

Carbon Monoxide - The Silent Killer

By Randolph J. Harris

Two small children were swimming and playing near their parents' new motorboat. One was seen staggering and was brought back on the boat and given water. The other was found ten minutes later, under the boat. The cause of death was not drowning. It was carbon monoxide (CO) poisoning.

Teenagers were having a party in a modern house. Due to the excessive cigarette smoke, they turned on the whole-house attic fan for approximately three minutes. Everyone left except for two boys who slept over in the house. One never woke up again. The cause of death- carbon monoxide poisoning.

Carbon monoxide- The silent and odorless killer. Carbon monoxide is the number one cause of poisoning deaths. Fuel-burning appliances, automobiles and generators make our lives much easier, however, they come with inherent hazards. Carbon monoxide poisonings are often thought to be obvious or fluke occurrences. Careful investigation and analysis is required to determine the true cause and prevent further deaths.

In the boat incident with the two small children, the operation of the boat was not well-understood by the new owners or the seller. When the generator is running, warm water flows out of the side of the boat. This is lake water, which is used to cool the generator motor. It was not understood that deadly exhaust gases were also exiting with this water stream. Generators are unregulated, and therefore produce enormous amounts of carbon monoxide. The 50,000 parts per million (ppm) measured is 1,000 times the OSHA limit (for eight hours of exposure). On this very hot and calm day, the temperature of the cooled exhaust gases was lower than the surrounding air, allowing the gases to settle on the surface of the water, where the children were swimming. At these extreme concentrations, it would only take a few breaths to cause death.

The teenagers were having their party on an extremely cold winter night, so all the windows and doors were closed tightly. The gas appliances in the home had been present for fifteen years and were still operating fine after the poisoning. However, when the whole-house fan was turned on, it reversed the flow of air down the flue pipes, instead of up.

This also caused the furnace burner to operate improperly and produce large amounts of carbon monoxide, which dumped into the living quarters. Within three minutes, the carbon monoxide level throughout the home was 300 ppm. When the attic fan was turned off, the gas burner returned to normal operation. This concentration was not high enough to cause any ill effects to the partygoers by the time they left. However, the concentration was high enough for continued exposure to cause a build-up in the blood of the two young men who remained. The carbon monoxide level in their blood slowly increased until one young man died and the other was put in the hospital.

Carbon monoxide incidents are usually caused by several factors combined. Very rarely is it caused by the "furnace failure" often noted by the gas company or fire department. Typically, in buildings, most of the factors involve improper installation and/or lack of maintenance. Gas appliances can usually operate fairly well for years until that one time when something changes. This one additional factor is "the straw that broke the camel's back." The additional factor may allow the incident to occur, but it is often not the primary cause.

Several people were starting to feel ill in an office building in an eastern US city. The heat exchanger of the furnace had been replaced only two years before. They called a heating contractor. He found a cracked heat exchanger and red-tagged the furnace. A lawsuit was filed against the furnace manufacturer.

Careful examination and testing indicated 14 separate problems, related either to improper installation or poor maintenance. The heat exchanger was found to be cracked, however, this alone did not cause the poisoning. The blower position was such that even though there was a crack, no carbon monoxide entered the heated air. Furthermore, the crack had resulted from not installing the new burners, which had accompanied the new heat exchanger. The old burners were corroded, causing an improper flame pattern. The improper heating of the heat exchanger caused it to crack. A heating contractor had replaced the “one-shot” flame roll-out switch with an auto-resetting type. Thus, the furnace continued to cycle off and on in this improper state. However, these factors were not the primary cause in the poisoning.

The primary cause of the poisoning was two-fold. The flue pipe exited the structure horizontally, out into a basement stairwell. The rectangular hole cut through the masonry wall was never properly sealed, and large gaps were present. The second factor were holes cut in the cold air return duct for the furnace in the basement. This created negative pressure throughout the basement. Thus, the exhaust gases in the basement stairwell were suctioned back into the basement, into the cold air duct and blown out with the heated air.

Four men traveling in a rented RV adventured across a rough field and bottomed out the rear corner of the vehicle. They continued on their way and camped that evening with several other RVs. That evening, they were watching TV and drinking. One of the four came back from visiting friends and said that he thought he smelled exhaust. His three friends ridiculed him, pushed him out the door, and locked it. This unkind act saved his life. In the morning, the three men were found dead from acute carbon monoxide poisoning.

The minor accident of bottoming-out the RV had caused damage. Impact with the ground had broken the hanger on the generator’s exhaust pipe and pushed the exhaust pipe up underneath the vehicle’s skirting. The impact also caused the rear wall to separate slightly from the floor, creating a “chimney.” When the generator was running, poisonous carbon monoxide gas traveled up the chimney and infiltrated the RV. Although the RV had a carbon monoxide detector, its battery was found lying on the bedside table. Apparently, the carbon monoxide alarm had sounded, but the men thought it was a low-battery alert and removed the battery.

In a mountain town, a man suffered a heart attack, brought on by carbon monoxide poisoning. The fire department and gas company found that debris in the chimney had fallen and partially blocked the flue pipe for the instantaneous water heaters. The chimney was cleaned, and the water heaters put back into operation. My investigation revealed that the instantaneous water heaters were still dumping large amounts of carbon monoxide into the living quarters.

Original installation errors were found, in addition to the dirty chimney. The appliances were not properly derated for altitude, and no outside combustion air ducts were present in the mechanical room. Careful examination showed that the metal of the heat exchanger had overheated, flaked, and was now partially blocking the air flow through the appliances. Even though the flue had been cleaned, another poisoning incident could have occurred if these problems had not been identified.

In conclusion, several factors frequently come together in order for a carbon monoxide poisoning incident to occur. It is necessary to look beyond the obvious and find all the contributing factors to understand a carbon monoxide poisoning event.

If you are ever involved with the legal aspects of a CO event, Do Not Change Anything!