Case Study: Carbon Monoxide

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Carefully read the background information in articles before answering the following questions.

1. a) How does carbon monoxide enter homes?
   
   b) Why is carbon monoxide considered so dangerous?
   
   c) What are the symptoms of carbon monoxide poisoning?

2. Carbon monoxide has a strong affinity for haemoglobin, Hb, which can be represented by the following equilibrium equation.

   \[ \text{Hb(aq)} + 4\text{CO(g)} \rightleftharpoons \text{Hb(CO)}_4(aq) \quad \text{Keq} = 1.46 \times 10^{17} \]

   A person breathing air that contains carbon monoxide converts his/her haemoglobin to Hb(CO)_4, thus reducing the blood’s normal oxygen-carrying capacity.

   Blood typically contains 0.002330 mol/L Hb. If the equilibrium concentration of Hb in the blood after a person has been breathing carbon monoxide is found to be 0.000932 mol/L, what is the concentration of free carbon monoxide in the blood at equilibrium?

3. Having read the two articles, do you think a regulation requiring carbon monoxide detectors should be considered in Nova Scotia? Write a paragraph using the material from the articles as the basis for your argument. You should use at least four pieces of information to support your opinion.
Precautions can prevent carbon monoxide dangers
By Hoi Sin Lai, The Western herald, October 20, 2003

Fuel-fired furnaces, gas water heaters, gas stoves, and automobiles are intended to improve the lives of people, but they could also be killers if improperly used.

“These devices could possibly release carbon monoxide, a toxic gas that can cause death in a few minutes” said David Huffman, assistant professor of chemistry at Western Michigan University. “Every year, more than 200 people in the United States are killed by accidental carbon monoxide poisoning from fuel burning appliances.”

Carbon Monoxide is a colorless, tasteless, odourless and non-irritating gas that is undetectable to humans. Incomplete burning of solids, liquid, or gaseous fuels such as natural gas, liquefied petroleum, oil, kerosene, coal, and wood produces carbon monoxide.

Huffman said the gas is toxic because after people inhale it, it strongly bonds to the oxygen carrying protein in the bloodstream and cannot be released out of the body immediately. That protein then becomes no longer available for transporting oxygen, which is vital for human survival. “If we don’t have enough oxygen, we just can’t live,” Huffman said. “If our blood cannot get oxygen to ourselves, we’re going to be history.”

According to the Consumer Product Safety Commission, the health effects of carbon monoxide depend on the concentration of carbon monoxide and each individual’s heath condition who is exposed to the gas. High concentrations of carbon monoxide in a person’s system can induce a coma or cause death. According to the commission, initial symptoms of carbon monoxide poisoning are similar to the flu. They include headache, fatigue, nausea, dizziness, and shortness of breath.

Huffman said people should carefully use the appliances operated with these fuels and check them regularly because the appliances may be operating improperly and may cause carbon monoxide to leak out. When using such appliances, people should make sure to use them in places with enough ventilation, where the gas can be diluted by a large amount of air in the atmosphere.

City may require CO detectors in homes
By Melissa McGrath, The Diamondback, October 3, 2003

“Carbon monoxide detectors may be required in every College Park, Maryland home if the City Council approves a recommendation at the beginning of next year,” city officials said, but it may meet opposition from landlords who say they are unnecessary.

The detectors would alert the household when there is an unhealthy amount of carbon monoxide – a colorless and odourless gas that can come from any fuel-burning appliance such as a car or gas generator. Detectors calculate the amount of carbon monoxide in the air as well as how long it has been there, said Ken Giles, U.S. Consumer Product Safety Commission spokesman.

At least six people in Maryland and Virginia died of carbon monoxide poisoning after using generators in their homes during Hurricane Isabel.

The recommendation is still in the study phase and will be researched further, but Bob Ryan, director of Public Services, said he thinks it has a good chance of passing. “I think it’s feasible. The technology is affordable and it’s not a major expense,” he said.

Others would like to see more evidence before deciding if the requirement is a good proposal. “I’m not sure it’s necessary,” said Dave Dorsch, chairman of the city’s Landlords’ Committee. “I would rather see some studies instead of just launching into it.”

Dorsch said despite the benefits, there are some problems with carbon monoxide detectors. Because people cannot see or smell carbon monoxide, some may think it is a false alarm if the detector goes off.

But Giles said carbon monoxide detectors have improved greatly over the past decade. “Ten years ago, CO alarms were much more sensitive,” Giles Said. “False alarms were a problem, especially on a heavily-polluted summer day.” But the Underwriters Laboratories “improved the standard of detection for alarms on the market. It will wake you up before the health effects show up,” he said.

