EIGA Safety Newsletter

Prepared by the Safety Advisory Group

SPECIAL EDITION

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CAMPAIGN AGAINST ASPHYXIATION

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1. Asphyxiation – the silent killer

Each year some 20 deaths are reported worldwide to EIGA involving asphyxiation with industrial gases. Faced with this situation EIGA has decided to launch a Europe-wide campaign and details are given in part 2 of this Newsletter.

Asphyxiation is the greatest hazard associated with nitrogen and other inert gases, such as argon, CO_2 and helium, since they do not support life and are capable of reducing oxygen concentration to very low levels through displacement and dilution. Most accidents occur due to workers entering vessels that are connected to a nitrogen supply and that have not been properly checked for oxygen concentration before entry. Fatalities have occurred due to workers simply leaning in to inspect a vessel with an oxygen depleted atmosphere. Complete entry is not necessary for a very serious or fatal accident to occur. Inhalation of an oxygen depleted atmosphere can cause a person to immediately lose consciousness with no warning, such as dizziness, and die from asphyxiation. Tragically, there have been many examples of fellow workers going to the aid of victims and becoming victims themselves because they were not aware of the cause of the initial incident.

Oxygen Means Life

Oxygen is the only gas that supports life; the normal concentration in the air which we breath being approximately 21%. Any depletion of oxygen below 21% must be treated as hazardous, and relevant precautions taken. The overall effects of reduced oxygen concentration is summarised as follows:

Asphyxia – Effect of O_2 Concentration	
O_2 (Vol %)	**Effects and Symptoms**
18-21	- No discernible symptoms can be detected by the individual. A risk assessment must be undertaken to understand the causes and determine whether it is safe to continue working.
11-18	- Reduction of physical and intellectual performance without the sufferer being aware.
8-11	- Possibility of fainting within a few minutes without prior warning. Risk of death below 11%.
6-8	- Fainting occurs after a short time. Resuscitation possible if carried out immediately.
0-6	- Fainting almost immediate. - Brain damage, even if rescued.

No Warnings

Inert gases such as nitrogen, argon and helium are odourless, colourless and tasteless and, as a result, are insidious in nature in that they give no warning signs as to their presence and the inevitable reduction in the content of the local atmosphere. For an unaware person, the asphyxiation effect of inert gases takes place without any preliminary physiological sign – the action can be very rapid; only a few seconds for very low oxygen contents. Simply "you do not notice you are passing away". For longer exposures to oxygen depleted atmospheres the symptoms of asphyxia may indicate:

⇒ Rapid breathing and shortness of breath
⇒ Rapid fatigue
⇒ Nausea and vomiting.

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However, it is not unusual for the person suffering from asphyxia to be totally unaware of the symptoms and may even feel euphoric. It can take as little as two breaths in an oxygen deficient atmosphere to cause unconsciousness ..... death occurs within minutes.

Confined Spaces

Entry into a confined space presents, by far, the most hazardous situation to those using or exposed to inert gases. Examples of such spaces could be the more obvious ones such as tanks, vessels, reservoirs and underground galleries, but could also include internal rooms of buildings, garage pits, basements, cellars and trenches for piping. Before anyone enters a confined space, it is essential that a formal risk assessment is undertaken which identifies all the hazards and the controls that must be put in place to ensure the safety of any workers. Typical controls would include:

- All staff are fully trained and understand the hazards involved.
- Atmospheric monitoring including the use of personal monitors where required.
- Safe system of work detailing specific instructions.
- Formal mechanical and electrical isolation procedures.
- Provision of the correct personal protective equipment.
- Provision of breathing apparatus.
- Placement of a standby man.
- Provision of alarm system and rescue procedures.
- Adequate warning signs.

Liquid Nitrogen

The use of liquid nitrogen is accompanied by two additional hazards:

- It is a very cold fluid (boiling point –196^{o}C) which can cause serious burns on contact with the skin.
- After vaporisation, it becomes a very large volume of cold gas, heavier than air (1 litre of liquid nitrogen yields 700 litres of gaseous nitrogen) with a tendency to accumulate in low points such as garage pits, culverts and trenches.

In processes where liquid nitrogen is handled and vaporisation takes place, special care must be taken to avoid exposure of personnel to oxygen deficiency. These same warnings are valid for liquid argon and cold vapours from CO_2.

