Liquid Oxygen

General

Liquid oxygen (also known as Lox) is pale blue and extremely cold. Although nonflammable, oxygen is a strong oxidizer, which means that materials which burn in air will burn more vigorously whne enriched by oxygen, and that oxygen will react with nearly all organic materials and metals to form an oxide. Liquid oxygen can also cause the materials it comes in contact with to become brittle and fail

Oxygen service equipment must meet stringent cleaning requirements and constructed of materials with high ignition temperatures that are non-reactive with oxygen under service conditions. Vessels should be designed to withstand the process temperatures and pressures, and manufactured to American Society of Mechanical Engineers (ASME) codes.

Liquid oxygen is a cryogenic liquid. Cryogenic liquids are liquefied gases with a normal boiling point below -238°F (-150°C). Liquid oxygen's boiling point is -297.3°F (-183.0°C). Since the temperature difference between the liquid oxygen and the surrounding environment is significant, even in winter, keeping the process insulated from the surrounding heat is essential.

Liquid oxygen also requires special equipment for handling and storage. Even though it is used primarily as a gas, liquid oxygen is generally stored as a liquid.

A typical storage system comprises a cryogenic storage tank, one or more vaporizers, a pressure control system, and the piping necessary for fill, vaporization, and supply functions. The cryogenic tanks are constructed with an inner vessel inside an outer vessel, between which is a ring-shaped space containing an insulating medium which keeps heat away from the liquid oxygen in the inner vessel. Vaporizers convert the liquid oxygen into a gas. A pressure control manifold controls the gas pressure that is fed to the process or application. Vessels should be designed according to ASME codes for the pressure and temperatures involved. Piping design should follow similar codes issued by the American National Standards Institute (ANSI).

Health Effects

Normal air contains 21% oxygen. No health effects have been observed in people exposed to concentrations up to 50% for 24 hours or longer. More than 12 hours at 1 atmosphere of 80% oxygen can cause irritation of the respiratory tract, coughing, nasal stuffiness, sore throat, chest pain, and progressive decrease in vital capacity, followed by tracheobronchitis and later by pulmonary congestion and edema. Reduced lung function is the earliest measurable sign of toxicity. Continued exposure can cause severe convulsions leading to death. The effects are reversible after reduction of oxygen pressure.

Safety Considerations

The hazards associated with liquid oxygen are:

- Exposure to cold temperatures causing severe burns
- Over-pressurization from expansion of small amounts of liquid into large volumes of gas in inadequately vented equipment
- Oxygen enrichment of the atmosphere surrounding the process
- Combustion reaction resulting from the oxygen contacting a non-compatible material
- Construction materials become brittle enough to shatter

Liquid oxygen can expand rapidly to form large volumes of gas, which can put high pressures on systems where liquid can be trapped. These areas must be identified and protected with pressure relief.

Atmospheres of oxygen-enriched air can form in the area surrounding a release. Fire chemistry starts to change when the concentration of oxygen increases by as little as 2%. Materials easily ignited in air become more susceptible to ignition and burn with added violence, including materials like clothing and hair. Clothing splashed or soaked with liquid oxygen or exposed to high oxygen concentrations should be removed immediately and aired for at least an hour. Employees should stay in a well-ventilated area and avoid all ignition sources until their clothing is unquestionably free of any excess oxygen.

Never allow smoking or open flames in any area where liquid oxygen is stored or handled. Liquid oxygen and oxygen-enriched air must not come into contact with organic materials, or with flammable or combustible materials. Organic substances which react violently with oxygen when ignited by flame, a spark or a mechanical shock, include asphalt, grease, kerosene, oil, tar and cloth or dirt that may contain these substances. In the case of a liquid oxygen spill, do not walk on or roll equipment over the area of the spill, and keep all sources of ignition away for at least thirty minutes after all traces of fog or frost have disappeared.

Also, review the Material Safety Data Sheet (MSDS) and follow all recommendations.

Handling and Storage

Store and use liquid oxygen in areas with adequate ventilation. Cryogenic containers have pressure-relief devices which control internal pressure, and periodically vent product. Never store in a confined space, or plug, remove or tamper with the pressure-relief device. When storing outside, protect against weather extremes.

Separate oxygen from flammables and combustibles by at least 20 feet, or a half-hour fire wall. Post signs saying, “No Smoking” and “No Open Flames,” and enforce those rules. Use only oxygen-compatible lubricants.

If your storage site has a capacity of more than 20,000 scf, install it in accordance with the National Fire Protection Association (NFPA) Standard 50.

Personal Protective Equipment (PPE)

Make sure you're thoroughly familiar with the properties of cryogenic liquids, and all safety considerations involved in handling and storage and associated equipment, before working with these dangerous chemicals. The extreme cold of cryogenic liquids and their vapors is especially dangerous to your eyes, so recommended personal protective equipment includes safety glasses covered by a full face shield. Your hands are also at risk, so recommended personal protective equipment includes loose-fitting thermal insulated or leather gloves. You should also wear long-sleeved shirts and trousers without cuffs. If you are involved in handling containers, wear safety shoes. Depending on the application, you may require special clothing suitable for that application, and in emergency situations, you may need a self-contained breathing apparatus (SCBA).

Insulated gloves should be loose-fitting so they can be quickly removed if cryogenic liquid is spilled on them. They do not allow you to put your hands into a cryogenic liquid, but instead provide short-term protection from accidental contact.