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Bulk oxygen (O₂) safe storage and handling

Scope

This TIP provides basic information for personnel for the safe handling and use of oxygen. It is vitally important that any new bulk oxygen gas and liquid facility installation be undertaken with advice from a producer of the gas and liquid in order to cover all of the unique design parameters for bulk oxygen gas and liquid. The suppliers of always unload the bulk liquid oxygen into the liquid storage facility. Users of bulk oxygen gas and liquid are urged to comply with these guidelines and to periodically review their practices to ensure that they remain in compliance.

Physical properties

Properties of Oxygen

Properties	
Chemical name	Oxygen
Formula	O ₂
Molecular Weight	32
Physical state	Gas at normal temperature and pressure
Color	Colorless as a gas Pale blue when a liquid or solid
Odor	Odorless
Taste	Tasteless
Boiling Point @ 760 mm Hg	-183°C (-297°F)
Freezing Point	-218.6°C (-361°F)
Vapor Density (air =1)	1.105 @ 25°C
Latent Heat of Vaporization	2934 BTU/lb mol (212.89 J/g)
Liquid to gas expansion ratio Boiling point to 20°C	1 to 860

Liquid oxygen has a purity of 99.5% minimum. On-site oxygen generators are able to produce 90% to 99% purity oxygen gas stream.

The earth's atmosphere air contains 20.5% oxygen by volume. The outstanding properties of oxygen are its ability to sustain animal life and to support combustion. Oxygen enriched atmospheres will greatly enhance combustion. The combustion rate doubles and flame propagation is increased when oxygen concentrations are increased to as little as 24%. Many so-called non-flammable textile materials will burn fiercely in an atmosphere containing 30% or more oxygen.

The low temperature of liquid oxygen and the vapors it releases not only pose a serious burn hazard to human

tissue, but can also cause many construction materials to lose their strength and become brittle enough to shatter. When liquid oxygen is vaporized under atmospheric conditions, it will expand 860 fold in volume. In a closed vessel, this can result in a tremendous pressure increase due to the volume expansion associated with vaporization.

Safety precautions

Hazards and personnel protection

The National Fire Protection Association (NFPA) and U.S. Occupational Safety and Health Administration (OSHA) define oxygen as a Class 2.2 gas/liquid. The U.S. Department of Transportation (DOT) classifies it as a gas/liquid with a UN number of UN 1072. It has a CAS Registration number 7782-44-7.

One must be thoroughly familiar with the properties and safety considerations before handling a cryogenic liquid, such as liquid oxygen (LOX), and its associated equipment. The eyes are the most sensitive body part to the extreme cold of the liquid and its vapors. The recommended personal protective equipment (PPE) for handling cryogens includes a full-face shield over safety glasses, loose-fitting thermal insulated or leather gloves, long sleeve shirts, and trousers without cuffs. In addition, safety shoes are recommended for people involved in the handling of containers. Depending on the application, special clothing suitable for that application may be advisable.

Gloves should be loose-fitting so they are able to be quickly removed if cryogenic liquid is spilled on them. Insulated gloves are not made to permit the hands to be put into a cryogenic liquid. They will only provide short-term protection from accidental contact with the liquid.

Health hazards

The inhalation of oxygen gas is used appropriately in many medical emergencies as well as for long-term treatment. Such use should be with the advice of a physician. Inhalation of high concentration of oxygen for a few hours has not been found to produce harmful effects, except for some special classes of patients. When pure oxygen is breathed for 5 hours at sea level, for 3 hours at 3 atmospheres, 30 minutes at 4 atmospheres, or 5 minutes at 7 atmospheres, signs and symptoms of toxicity will appear. These include nausea, dizziness, bronchial irritation, hypothermia, increased depth of respiration, bradycardia, pulmonary discomfort or injury, peripheral vasoconstriction, amblyopia or loss of vision, syncope, epileptic seizures, and death.

Contact with liquid oxygen may cause severe cryogenic burns or frostbite.

First aid

Refer to supplier's Materials Safety Data Sheet (MSDS). In case of long term exposure to gaseous oxygen, remove to fresh air. Contact Emergency Medical Services (EMS) or a physician. In the event of contact with liquid oxygen, be aware of cryogenic burns or frostbite and take appropriate action.

Combustion at elevated oxygen levels

Persons who have been exposed to an oxygen-rich atmosphere should not smoke or go near hot spots or sparks until they have changed clothing or properly ventilated their clothes in a normal atmosphere. A ventilation period of not less than 30 minutes, with movement of the arms and legs and with coats unbuttoned, is recommended.

Precautions in handling, storage and use

Liquid oxygen is shipped at pressures below 1380 kPa (200 psig) in heavily insulated small portable containers, tank cars, or tank trucks. Liquid oxygen is stored in specially designed tanks, commonly supplied by the oxygen supplier.

One gallon of liquid oxygen will expand into a gas with an 860 fold increase in volume at typical atmospheric temperature, and if contained, can result in a tremendous pressure increase in an enclosed area.