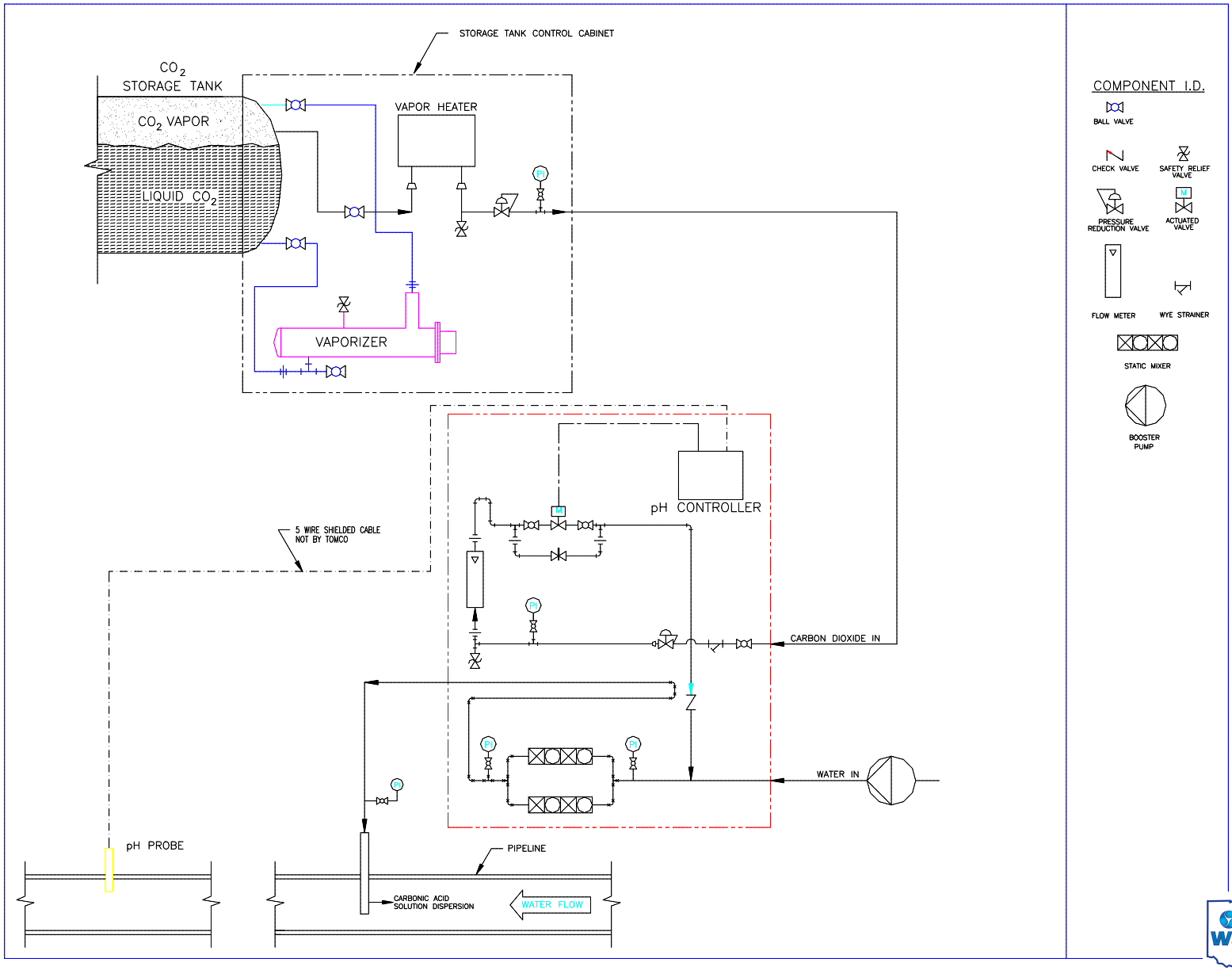
- Gas Feed
  - Uses fine porous diffuser to disperse the CO_2 into a deep basin.
- Carbonic Acid
  - Disperses Carbonic Acid into a water stream to form the chemical reaction desired. Designed to fit in any situation

Carbonic Acid Diffuser

Patent # 6637731 & 6767008

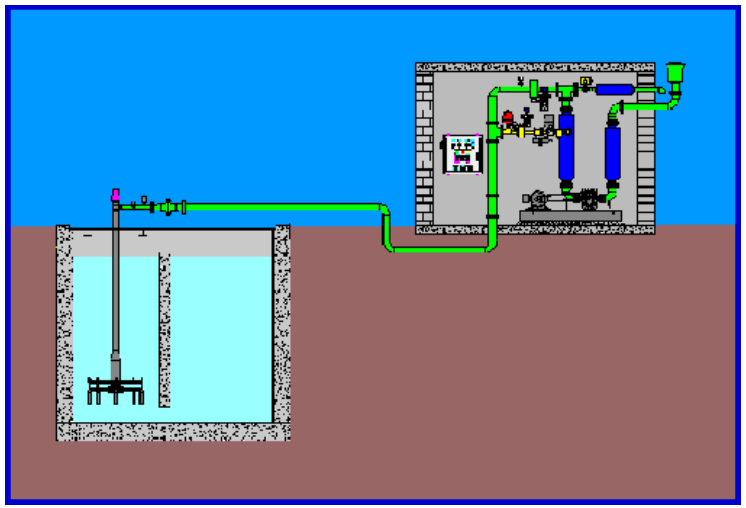
- Counter Current
- Cross Sectional Coverage
- Pressure
- Efficient Mixing
- Immediate Reaction