Although Giles said he has no formal position on the city’s proposal, he thinks it beneficial for every home to have a detector because “any fuel-burning appliance has the capacity to generate carbon monoxide.”

Yukon to make carbon monoxide detectors mandatory
Law would apply to homes with oil-fired furnaces or attached garages
CBC News Posted: Feb 16, 2013 8:22 AM CST  Last Updated: Feb 16, 2013 1:00 PM CST

The Yukon government is set to make it mandatory for homes to have a carbon monoxide detector.

The change to legislation would apply to every home that heats with an oil furnace and those with attached garages.

Another change would require the use of a certified oil-burner mechanic when installing or modifying heating appliances.

A news release from Elaine Taylor, minister of Community Services, said the legislation could be passed in the spring.

The change is one of the recommendations of a working group formed after five people in Whitehorse died of carbon monoxide poisoning in January 2012.
Carbon monoxide detector standards
By Carbon Monoxide Survivor.com (n.d.) Retrieved 2013-04-17

Carbon monoxide is a leading cause of poisoning death and poisoning related injury worldwide.

Obviously carbon monoxide detector standards are important but do existing standards actually protect your health and family? Shockingly they only protect against acute poisoning but do not protect against chronic poisoning.

Carbon Monoxide Alarm Standard (USA & Canada) UL-2034 / CSA-6.19

This standard was implemented in the early 1990’s to cover detectors supplied and used in the US, Canada, and Mexico. The standard has been amended a number of times since its inception (1997, 1998, 2001). Products officially approved to this standard must be clearly marked with the UL symbol.

American carbon monoxide detector requirements:
• Must NOT sound an audible alarm at 70 ppm or less for 60 minutes
• Must NOT sound an audible alarm at 30 ppm for 30 DAYS
• MAY NOT sound an audible alarm at 70 ppm for up to 4 hours, [240 minutes]
• ALL UL-2034 / CSA-6.19 CO alarms are “Tested” only at 70, 150 and 400 ppm
• The Standards state that 70 ppm can be +/-5 ppm; therefore the LOWEST LEVEL that a UL-2034 / CSA-6.19 C O alarm MUST BE TESTED is 65 ppm.

The "WARNINGS LISTED" on every UL-2034, CSA-6.19 or I.A.S. detector make it VERY CLEAR that their alarms DO NOT provide "Health" Protection because they FORBID AUDIBLE WARNINGS AT 30 PPM for 30 DAYS; thereby providing NO, ZERO PROTECTION from chronic low level carbon monoxide poisoning.

European CO Detector Standard: ENS0291

This standard was implemented in April 2001 and superseded the British Standard BS7860 in April 2006. Approved products must be clearly marked with the ENS0291 number and may also display the Kitemark symbol.

European carbon monoxide detector requirements:
• at 30 ppm CO, the alarm must not activate for at least 120 minutes
• at 50 ppm CO, the alarm must not activate before 60 minutes but must activate before 90 minutes
• at 100 ppm CO, the alarm must not activate before 10 minutes but must activate before 40 minutes
• at 300 ppm CO, the alarm must activate within 3 minutes

The problem with carbon monoxide detector standards
Carbon monoxide detector standards are designed to trigger alarms when carbon monoxide levels reach a certain level (for a certain amount of time).

They are designed to prevent acute poisoning (one time accidental poisoning). They are not designed to prevent chronic poisoning (multiple low level poisonings).

The standards totally ignore the risk and danger of [ongoing] exposure to low levels of carbon monoxide - which is a genuine threat and danger to a far greater number of people.

For example: The United States (Underwriters Laboratories or UL) and Canada (CSA) have coordinated carbon monoxide standards and product testing. 2010 standards prohibit showing CO levels of less than 30 ppm on digital displays. New standards require the alarm to activate at higher (not lower) levels of carbon monoxide than the old standard.

The reason for the changes is to reduce calls to fire departments, utilities and emergency response teams when the carbon monoxide levels are not life threatening (but ignores the fact that low level CO exposure is health threatening).

This means that new alarms will not sound at CO concentrations up to 70 ppm. It is ironic and "alarming" as this is significantly in excess of Health Canada guidelines as well as Occupation Safety and Health Guidelines.

Detectors with a digital display and a "history" option can provide the true CO concentrations in a house. A low-level display is useful for people with existing respiratory problems, heart conditions, or anyone wanting to be proactive (rather than waiting for a situation to become serious). Low-level CO detection products are commercially available but are not certified to CSA or UL standards as these standards prohibit low-level displays.

Although not widely available, low level carbon monoxide detectors save lives and also alert people to low levels of CO - which can trigger symptoms and injuries.