



CO2 safety – Considerations for merchant carbon dioxide applications

By [Sam A. Rushing](#) on May 23, 2012

Numerous CO2-related organisations and publications provide guidance and govern the aspects surrounding safety in the merchant CO2 industry. The material safety data sheet (MSDS), which is provided by the CO2 suppliers, is quite a comprehensive means of understanding safety considerations when handling and working with carbon dioxide.

In the US, the Compressed Gas Association (CGA) improves safety measures in the CO2 industry through the development and revision of safety publications that relate to the industry at large. Further, the CGA provide guidance to government regulators for the creation of regulations and rules.

The CO2 specifications outlined in the CO2 publications encourage standardisation with product quality, and standards for allied equipment, thus enhancing safety, quality, and productivity.

Next, there is OSHA, a federal agency which has stated standards surrounding safely handling CO2. In the US, there are also agencies such as DOT (US Department of Transportation), which has its own safety regulations associated with CO2 transportation.

Health risks for CO2 are the greatest among specific occupations, including CO2 manufacturers, brewers/ethanol producers, miners, carbonated beverage workers, and grain elevator operations. However, in my experience, perhaps the worst offenders have often been a range of meat and food processing plants; and secondly, dry ice manufacturing and storage facilities. On the subject of the former, I can readily state that many food processing plants have inadequate CO2 venting into the atmosphere (often from

cryogenic freezers with inadequate ventilation) and operations which produce CO2 snow for products such as boxed poultry.

This dry ice snow sublimates and gases can exceed reasonable levels for comfort and ultimately safety. Of course there are OSHA standards which have the PEL (personal exposure level) limits set at 5,000 ppm or 0.5%, limited to an 8-hour work period for such workers exposed to the gas. Often atmospheric content for CO2 has been defined as 0.035%, however over time, due to rising carbon content in the atmosphere and rising greenhouse gas levels, this value may be rising in true terms.

In any event, as CO2 values increase, and exposure is a greater risk, varying health risks and results may happen when CO2 concentration rises – as shown in the table (below).

CO ₂ Content (%)	Resultant Health Risk/Physical Reaction
2-3	Shortness of breath, deep breathing
5	Intoxication, heavy breathing, increased pulse
7.5	Dizziness, increased blood pressure, headaches, visual distortion
10	Nausea, impaired hearing, vomiting, loss of consciousness
30	Convulsions, coma, and death

OSHA has more specific definitions covering CO2 exposure in the workplace, where values are expressed as 'permissible exposure limit', 'time weighted average' and more. High levels of carbon dioxide in an outdoor setting can also occur, such as from underground mining operations, natural gas production operations, and as a product of volcanic activity. In any event, one should carefully note the physical and physiological signs which can result from exposure to higher than comfortable or safe levels of CO2.

The Material Safety Data Sheet, once again, is an excellent tool of a comprehensive nature, giving the chemical company identification for contact information, then hazards identification with a full disclosure of physiological effects, and the potential health effects for all forms of CO2 during exposure. There is first aid information provided, provisions for fire fighters, and accidental release measures; here duly noted a need for breathing apparatus in the event of product loss, and the need for ventilation. Under handling and storage of CO2, the subject of extreme cold is noted and the precautions needed for displacement of oxygen by CO2 due to a heavier-than-air state.

The information for personal protective equipment (PPE) for insulated gloves, eye and face protection and in particular, respiratory protection is well noted. Much more is further noted, including toxicological and transport information, and regulatory information too. Retarding the hazardous effects of CO2 starts with using common sense and understanding the hazards surrounding the commodity, including applying caution to the application of the product in contained areas, and the need for proper ventilation.

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CO2 is also categorised as an asphyxiant, which is one common application in livestock kill operations; where hog-kill operations commonly use CO2 specific for this service. Keeping this in mind, one must always be aware of the potential for breathing excessive levels of CO2.

Of course, the subject of gas and liquid storage under pressure is another subject which must be respected, whereby all high pressure storage vessels have the potential for hazardous conditions. I have also noted during my tenure in the CO2 industry that I have observed many marginally vented CO2 consuming operations, such as food processing plants and dry ice pressing/storage operations, which tend to be some of the worst offenders with respect to exposing workers to excessive levels of airborne CO2.

It is also essential to review the MSDS provided by the gas suppliers; and post appropriate notices and signs in all CO2 producing and consuming operations – usually in conjunction with the rules and laws surrounding the use of gases. Organisations including the CGA, OSHA, and the gas companies themselves are the best sources of information and data which is necessary to make a workplace safe, and for the safe handling of the product to occur.

The US Supreme Court gave a final opinion during the summer of 2012, reaffirming its finding that CO2 is an air pollutant, subject to control under the Clean Air Act, and upheld the authority of the US Environmental Protection Agency (EPA) to regulate the greenhouse gas. This is a significant definition on the US federal level, pertaining to CO2 being a pollutant. In the end, as CO2 levels rise globally, the end result will lead to global warming; and all of the products of climate change have an adverse effect on the world's health at large.

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Of recent change surrounding CO2 safety in the US, is the 3rd January 2012 signing of the pipeline safety act, which addresses pipeline safety-related issues which have been brought to the forefront by a series of high profile incidents surrounding all types of pipelines. Within this bill, carbon dioxide pipelines are addressed, which require the DOT to prescribe minimum safety standards for transporting gaseous CO2 via pipeline.

Of course the concern is leakage and blow – out of a pipeline carrying the commodity; and of course such would represent anything from simple discomfort to death as a product of CO2 loss from such a pipeline, in the event of a leak or accident. Since the era of CO2 sequestration projects began, more pipeline projects have appeared. To date, CO2 pipelines in the US have experienced few serious accidents. According to statistics, some 12 leaks have been reported from 1986 through to 2006; none resulting in injuries.

However, as more CO2 pipelines for sequestration and EOR are built, the subject of CO2 pipeline safety is magnified.

Concluding thoughts

In conclusion, carbon dioxide, when handled improperly as a gas, liquid, and solid, can be very harmful, and even deadly. On the other hand, with sufficient precautions taken, the commodity can have many safe, environmentally friendly, and satisfying applications in industry.

The means toward the actual application, from recovery, through refinement/production, then through storage and transportation to the customer, has a vast number of potentially dangerous mishaps which could occur if not handled properly, and if the hardware is not functioning properly as well. From the recovery, production and storage prior to delivery, possible dangers surrounding inhaling excessing amounts of product exist, along with pressurised vessel leakage and blow-out – and cold surfaces can all present their dangers.

Safety considerations surrounding the transfer of product and integrity of hoses, vessels, and hardware surround the next step (that being loading the product into transportation vessels) and handling dry ice are potentially hazardous, and all have definitions surrounding proper safety considerations.

Further still, delivery of the commodity to the customer and viable storage vessels for liquid, and for dry ice, proper ventilation when handling dry ice must be observed; then the actual application of the commodity in the service chosen is also surrounded by safety considerations.

About the author

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