

CO₂ A Silent Killer

Fatality

- In Cincinnati, Ohio a delivery driver succumbed to carbon dioxide asphyxiation while dispensing CO₂ from his tractor-trailer. Restaurant employees started to look for the driver and found him unconscious and lying face up at the bottom of the stairwell; they immediately called 911.
- The paramedical team had to use SCBAs to remove the victim from the stairwell.
- The paramedics were unable to revive him and he was declared dead at the local hospital.

Two Deaths

- In Sanford, Florida two employees died from exposure to carbon dioxide (CO₂) that was being delivered from a tank truck to a stationary storage tank on premises. Sufficient CO₂ was released to cause both employees to lose consciousness and the ability to escape from the confined area. As with carbon monoxide, there is no warning and rescue must be made by a person with an oxygen supply mask.

One Death

- An 80-year-old woman died after being found unconscious in a restroom at an eastern Georgia Restaurant; she was killed by a lethal dose of carbon dioxide.
- Ten other people including three firefighters were treated at a local hospital for exposure to the gas.

Near Miss

- In Phoenix AZ a restaurant employee was found unconscious at the top of a stairwell that leads to the basement storage area.
- A Firefighter and an Engineer went into the basement to see if the patient had tripped or slipped on something.
- After entering the basement both men became lightheaded and exited the basement.
- Upon exiting the basement, the Engineer fell and both members reported dizziness and a bitter taste in their mouths.

It Happened Here!

- A carbon dioxide leak from a faulty carbonated beverage system occurred Saturday, August 25, 2012 at a local restaurant . The source of the leak was determined to be the beverage system.
- One patient complained of dizziness.

It Happened Here!

- November 14, 21012 Brentwood Borough Fire Department responded to a reported structure fire at 4214 Brownsville road, found the basement full of smoke, and the CO₂ tank covered in ice. A carbon dioxide leak from a faulty carbonated beverage systems produced a fog in the basement which was mistaken for smoke.

General Information

- Carbon dioxide (CO₂) is a colorless, odorless, non-flammable gas that is a product of cellular respiration and burning of fossil fuels.
- It has a molecular weight of 44.01g/mol (NIOSH 1976).
- Although it is typically present as a gas, carbon dioxide also can be a solid form as dry ice and liquefied, depending on temperature and pressure (Nelson 2000).
- Occupations that are most at risk from CO₂ exposure include miners, brewers, carbonated beverage workers, and grain elevator workers (CCOHS 2005; Nelson 2000).

General Information

- Some sources of hazardous concentrations of carbon dioxide are:
 - Carbon dioxide storage containers that are not properly vented to a well-ventilated area outside of the building not just into walls or ceilings;
 - Leaking fittings, connections, piping/tubing/hoses, or storage container plumbing.
 - Leaking carbonators, syrup pumps, bag in box (BIB) racks (i.e., any equipment using carbon dioxide); and
 - Leaking beer keg connections and equipment.

CO₂

- Carbonated or fizzy drinks are widely available in many venues, from bars to restaurants to night clubs, from sports venues to airports to cinemas.
- Anywhere supplying such drinks is doing so using carbon dioxide or CO₂, a toxic gas which, in the event of a leak, is dangerous to humans.

How CO₂ affects the human body

- CO₂ is heavier than air, and therefore in the event of a leak in an enclosed space, such as a walk-in cooler or backroom, anyone entering can be put at risk.
- As little as 5% concentration of CO₂ can quickly cause problems.
- As an odorless and colorless gas, a human will not detect it, and the risks are exacerbated because rising levels of the gas affect the human body with symptoms that could easily be attributed to other factors.

How CO₂ affects the human body

- CO₂ may act as an oxygen displacer in confined spaces and cause a number of reactions.
- These reactions include, but are not limited to, dizziness, disorientation, suffocation, and under certain circumstances, death.
- Death occurs when there is a depression of the central nervous system (CNS) with prolonged exposure to high levels of CO₂ and the body's compensatory mechanisms are overwhelmed or fail (Farrar et al. 1999; IVHHN 2005; Nelson 2000; NIOSH 1976; NIOSH 1996).

How CO₂ affects the human body

- Even small increases in the concentration of the gas can rapidly increase the risks to humans.
- Initially exposure to low level CO₂ can cause problems concentrating, an increased heart rate and breathing issues.
- Higher concentrations of the gas and longer exposure can lead to headaches or dizziness.
- The risks to humans continue to escalate, with higher concentrations causing more severe reactions which can occur much more quickly.