Areas of Regular Work

Because asphyxiation is a widespread and recurring problem for the industry and its customers the Safety Advisory Group of EIGA has decided to launch a campaign to raise the awareness of all those at risk. The classical approach of publishing best practice advice has not been sufficient to get the message home to the many people who need to know. SAG believes there is a need to generate a much better knowledge and understanding of the issues and preventative measures.
Entry into an enclosure or a vessel is normally non-routine work and this work would be controlled by the use of specific risk assessments and a safe system of work. However, there are areas where people regularly work or enter where an inert gas may be present such as:

- Rooms where liquid nitrogen or CO_2 food freezers are located.
- Control rooms (control/analyser panels).
- Compressor houses (inert gases).
- Rooms in which dewars are fitted and/or stored.
- Rooms where dry ice is prepared or handled.

In these instances building sizes, ventilation capacity, system pressures etc. must be determined for each specific case to which the following guidelines apply:

- Ventilation must be continuous with an appropriate number of air changes per hour.
- The ventilation system should be interlocked with the process power supply.
- Exhaust lines containing inert gases to be clearly identified and piped to safe, well-ventilated areas.
- Use of indicating devices such as:
  - Warning lights
  - Streamers in the fan outlet
  - Flow switches.

Consideration should be given to the use of atmospheric analysers, either personal or continuous, in the work area.

Erroneous Use of Nitrogen

In factories, there are often compressed nitrogen networks used for safety purposes, e.g. inerting/purging or using nitrogen as a pressure source to operate pneumatic tools, or as instrument air. In these instances, all nitrogen lines should be clearly marked and, where nitrogen is used for instruments or as a back up for an instrument air system, all lines should be marked as instrument gas and **not** instrument air.

There are numerous reported cases of breathing apparatus being connected to nitrogen systems; to prevent this happening, product specific couplings/quick connectors **MUST** be used on the nitrogen headers.

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Rescue and First Aid

If a person suddenly collapses and no longer gives any sign of life when working in a vessel, a partially enclosed space, a trench, a pit or a small sized room, assume that the person may lack oxygen due to the presence of an inert gas (which is, as has been mentioned, odourless, colourless and tasteless).

WARNING: Do not hurry to help him/her without thinking, the risk is that you will become the second victim.

Only adequately trained personnel should attempt rescue using the correct equipment such as:

- Self-contained breathing equipment
- Safety belts/harnesses and winches
- Personal monitors
- Resuscitation equipment.

Where this equipment is not available, a rescue should not be undertaken.

Once a rescue has been effected, keep him/her warm and administer oxygen from an automatic resuscitator, if available, or supply artificial respiration by an approved method. Summon medical advice and continue treatment until the patient revives.

In conclusion, it is vital to recall the essential two points relative to accidents with inert gases:

- Accidents due to inert gases always happen unexpectedly and the reactions of personnel may be incorrect. Because of this, awareness of personnel with regard to hazards of inert gases must be permanently maintained.

- When such an accident does occur, it is **always** serious, if not fatal, and hence the absolute necessity to carry out regular and periodic training and awareness sessions for personnel, as well as rescue work drills.

References

IGC Doc. 44/00 Hazards of inert gases
IGC Doc. 40/02 Work permit systems

2. EIGA launches a campaign against asphyxiation

Because asphyxiation is a widespread and recurring problem for the industry and its customers the Safety Advisory Group of EIGA has decided to launch a campaign to raise the awareness of all those at risk. The classical approach of publishing best practice advice has not been sufficient to get the message home to the many people who need to know. SAG believes there is a need to generate a much better knowledge and understanding of the issues and preventative measures.

- The EIGA campaign is Europe-wide, targeted at the following users of inert gases:
  - The chemical industry;
  - Builders of chemical and other major plant;
  - Water and other utility companies;
  - The fabrication industry;
  - Laboratories using liquid nitrogen;
  - Users of gases for dispensing beverages (in some countries);
- The campaign will be organised by EIGA and run through each national association affiliated to EIGA. Industrial gases companies will take the lead where no national association exists.
- National associations may decide to reach the target audience by using their member companies' channels of communication.
- SAG has produced a leaflet and PowerPoint presentation which will be the principal tools used for the campaign.
- This leaflet can be translated and customised in each country of Europe.
- The leaflet will give the basic message and publicise the availability of the slide show and other publications from EIGA's website and any national publications and legislation.
- EIGA will prepare a press release and send it to European organisations and magazines with a Europe-wide circulation.
- The national associations will prepare similar press releases based on the EIGA model and circulate them to national organisations and magazines.

The campaign will be launched at the EIGA Winter Technical Meeting, 23rd January 2003.

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