SAFETY MEMO

November 1st 2021 – Heavier than Air Inert Gases

Did you know?

Inert Gases

Inert gases are primarily characterized by their relative chemical unreactivity. Unreactive noble gases such as helium, argon, and xenon can be classified under this term. When human safety is concerned, this definition can be expanded to include "physiologically inert" gases. These gases lack toxic properties and cause no immediate reactions to a person's body unlike gases such as methane, butane, and propane.

Asphyxiation

Inert gases in air are typically safe to breathe. Due to their non-toxicity, they cause no long-term or short-term health problems in low concentrations. However, if the concentration reaches a certain threshold, the oxygen in the air is diluted to dangerously low levels. Inert gases are also odourless, making them sometimes difficult to detect.

Heavier Gases

The heavier than air inert gases pose a threat slightly higher than their counterparts. Asphyxiation via the lighter gases is only possible when multiple things go wrong at once. This included confined spaces combined with gas leaks, disregard or ignorance of safety protocol, or a large-scale release of gas. Dense gases like sulfur hexafluoride, argon, or cold nitrogen require only two other circumstances besides accidental leakage to be a threat: improper ventilation, and an area of lower elevation that allows the gas to "settle".

Symptoms

Symptoms vary somewhat depending on the dilution of oxygen and the time exposed to the gas. When the level of oxygen in the air drops below 19%, unnoticeable, but adverse changes, begin affecting the body. At 16%, a person may unconsciously try to compensate for the lack of oxygen and breathe in more deeply and frequently. This hastens the depletion of oxygen in the blood and results in the reduction in higher mental functions, such as coordination, thinking, and attention. Abnormally high levels of fatigue are inflicted on the person at oxygen concentrations below 14%, in addition to emotional imbalances and poor judgment. At 12.5%, respiratory issues may cause nausea and permanent heart damage. Loss of consciousness and convulsions occur at concentrations below 10%.[1] When oxygen levels drop to 4%-6%, death may occur within the next few minutes.[2] Brain damage will occur even if the victim survives. With no oxygen, a person can fall unconscious with only one or two breaths.[3]

Risk Mitigation

While the consequences of inert gas asphyxiation are dire, fortunately there are a multitude of ways to reduce this risk:

- Requiring the use of respirators in environments with low oxygen levels.
- Proper installation and operation of equipment.
- Training staff to properly handle inert gases, respond to gas leaks, and recognize symptoms of asphyxiation.
- Monitoring entry and exit of potentially hazardous areas and confined spaces.
- Identifying and safeguarding potentially hazardous areas.
- Odorizing gases when applicable.
- Designing facilities with proper ventilation, especially in areas where heavier than air gases may collect.
- Installing gas sensors and testing of oxygen content.
- If an accident does occur, avoid initiating a rescue operation without an airtight plan, as poor planning often results in more victims.

[1] U.S. Chemical Safety and Hazard Investigation Board, "Hazards of Nitrogen Asphyxiation", No. 2003-10-B, June 2003.

[2] DiMaio, V., DiMaio, D., "Asphyxia", in *Forensic Pathology*, 2nd ed., CRC Press, 2001.

[3] Asia Industrial Gases Association, "Hazards of Inert Gases and Oxygen Depletion", AIGA 008/11.

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