

## Carbon monoxide

# Speaking Up on the Silent Killer

**ATTENDING WHAT WAS THOUGHT** to be a cardiac arrest call at a Calgary residence in December, eight emergency workers found out too late that a high level of carbon monoxide (CO) was the real culprit. They were fortunate enough to remove themselves from the hazardous environment before succumbing to harm.

That's not always the case with CO, often dubbed the "silent killer". The Calgary incident raises questions and may offer life-saving lessons. It also speaks to the importance of CO detection, education and communication.

That need may surface at countless workplaces: a cleaner, polishing a retail store floor with a propane-powered burnisher, loses consciousness; eight Toronto subway maintenance workers, operating gasoline-powered equipment inside a tunnel, begin feeling the effects of CO exposure; a farmer, using a gas-powered washer to spray down the inside of his barn, falls unconscious.

Fortunately, the Calgary emergency workers look to be showing no signs of ill effect. But that, too, is not always the case with CO. True, the cleaner has since recovered from his scary encounter, but two subway maintenance workers were still sick a year after their exposures. And the farmer? He's dead.

### Telling signs

Carbon monoxide, the result of incomplete combustion of carbon-containing fuels, can be lethal and, having no colour, odour or taste, may not be recognized as being present without the use of some detection aid. At low levels of exposure, flu-like symptoms can occur, such as dizziness, confusion, headache and nausea.

Once inhaled, CO quickly deprives the bloodstream of oxygen by binding with hemoglobin. Work Safe Alberta notes that "hemoglobin is a compound that usually carries oxygen. However, hemoglobin takes up carbon monoxide much more readily than it takes up oxygen, forming a compound called carboxyhemoglobin (COHb). The more COHb that is formed, the less oxygen the blood will be able to carry."

A regular supply of oxygen to body tissues is critical if they are to continue functioning, the Canada Safety Council (CSC) reports. The brain is particularly vulnerable to inadequate oxygen supply, and many warning signs of CO exposure are the result of brain malfunction.

Such was the case for the Calgary emergency workers shortly after entering the home of an elderly couple last December 5. "They were symptomatic, to be sure," Stuart Brideaux, a public education officer for Calgary Emergency Medical Services (EMS), says of the responders.

"They were getting dizzy, they were feeling nauseated, they had headaches," Brideaux reports.

The couple's son had called 911 after discovering his father collapsed, unresponsive and not breathing, says Jeff Budai, public information officer for the Calgary Fire Department (CFD). Police officers, firefighters and paramedics charged into the house, unaware that a vehicle running in the attached garage was providing an ever-growing supply of CO.

A fire captain speaking to the son inside the house noticed he had started to sway from side to side. The odd behaviour triggered alarm bells.

Suspecting CO, the captain ordered the house evacuated. Two firefighters returned to their pumper, put on breathing apparatus, and re-entered the home, Budai reports. Locating the elderly mother unconscious in one bedroom, she, too, was quickly removed from the home.

Eight workers — four firefighters, two paramedics and two police officers — were taken to hospital, where they received treatment for CO exposure. The son survived but, tragically, lost both of his parents.

CFD readings showed CO measurements of more than 1,000 parts per million (ppm). Alberta does not have a regulated 15-minute occupational exposure

limit (OEL) for CO, but 100 ppm is a common measure elsewhere. The eight-hour OEL in Alberta is 25 ppm.

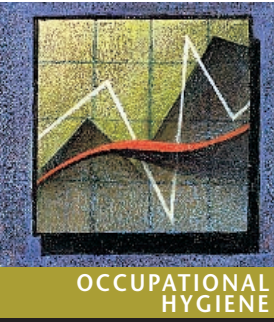
### Aiming low

In practice, occupational hygienists aim to keep exposures even lower. Susan Ing, occupational hygiene specialist with the Industrial Accident Prevention Association (IAPA) in Mississauga, Ontario, cites what are often called "action limits," about 50 per cent of the OEL.

For instance, says Ing, if an environment has persistent CO levels, steps should be taken to reduce them. "We certainly don't want a company to say, 'Oh, we're fine [at] 25 ppm. Go back to work,'" she says, adding that some companies opt for action limits as low as 10 per cent.

