

## AWARENESS

### WHAT IS CARBON DIOXIDE?

Carbon dioxide gas is **colourless** and **odourless** gas or extremely **cold** liquid under pressure or refrigeration. It will not **burn**. Carbon dioxide is a **compressed** gas. It can displace oxygen in air and may accumulate in low areas which can be a confined space hazard. Carbon dioxide is a very mild central nervous system **tranquillizer**. Very high concentrations may cause headache, nausea, dizziness, sweating, restlessness and disorientation. Liquefied gas may cause **frostbite**.

### FORMS OF CO<sub>2</sub>

At higher concentrations it has a sharp, acidic **odor**. Another form of solid carbon dioxide observed at high pressure is an amorphous glass-like solid.

Carbon dioxide has **no** liquid state at pressures below 5.1 standard atmospheres.

### AIR QUALITY

Carbon dioxide (CO<sub>2</sub>) is a by-product for indoor pollutants emitted by **humans** and relates with human metabolic activity. Carbon dioxide at levels that are unusually high indoors may cause occupants to grow **drowsy**, get **headaches**, or function at lower activity levels. Humans are the main indoor source of carbon dioxide. Indoor levels are an indicator of the adequacy of outdoor air ventilation relative to indoor occupant density and metabolic activity.

### INDUSTRIAL APPLICATIONS OF CARBON DIOXIDE

- Foods
- Gas Stunning
- Flash Freezing
- Green Houses
- Mushroom Growing
- Beverages
- Wine Making
- Fire Extinguisher
- Refrigerant

### CO<sub>2</sub> EXPOSURE

Workers briefly exposed to very high concentrations showed damage to the **retina**, sensitivity to **light** (photophobia), abnormal **eye** movements, constriction of visual fields, and enlargement of blind spots. Exposure to up to 3.0% for over 15 hours, for six days, resulted in decreased night vision and colour sensitivity.

### TYPICAL CONCENTRATIONS

Carbon dioxide CO<sub>2</sub> levels outdoors near ground level are typically 300 ppm to 400 ppm or 0.03% to 0.040% in concentration. Carbon dioxide (CO<sub>2</sub>) levels indoors in occupied buildings are typically around 600 ppm to 800 ppm or 0.06% to 0.08% in concentration.

### EXPOSURE ROUTES

- Inhalation
- Ingestion
- Dermal

### ASSIGNED RESPONSIBILITIES

According to the Occupational Health and Safety Regulations (OHSR), employers must develop and implement an **effective** health and safety program, which includes **training** workers and supervisors in relevant sections of the program.

### HAZARD ASSESSMENT

The potential hazard to workers from Carbon Dioxide must be assessed. This should be done by a **qualified person** familiar with the use(s) of carbon dioxide.

Section 9.11(1) of the OHS Regulation ("Regulation") requires a hazard assessment and written confined space entry procedures be prepared by a "qualified person who has adequate **training** and **experience** in the recognition, evaluation and control of confined space hazards"

### MOST SERIOUS HAZARD WITH CARBON DIOXIDE

CO<sub>2</sub> has been recognised as a **workplace hazard** for over a century. It is significantly **heavier** than air and many **fatalities** from suffocation have resulted from entry into pits, tanks, sumps or cellars where CO<sub>2</sub> has accumulated and **displaced** oxygen.

### CONTROLLING EXPOSURE

**Engineering** and **administrative** controls are the first line of defence against exposure to CO<sub>2</sub>. Proper building **design** and **ventilation** are important engineering considerations. Monitoring **alarm systems** is also essential in preventing CO<sub>2</sub> exposure.

### HANDLING CYLINDERS

- Store cylinders at or above ground level in a cool, dry, well-ventilated area, out of direct sunlight and away from heat and ignition sources.
- Ground all cylinders and secure them upright
- Leave valve caps on cylinders
- Close all valves when not in use
- Label empty containers
- Store separately from incompatible materials
- Consider a leak detection and alarm system for storage and process areas

## VENTILATION

Ventilation is one of the most common **engineering** controls for airborne contamination. It is also one of the most poorly understood. Some ventilation systems are designed to move fresh air in, around and out of rooms. Other systems move air in order to provide a comfortably cooled or heated environment. Still other systems move air to remove airborne contamination from the work environment.