How CO₂ affects the human body

- In terms of worker safety, Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) for CO₂ of 5,000 parts per million (ppm) over an 8-hour work day, which is equivalent to 0.5% by volume of air.
- A value of 40,000 ppm is considered immediately dangerous to life and health. (NIOSH 1996; Tox. Review 2005).
- Additionally, acute toxicity data show the lethal concentration for CO₂ is 90,000 ppm (9%) over 5 minutes (NIOSH 1996).

How CO₂ affects the human body

- The true concentration of CO₂ could be substantially higher if the oxygen deficiency is due to displacement rather than consumption of the oxygen in the confined space.

How CO₂ affects the human body

- The bottom line is that if you wait until the oxygen deficiency alarm is activated, and the deficiency is due to the presence of CO₂, you will have substantially exceeded the toxic exposure limit long before leaving the affected area.

Toxicology of CO₂

- CO₂ is considered to be a potential inhalation toxicant and a simple asphyxiate (Aerias 2005; NIOSH 1976; Priestly 2003).

Toxicology of CO₂

- Treatment for high exposures of this compound involves removing the victim from the confined space or oxygen inadequate environment, and increasing the oxygen supply to the exposed individual (MSDS for CO₂ 2003; Nelson 2000; Priestly 2003).

The value of a CO₂ alarm

- Because CO₂ is undetectable by human senses, the only way to safely monitor CO₂ is by using fixed or portable alarm systems.



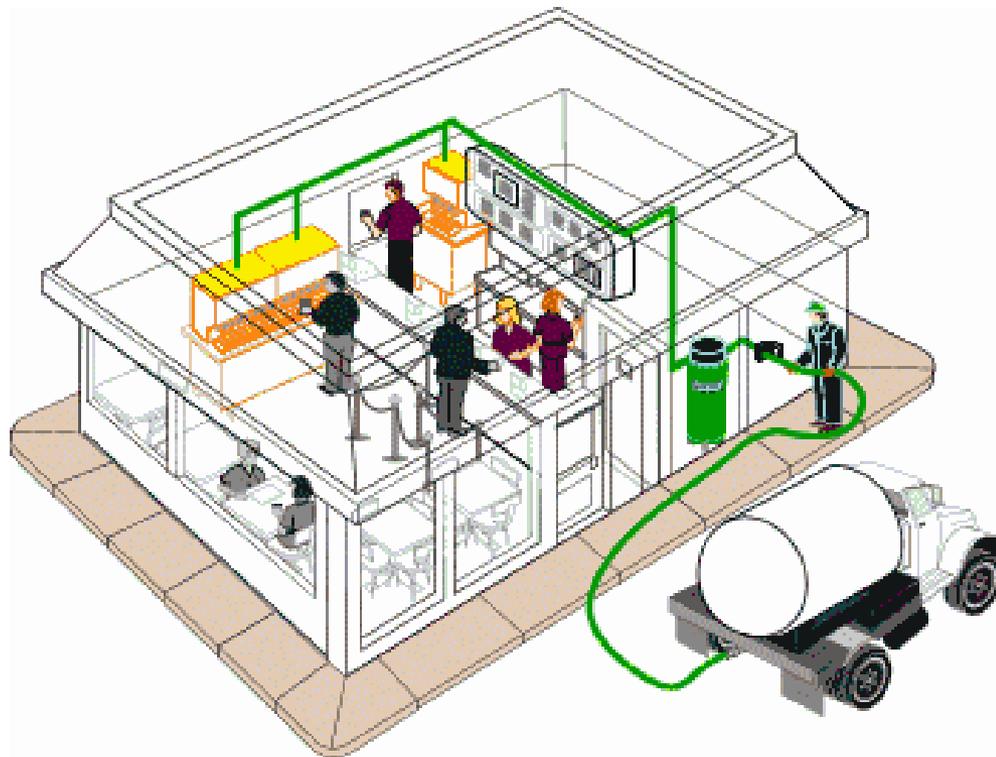
The value of a CO₂ alarm

- Alarms are available that have been purposely designed for the hospitality industry.
- The alarm monitors the level of CO₂ in the air.

How Does It Work?