Not all people exposed to CO react in the same way. Pregnant women, the physically active, older workers, heavy smokers and people with respiratory or heart diseases are more vulnerable to CO "because of their greater need for oxygen or an impaired ability of their bodies to provide an adequate supply," notes a CO information booklet from the IAPA. The effects of CO exposure, the booklet states, vary according to concentration level:

- 30 to 60 ppm — fatigue may begin to set in;
- 60 to 150 ppm — frontal headache and shortness of breath;
- 150 to 300 ppm — throbbing headache, dizziness, nausea and diminished manual dexterity;



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## A Little Learning

Work-related carbon monoxide (CO) exposures continue to occur across Canada, despite a wealth of hazard bulletins, guides and websites dealing with the deadly gas.

"There's always more opportunity to get education out there," says Al Johnson, regional director for construction and occupational hygiene at WorkSafeBC in Vancouver. However, there are "so many different things out there that people need to be reminded of," Johnson adds.

On the opposite coast, the Workers' Compensation Board of Nova Scotia wrestles with the same dilemma. Mary Kingston, director of communications for the board, makes it clear that CO exposure is an important issue, but others, such as back injuries, sometimes take centre stage given the number of claims involved. CO exposure is instead included in the board's general awareness messaging, Kingston says.

"Any time that there is a death [from CO], one could make the argument that more needs to be done," notes Michelle Vanek, communications advisor for Ontario's Technical Standards and Safety Authority.

Employers should be clear that they are not excused from taking preventive steps. By tapping into the Internet and other sources, employers can provide workers with crucial CO information without incurring significant expenditures, suggests Chet Ramphal, a trainer/consultant with Occupational Health and Safety Consultants Inc., a private firm in southern Ontario.

"Knowledge is still lacking for employees regarding the potential hazards [of CO]," Ramphal argues.

- 300 to 650 ppm — severe headache, nausea/vomiting, confusion and possible collapse;
- 700 to 1,000 ppm — convulsions and coma;
- 1,000 to 2,000 ppm — potentially fatal impairment of heart and lung functions; and,
- more than 2,000 ppm — unconsciousness and death.

For the Calgary emergency workers, however, their brush with CO may have been avoided altogether.

The emergency call came in as a purely medical call, says Brideaux. As far as paramedics knew, one elderly man was unconscious, suffering possible cardiac arrest. Had the information received been different, even slightly, responders might have suspected CO, he suggests. Firefighters wearing self-contained breathing apparatus would enter a CO-rich environment first.

While there has been no change to the CFD's policy on responding to hazardous environments, CO now seems to be more top of mind and firefighters have been reaching for their detectors more often, Budai reports.

### Back and forth

Overall, the Calgary incident underscores just how crucial information is to safely work, whatever those duties may be. For the Toronto subway workers, important questions remain, answers to which may help determine if inadequate information-sharing or non-compliance played a role in the CO exposures during the early-morning hours of February 7, 2006.

The eight-person maintenance crew, including a foreman, was using a gasoline-powered generator and power washers to remove man-made mineral fibre (MMMF) from the interior of a tunnel, reports Ontario's Ministry of Labour (MOL). As that removal work was under way, a separate work crew elsewhere in the same tunnel was taking out asbestos-containing insulation.

Since the two crews shared a single mechanical ventilation shaft and because asbestos was being disturbed, the ventilation system could not be activated, explains John O'Grady, chief safety officer for the Toronto Transit Commission (TTC). Without adequate ventilation, unsafe levels of CO built up.

The eight workers had to be rescued by Toronto firefighters, whose CO detectors registered concentrations in excess of 1,000 ppm, the MOL notes. Fortunately, no lives were lost.

Did the crew members removing the MMMF know the ventilation system was inactive? Had they been informed, prior to work beginning, about the sources, warning signs and health risks of CO? And who made the decision to work without ventilation? O'Grady is unable to provide answers, noting that charges

against a TTC general superintendent are still before the courts.

Some conclusions, however, have been reached. In December, the TTC was fined \$165,000 for failing to ensure no internal combustion engines were operated unless fumes or gases were discharged to a remote outdoor location, or unless there was an adequate supply of air for combustion and adequate natural or mechanical ventilation to ensure gases or fumes would not accumulate.

