Oxygen Enrichment

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Too much oxygen in the air can be as dangerous as too little. As we know, the air we breathe contains about 21 percent. When the atmosphere is less than 19.5 percent oxygen by volume it's considered an oxygen-deficient atmosphere and when the atmosphere contains more than 23 percent oxygen by volume it's an oxygen-enriched atmosphere. As you can see, just a few percent more or less, from the air we breathe, begins to increase the hazard.

Both conditions are hazardous, but this month's topic is going to address oxygen enrichment. We will review some of the main causes and effects of oxygen enrichment as well as its improper use and the general hazardous conditions and results it can produce.

Partial Properties of Oxygen

Oxygen is colorless, odorless and tasteless, hence the presence of an oxygen-enriched atmosphere cannot be detected by normal human senses and it does not give any physiological effects, which could alert personnel to the presence of oxygen enrichment. Oxygen is not flammable in itself, but supports and accelerates combustion. Materials that do not burn in air can burn vigorously in oxygen enriched air or pure oxygen. In enriched oxygen it's heavier than air and accumulates in low-lying areas. This is particularly relevant when liquid oxygen spills because it is three times heavier than air.

Greatest Risk to Personnel

In enriched oxygen atmosphere the most common combustible materials that directly affects safety and personnel is clothing. Clothing tends to absorb oxygen. All clothing materials will burn fiercely in an oxygen-enriched atmosphere. Even the hair can easily catch fire. Every year several incidents are reported where workers' oxygen enriched clothing catch fire. Fires in oxygen enriched atmosphere start easily and are very intense and people suffer very serious burns, which are often fatal.

If you suspect that your clothing is oxygen enriched, you must not smoke and must avoid all sources of ignition for at least 15 minutes. The clothing must be properly ventilated in a normal atmosphere and away from ignition sources while the oxygen enriched atmosphere in the clothing is replaced by air. The clothing must be loosened, with coats removed, and aerated by movement of the arms and legs to help disperse the oxygen enriched air.

A person whose clothing catches fire should be deluged with water by hose or any means possible, from a distance, and removed to fresh air as quickly as possible. It is extremely dangerous to attempt to rescue a person on fire in an oxygen-enriched atmosphere, because the rescuer will most likely catch fire also. A rescuer may be able to enter such a space, in certain cases, if the rescuer is totally deluged with water and protected by constant water hosing.

Causes of Oxygen Enrichment

o Leakage of equipment because of damage, poor connections or poorly maintained equipment.
o Failure to close cylinder valve or oxygen supply stop valve.
o Opening valves deliberately or accidentally.
o Poor ventilation where oxygen is used.
o Excess oxygen in metallurgical processes such as gouging, cutting, scarfing, lancing, etc.
o Venting from cryogenic receptacles.
o Oxygen vents.
o Improper use of oxygen for such things as:

- Driving pneumatic tools,
- Inflating vehicle tires,
- Cooling or freshening the air,
- Cooling of personnel,
- Blowing off benches, machinery and clothing,
- Starting diesel engines,
- Cleaning parts,
- Pressurizing hydraulic systems.

o Respiratory oxygen therapy where the air can become oxygen enriched.
o Liquid oxygen spill.
o Desorption*.
o Liquid disposal**.
o Liquefaction of air***.

Oxygen Enrichment Precautions and Safeguards

o Comprehensive employee training regarding improper use of oxygen and oxygen enrichment hazards and safeguards are critical.
o Smoking must be forbidden in all areas where oxygen enrichment is possible.
o Ensure that only equipment and material approved for use in oxygen is placed in service and it is properly maintained. All replacement parts must be approved for oxygen service.

o Make sure that all equipment is leak-tight and in good operational condition.
o Ensure that employee clothing is free from oil and other easily combustible contaminants.
o Never use oil or grease to lubricate oxygen equipment.
o Atmospheric analysis in confined spaces or areas with restricted or limited ventilation.
o Control access of personnel to oxygen enriched zones (e.g., vents, disposal areas etc.).
o Use personnel monitors in potentially oxygen-enriched atmospheres.

Training

In addition to using the material in this safety topic to accomplish your training, you should also utilize your oxygen Material Safety Data Sheet (MSDS) and consider showing and discussing the Power Point Training Package "**Fire Hazards of Oxygen Enriched Atmospheres**" from the European Industrial Gases Association (EIGA).

*Desorption - Oxygen can be released in appreciable quantities when cold material which have absorbed oxygen such as absorbents (molecular sieve, silica gel, etc.) or insulation materials are warmed to room temperature.
**Liquid disposal - Large volumes of gas can result from relatively small liquid leaks in such operations as incorrectly operated disposal systems, LOX pump priming, manual drains and tanker disconnection.
***Liquefaction of air - When using cryogenic gases with boiling points lower than oxygen, e.g. nitrogen, hydrogen and helium, oxygen enrichment can also occur. Ambient air will condense on uninsulated equipment where the temperature is lower than the liquefaction temperature of air (approx. - 193 degrees C)