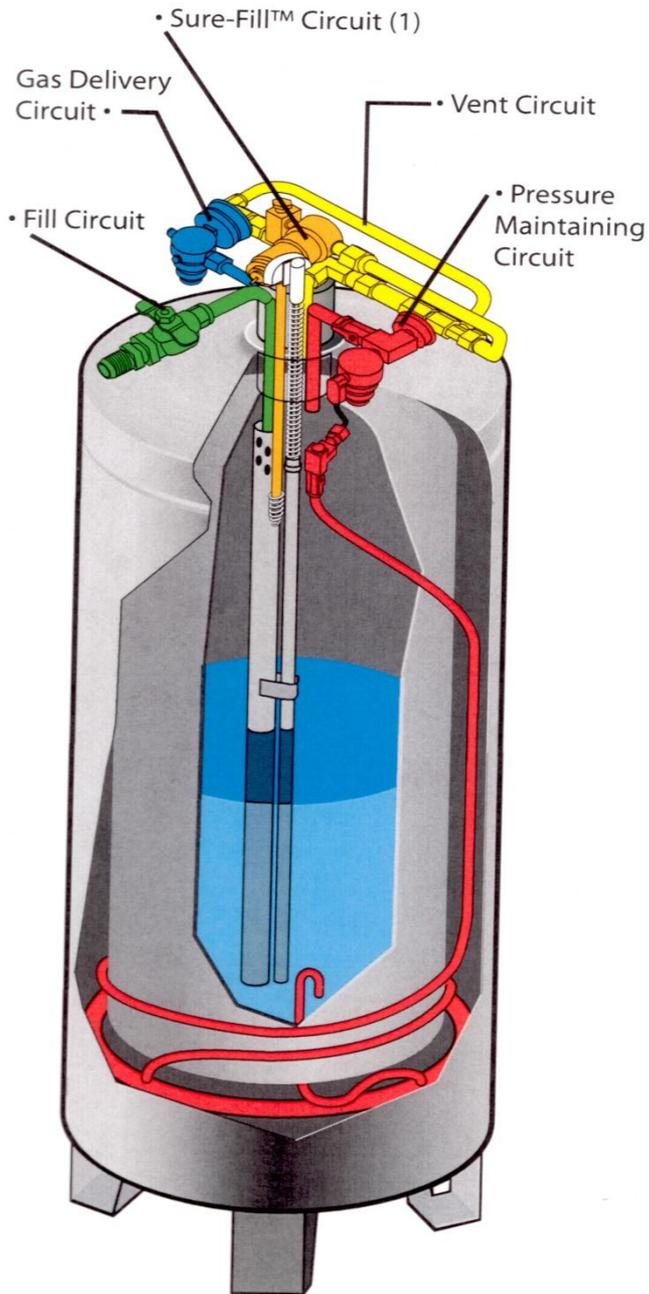
The Bulk CO₂ tank stores carbon dioxide as a cold liquid, which requires less space and lower, safer pressure.

When the store needs CO₂, the Bulk CO₂ tank converts the liquid to gas and supplies CO₂ gas to the carbonator, BIB pumps, bulk syrup or wherever needed.





- A bulk CO₂ system replaces numerous high-pressure cylinders.
- A bulk CO₂ system eliminates the handling of heavy tanks, minimizing store damage and personal injury.
- Low tank pressure creates a safer work environment.



A bulk CO₂ system is a single storage vessel that provides a continuous supply of CO₂ to the beverage machine. The bulk CO₂ tank is located conveniently inside the restaurant. The CO₂ delivery truck connects the hose to a fill box located outside the restaurant, and fills the bulk tank without entering the store.



The Bulk Syrup system consists of two or more bulk syrup tanks permanently installed inside the restaurant. Each tank holds 80 gallons of syrup and replaces bag-in-a-box and other syrup packages.

Syrup is withdrawn from one syrup tank at a time and fed to the beverage machine upon demand. When one tank is completely empty, the system switches to the next full tank.

**Safety Guidelines for Preventing
Potential Carbon Dioxide CO₂
Asphyxiation When Filling Stationary
Low Pressure CO₂ Supply Systems.**

Safety Guidelines

- 1. Personnel handling liquid carbon dioxide should be thoroughly familiar with the hazards associated with this product.
- 2. When new carbon dioxide receptacles are installed (as in new construction or remodeling), they should be installed at ground level in an open area.
 - If feasible, it is recommended that existing CO₂ fill stations be relocated to above grade locations in order to prevent dangerous accumulations of CO₂ in below grade areas.
 - Where fill stations are located in confined spaces, the requirements of the permit in the required confined space standard must be followed.