The TTC has taken lessons to heart. To that end, O'Grady says it is hoping to move away from gas-powered equipment and has already purchased \$800,000 worth of battery- and diesel-powered units (with emission controls). As well, the incident has highlighted the need to conduct work risk assessments to ensure, among other things, that scheduled work is compatible.

These changes are part of a larger, systemic adjustment to TTC safety culture, says O'Grady. "That was a terrible incident, but hopefully that will make [the TTC] a better company for all the other 12,000 employees."

Lessons can be taken, too, from the cases of the farmer and the floor cleaner. Like the subway crew, the farmer was using gas-powered equipment in a space without adequate ventilation. The task could have been safely carried out by placing the washer's power unit outside of the barn and ensuring exhaust did not enter the barn through an air intake, notes information from the National Institute for Occupational Safety and Health.

Propane-powered burnishers, such as the one used by the cleaner, should be replaced, whenever possible, with battery- or electric-powered models, the Canadian Centre for Occupational Health and Safety advises. Failing that, they should only be used in well-ventilated areas and CO detectors should be employed.

### Persistent numbers

Calgary emergency personnel and Toronto subway workers aren't the only employees being exposed to CO. Statistics from four provinces — British Columbia, Alberta, Ontario and Nova Scotia — show mostly consistent numbers of work exposures.

In British Columbia, between six and 18 workers' compensation claims were accepted each year from 2001 to 2005; from two to 13 each year in Nova Scotia between 2003 and 2007; and from 127 to 214 annually in Ontario between 2000 and 2006.

In Alberta, however, the number of accepted CO exposure claims has recently risen sharply. The combined number of lost-time and disabling-injury claims remained relatively steady from 2002 to 2005, with 21 claims accepted in the latter year. In 2006, there was a marked upturn to 57 claims.

“We don’t know why the numbers would have been up,” says Barrie Harrison, a spokesperson for Alberta Employment, Immigration and Industry (AEII). “It could be due to increased awareness [prompting more reporting]. It could be a statistical blip,” Harrison says.

Other possible contributing factors, he suggests, include a colder winter in 2006-2007 and the continued growth of Alberta’s population and red-hot economy.

### Careful detection

The fact that these work-related injuries and deaths are continuing raises a question: Should CO detectors be required on the job?

Carbon monoxide detectors on the market run the gamut, from single gas-sensing portable models to multi-gas fixed units. Detection ranges differ, with some units maxing out at 200 or 500 ppm; others reach 1,000 ppm.

Typically, a detector can be programmed to sound its alarm according to different criteria — for instance, if the designated short-term or time-weighted average exposure limit is surpassed. Detectors should be placed in any workspace where there is a potential for elevated CO levels, the CSC advises.

Because employers are required to provide safe working environments, they sometimes use periodic or fixed detection systems to ensure CO or other dangerous gases remain below prescribed OELs, says Al Johnson, regional director for construction and occupational hygiene at WorkSafeBC in Vancouver. “We don’t prescriptively say you must have monitors in place, but for

all intents and purposes, that’s often the easiest way to evaluate and control the CO hazard,” Johnson says.

While fixed detectors have their place, the IAPA’s Ing says they are not often seen in the workplace. “They’re very sensitive,” she advises. “If there’s a certain pocket of gas that hits it, the alarm will go off. What happens when it goes off is the employees get annoyed and they turn it off,” she contends.

Michael Glassco, operations manager for Theodor Sterling Associates in Vancouver, also finds a lot of places that probably should have detectors don’t. In particular, environments where propane is burned should have the equipment. “People think propane burns a lot cleaner than gasoline and diesel, but propane pumps out tons of CO,” Glassco says.

There are cases where portable/personal detectors would be more effective than fixed detectors, he says, pointing to a shipping/receiving warehouse. “When that [propane-powered] forklift enters the back of the big truck that it’s loading, that

stationary monitor that’s 50 feet away isn’t helping,” Glassco says. However, a small personal monitor carried by the forklift driver would be able to identify localized pockets of CO.

Indeed, a 61-year-old Calgary business owner died in January after he was exposed to CO levels that averaged 436 ppm in the closed storage bay where he had been working. A propane-powered forklift was the likely source, says the AEII’s Harrison.

The best option of all is to eliminate or greatly reduce CO at its source, Glassco emphasizes. A second step is to install a ventilation system, with personal protective equipment, including respirators, as the third line of defence. ●HS

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