## EQUIPMENT PREVENTATIVE MAINTENANCE

**Employers** are responsible for providing **written** preventive maintenance procedures and **written** emergency procedures to any person who works on a CO<sub>2</sub> system. **Workers** should be familiar with these procedures **before** carrying out repairs or maintenance on the CO<sub>2</sub> system.

## WRITTEN PREVENTIVE MAINTENANCE PROCEDURES

Employers, in consultation with equipment manufacturers or suppliers, must ensure that all equipment is **inspected regularly** and replaced when necessary. Employers must ensure that **written** preventive maintenance procedures and **written** emergency procedures are readily available to and understood by all people required to work on the CO<sub>2</sub> system.

## MONITORING REQUIREMENTS

Monitoring CO<sub>2</sub> is **required** if handled or there is a potential for CO<sub>2</sub> to displace oxygen in a confined or enclosed space.

There are two types of sensors:

- Non Dispersive Infrared (NDIR) CO<sub>2</sub> Sensors
- Chemical CO<sub>2</sub> Sensors

## TRAINING

One of the most important parts of a program to control exposure to carbon dioxide involves **education** and **training**. This training is **required** under R.R.O. 860/90, the (WHMIS) Workplace Hazardous Material Information System Regulation, made under the Occupational Health and Safety Act (OHSA).

## PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment is the last line of defence. It is **vital** in controlling exposure when a CO<sub>2</sub> leak has occurred or there is a possibility of such a leak. Personal Protective Equipment includes eye, skin, and respiratory protection.

## SKIN PROTECTION

- The employer must provide appropriate skin, hand, and foot or body protection if a worker is exposed to a substance or condition which is likely to puncture, abrade or otherwise adversely affect the skin, or be absorbed through it.
- If there is a danger of injury, contamination or infection to a worker's hands, arms, legs, or torso, the worker must wear properly fitting protective equipment appropriate to the work being done and the hazards involved.

## FACE/EYE PROTECTION

It is good practice to protect the eyes from **any** type of contact with CO<sub>2</sub> (causes frostbite).

## RESPIRATORY PROTECTION

Choosing the right respirator **must** be based on both the **needs** of each individual worksite and the **requirements** of the employer's written safe work procedures.

## ESCAPE RESPIRATORS

Two types of escape respirators are acceptable: **bite-block respirators** and **half face piece cartridge respirators**. Bite-block respirators **must** be worn with a nose plug. Anyone entering a CO<sub>2</sub> enclosure for any reason **must** carry an escape respirator and keep it within arm's reach at all times.

## SELF-CONTAINED BREATHING APPARATUS (SCBAs)

Workers **must** use SCBAs when the CO<sub>2</sub> concentration is unknown or is measured at more than 300 ppm. A worker wearing an SCBA **must not** enter a contaminated atmosphere until a second **qualified person** is present, also equipped with an SCBA and ready

## FIRST AID – INHALATION

If symptoms are experienced, **remove** source of contamination or **move** to fresh air and obtain medical advice.

## FIRST AID – SKIN CONTACT

Gas: Not applicable.

Liquefied Gas: Quickly remove victim from source of contamination and briefly flush with lukewarm, gently flowing water until the chemical is removed. **DO NOT** attempt to rewarm the affected area on site. **DO NOT** rub area or apply dry heat.

## FIRST AID – EYE CONTACT

GAS: No effects expected. If irritation occurs, remove source of contamination or move to fresh air.

Liquefied Gas: Quickly remove victim from source of contamination. Immediately and briefly flush with lukewarm, gently flowing water until the chemical is removed. **DO NOT** attempt to rewarm.

## DOCUMENTATION & RECORD KEEPING

Employers are usually required to maintain **written** records of all injuries and treatment given in a first aid treatment record book or log.

## PROGRAM EVALUATION & REVIEW

All documents (Exposure Control Plan, Safe Work Procedures) should be reviewed **annually** at a minimum. They may need to be reviewed more frequently if there are concerns, problems or changes in the processes, equipment or materials used.