Safety Guidelines

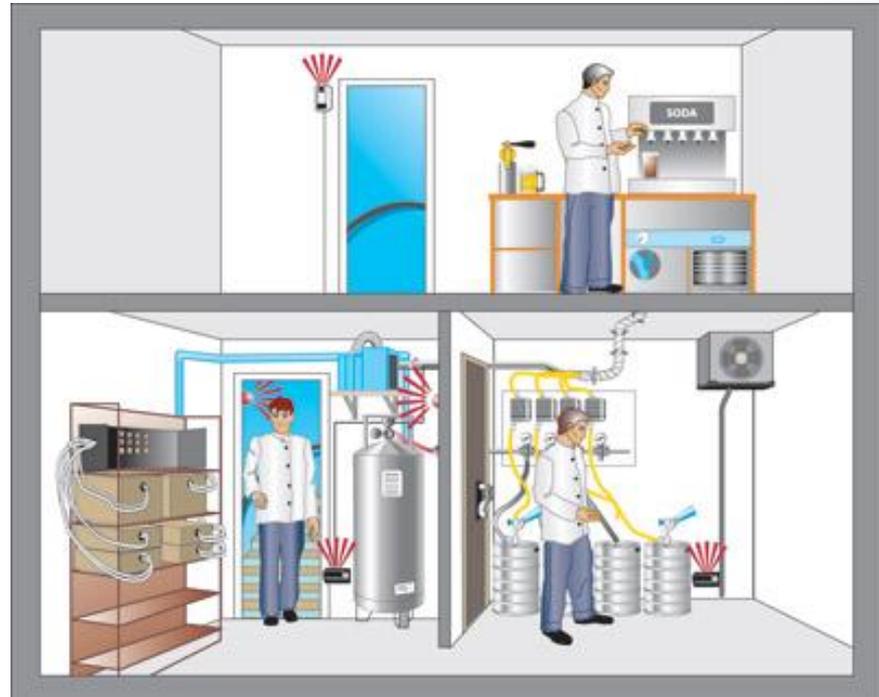
- 3. Even when carbon dioxide is delivered in enclosed areas or below grade locations that are not confined spaces, it is necessary to ventilate such areas adequately to maintain a safe working environment for personnel.
 - Since gaseous carbon dioxide is 1.5 times denser than air, it will be found in greater concentrations at low levels.
 - Therefore, ventilation systems should be designed to exhaust from the lowest level and allow make-up air to enter at a higher point.

Safety Guidelines

- 4. Develop and implement a procedure to monitor the atmosphere for CO₂ and provide local ventilation where levels may exceed the PEL.
 - **Do not** depend on measuring the oxygen content of the air because elevated levels of carbon dioxide can be toxic, even with adequate oxygen for life support.

Safety Guidelines

- 5. A Carbon Dioxide Detection device, and notification system should be provided to alert employees and the public of a hazardous condition.
 - Two notification methods are recommended, audible and visual. They should be provided near the area or room where the carbon dioxide cylinders are located, as well as the common area where the public gathers.
 - The Carbon Dioxide gas detection systems should send a signal to an approved central station to notify the fire department when the gas detection device reaches 30000 ppm



Safety Guidelines

- 6. Appropriate warning signs should be affixed outside of those areas where high concentrations of carbon dioxide gas can accumulate. Recommended language is shown below:

- CAUTION - CARBON DIOXIDE GAS
Ventilate the Area.

A High CO₂ Gas Concentration May Occur in this Area and
May Cause Suffocation.

Safety Guidelines

- 7. Establish a procedure for inspection and maintenance, at regular intervals, of all piping tubing, hoses, and fittings. The entire system should be maintained by qualified personnel in accordance with the manufacturer's instructions.
- 8. Provide adequate lighting to enable workers to use these systems safely.

Summary

- The employer needs to be aware of the risks of working with CO₂, especially when it is stored in an enclosed space such as a walk-in cooler or enclosed backroom.
- It is paramount that employers ensure that all their staff, whatever their level and experience, understand the risks from working with CO₂, and know the symptoms which could indicate that the gas is leaking.
- Installation of gas analysis equipment is a simple move which any proprietor can take to ensure that staff and customers are safe and lower their risk management.

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