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Gaseous ozone (O₃) safe handling

Scope

This TIP provides basic information for personnel for the safe handling and use of ozone. It is vitally important that any new ozone generation facility design be undertaken with advice from an equipment supplier of ozone generators in order to cover all of the unique design parameters for producing ozone on-site. Users of ozone are urged to comply with these standards and to periodically review their practices to ensure that they remain in compliance with current safety practices and regulations.

Definition

Ozone occurs in the atmosphere from the UV light action on oxygen at high altitude where it acts as an atmospheric shield against UV light penetration. It may also be found as a by-product in welding areas, in corona discharges by ultraviolet radiation and around high voltage equipment. Ozone's primary use is as an oxidizing agent for disinfection of water, COD and color removal in wastewater, odor abatement of air, and textile and pulp bleaching. Ozone is also used as a reagent in various organic syntheses. It is used in the processing of processing certain perfumes, vanillin, camphor and in peroxide production. Ozone may be present in air at up to 0.05 ppm by volume at sea level.

Ozone gas is manufactured on-site at pulp mills since it is chemically unstable and cannot be transported. It is typically derived by passing air or oxygen between two electrodes (separated from one another with a dielectric material) across which an alternating high-voltage potential/high density electrical current is applied:



On-site ozone generators for pulp bleaching use pure oxygen as the feed gas. Ozone concentration exiting the generator is typically from 10% to 14% by weight, the remaining gas being oxygen (76%-80%) and small amounts of nitrogen with argon (0-10%). Ozone has been designated with CAS Registration No. 10028-15-6.

Properties of Ozone

Properties	
Chemical name	Ozone
Formula	O ₃
Synonym	Triatomic oxygen
Molecular Weight	48
Physical state	Gas
Color	Colorless to blue gas (@ > -169°F (-112°C))
Odor	Odor similar to freshly mown hay at low concentrations [2] Pungent, irritating odor at high concentrations Odor threshold for most people is about 0.0076 – 0.05 ppm Olfactory fatigue occurs (<i>i.e.</i> , ability to smell ozone is lost as exposure continues) [2]
Taste	Tasteless
Boiling Point @ 760 mm Hg	-111°C (-168°F)
Freezing Point	-193°C (-315°F)
Vapor Density (air =1)	1.655 @ 25°C (77°F)
Solubility in water	4.0 mg/L per % O ₃ by weight @ 20°C and 101.325 kPa and pH 7.0

Safety precautions

Reactivity data

Ozone is an oxidizing agent for both organic and inorganic materials; it is a stronger oxidizer than oxygen, but weaker than fluorine. Some of its reaction intermediates with organics, such as ozonides, can be highly explosive.

Keep away from heat, flame, friction, organic materials, strong reducing agents and combustible materials, such as grease and oil. Some of the materials to avoid with ozone include: copper, aluminum, PVC, ABS, acetylene, benzene, potassium iodide, carbon, and grease.

Materials recommended for use with ozone are stainless steel (*e.g.*, SS 304, SS 316L) and Teflon[™]. Always consult your ozone equipment supplier prior to materials selection with ozone.

Ozone can be decomposed through: (a) the use of a proper catalyst, such as MnO₂, Al₂O₃ and CuO, at room temperature; (b) chemical destruction with caustic soda; or (c) proper heating at 350°C (662°F). The decomposition product of ozone is oxygen.

Fire and explosion data

Ozone gas is nonflammable, but the oxygen associated with it will support or accelerate combustion processes. Ozone decomposition is exothermic and releases heat. Oxygen in the ozone gas or from ozone decomposition can intensify a fire. Use extinguishing agents suitable for surrounding fire or large amounts of water spray.

Persons who have been exposed to an ozone-rich atmosphere should not smoke and should not go near to ignition sources (*e.g.*, hot spots or spark) 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