Carbon Monoxide: The Silent Killer

May 1, 2017 By Francois Burman, Pr.Eng., M.Sc.

Risk management in our underwater world is something of a paradox: We want to make our dives free of accidents and incidents, but risk is inherent to venturing underwater.

Hazard identification and risk assessment (HIRA), a program based on general safety principles and adapted to suit the situations to which it's applied, is a tool that can empower dive businesses and professionals to assess, acknowledge and then address their approaches to their risks.

By means of this new column we intend to provide dive professionals and divers with useful articles about the risks dive operators face as well as practical, realistic and affordable ways to mitigate them. We begin with a discussion about preventing carbon-monoxide poisoning.

Carbon monoxide (CO), an odorless, tasteless and invisible toxic gas that could find its way into your scuba cylinder, has caused the deaths of divers all around the world.

Our natural environment should contain less than 0.1 parts per million (ppm) of CO. Occupied areas with potential sources of CO, per the U.S. Environmental Protection Agency, may not expose people to more than 9 ppm during an eight-hour period. A short-term exposure of up to 35 ppm within an hour — no more than once a year — is deemed safe.

Scuba divers are faced with a complicating factor: the surface equivalent value (SEV), which means we need to compute our CO exposure based on the depths to which we dive. In a dive on air to 130 feet, with the compressed air having been drawn from the compressor's surrounding environment, a value of 5 ppm (usually quoted as the safe limit) would have roughly the same effect as 25 ppm at the surface. Thus, divers who do multiple dives per year could exceed the accepted safe limits.

CO is produced in several ways. Incomplete combustion of any fuel (gas, diesel, kerosene and other hydrocarbons) usually appears at the top of the list and is most often quoted as the source. Diving businesses, especially those in remote areas, may have any number of motor vehicles, boats and gas- or diesel-powered compressors or generators.

But CO can come from other sources as well; operators of cylinder-filling stations should also consider the following in their environments:

- furnaces, boilers, wood-burning space heaters, water heaters, dryers and cookers
- trash, grass or forest fires
- gas-powered refrigerators
- oil or kerosene lamps
- charcoal grills/barbecues
- vegetable oils used to cook and prepare food
- cigarettes and especially cigars
- paint removers, metal oxide reducers and other organic solvents as well as nonflammable contact adhesives that contain methylene chloride (CH_2Cl_2) (the liver metabolizes this compound to produce CO)
- welding, specifically when carbon dioxide (CO_2) is used as the shielding gas (CO_2breaks down to form CO during the welding process.)
- biomass fuel sources or waste dumps containing vegetation, organic waste, wood or soil microorganisms
- cleaning fluids
- chemicals, reaction agents and synthesizers

Many of these sources are not readily apparent, and all could conceivably be found near an air-filling station.

Cylinder-filling station owners and operators, please take note, and be sure to perform a thorough risk assessment of your environment before you decide where to put your compressors. Ongoing awareness of risks introduced after initial placement is equally important. Knowing what to look for makes it easier to manage this risk.

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Issue

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