STORAGE TANK CONTROL CABINET
CO_2 STORAGE TANK
CO_2 VAPOR
LIQUID CO_2
VAPOR HEATER
VAPORIZER
pH CONTROLLER
5 WIRE SHIELDED CABLE NOT BY TOMCO
CARBON DIOXIDE IN
WATER IN
pH PROBE
PIPELINE
CARBONIC ACID SOLUTION DISPERSION
WATER FLOW
COMPONENT I.D.
BALL VALVE
CHECK VALVE
SAFETY RELIEF VALVE
PRESSURE REDUCTION VALVE
ACTUATED VALVE
FLOW METER
WYE STRAINER
STATIC MIXER
BOOSTER PUMP

Other CO_2 Storage & Sources

- Dewars (Mini Bulk)
  - 400 # Liquid CO_2
- High Pressure Cylinders
  - Multiple Size Gas
- Stack Gas
  - Contains 10 % - 12 % CO_2
- Submerged Combustion Burners
  - Uses natural gas, butane, propane or digester gas to produce CO_2.

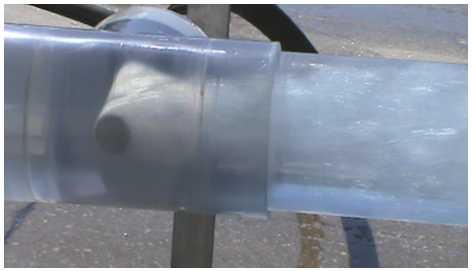


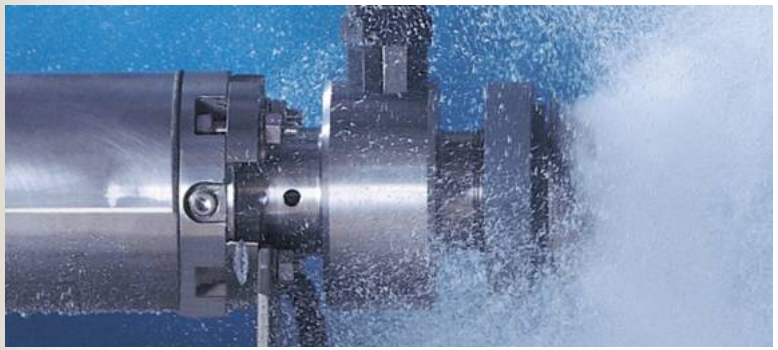
Areas to Use CO_2

- **Municipal Water Plants**
  - **Lime Softening**
  - **Enhanced Coagulation**
  - **Stripping – H2S**
  - **Corrosion Control**
  - **Membranes including RO**
  - **Disinfection – Sodium Hypochlorite**
  - **Filter Backwash**
  - **Bromate Reduction**
  - **Arsenic Removal**
  - **Waste Water**

Other pH Control Methods

- Liquid CO_2 Feed Systems
- Gas Eductor / Vacuum Feeder
- Chlorinator / Solution Feeder
- Carbonated Water Feeder
- Mineral Acids

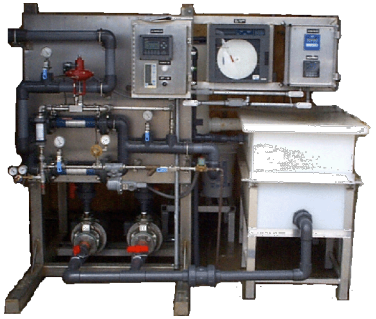


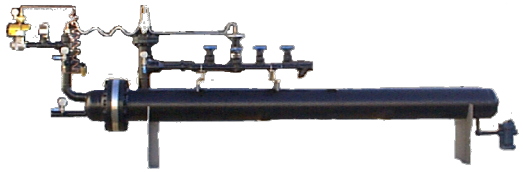


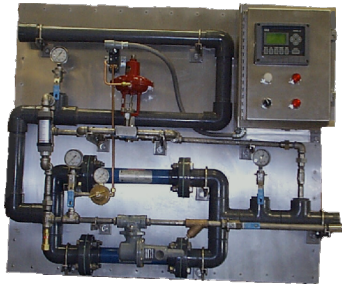
Manufacturer's Qualifications

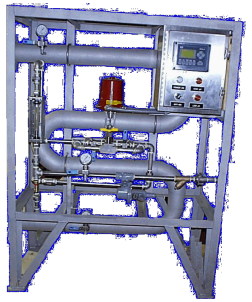
- Experience in CO_2 and Water Treatment Systems
- Number of systems installed
- Active member of CGA
- Engineering Capability
- Optimized pH control and CO_2 utilization
- Total System Responsibility
- ASME Pressure Vessel shop
- Service Capability
- Made in the USA @TOMCO_2
  –Loganville, GA

TOMCO$_2$ Systems
Water Technologies









One Water