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Chlorine and Ozone Gas Detection Systems in Aquatic Recreation Facilities

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A gas detection system is an important and required component for ensuring the health and safety of everyone in an aquatic recreation facility. Below is some general information about both gases and answers to a few of the commonly asked questions regarding chlorine and ozone gas detection systems.

CHLORINE (Cl_2)	OZONE (O_3)
Chlorine is a powerful, corrosive disinfectant and in both gas and liquid forms it is toxic and hazardous to living beings at concentrations as low as 1 ppm. Recreational facilities commonly use compressed cylinders of chlorine in a disinfectant maintenance program to treat the pool water, which requires a gas detection system with chlorine sensors.	Ozone is an oxidizing agent that is used as a powerful disinfectant. It is manufactured on site for immediate use because it is an unstable gas and decomposes quickly. It is toxic and hazardous to living beings at concentrations as low as 0.1 ppm. Recreational facilities that use ozone usually do so in combination with chlorine, which requires a gas detection system with chlorine and ozone sensors.
MOLECULAR WEIGHT:	
70.9 g/mol	47.997 g/mol
FIRE HAZARD RATING:	
On its own it will not burn, but will support combustion; at high temperatures reacts vigorously with most metals and can cause the metal to catch fire or melt.	Risk of fire and explosion on contact with combustible substances; may cause or intensify fire.
EXPLOSION RANGE:	
Neither explosive nor flammable on its own; reacts explosively or forms explosive compounds with many common substances such as acetylene, ether, turpentine, ammonia, fuel gas and hydrogen.	Neither explosive nor flammable on its own; reacts explosively when shocked, exposed to heat or flames or by chemical reaction with organic substances/reducing agents.
WORKSAFE BC EXPOSURE LIMITS:	
• TWA: 0.5 ppm (8-hour EL) • STEL: 1 ppm (15 min EL) • IDLH: 10 ppm (immediately dangerous to life and health)	• TWA: 0.05 ppm to 0.1 ppm (8-hour EL, light to heavy work) • STEL: 0.2 ppm (15 min EL) • IDLH: 10 ppm (immediately dangerous to life and health)

CHLORINE (Cl_2)	OZONE (O_3)
POTENTIAL CAUSES OF LEAKS:	
• Valve failure due to impurities lodged in valves • Worn, damaged or not using new gaskets • Damaged cylinders • Corrosion of equipment due to mixture of chlorine gas and moist, humid air • Accidental spill or release • Using incorrect pressure regulator for cylinder pressure and contents • Moving cylinders without ensuring the valve is closed	• Equipment that is not inspected regularly or replaced when necessary leading to equipment malfunction • A destructor that isn't working properly • A pipeline blockage or clogged valve • Worn or damaged pipes, tubing, gaskets or valves • Using an incorrect material for joint sealers, pipes, valves, gaskets, diaphragms, tanks, sealants, etc.
WHERE SHOULD THE GAS DETECTOR BE LOCATED?	
The chlorine gas detector should be located in the chlorine storage room near the cylinders being used and any other potential source of a chlorine leak. It should be mounted near the floor, but not be near ventilation inlets/outlets or in the path of rapidly moving air. It should also not be placed in dead air spots where there is little or no air movement. The best location for the gas detector is where it will detect the gas the quickest if there is a leak.	The ozone gas detector should be mounted in the ozone generator room near the equipment between the ozone generator and the destructor. More sensors may be required for additional destructors that are more than 5 m / 16 ft apart. Another ozone gas detector (or an ozone detector tube) should be positioned to monitor the exhaust air stream. The goal is to be alerted of an ozone leak as soon as possible so safety measures can be taken to stop and repair it and keep people safe.
AT WHAT HEIGHT SHOULD THE GAS DETECTOR BE MOUNTED?	
Chlorine is much heavier than air and it stays close to the ground, spreading rapidly and settling in low-lying areas. Therefore the gas detector/sensor should be mounted approximately 15 cm / 6 in from the floor. The goal is to be alerted of a chlorine leak as soon as possible so safety measures can be taken to stop and repair it and keep people safe.	Pure ozone is heavier than air, but it doesn't necessarily settle to the floor because it easily mixes with air. The gas detector/sensor should be mounted approximately 0.6 m / 2 ft from the floor between the ozone generator and the destructor.
HOW MANY GAS DETECTORS ARE REQUIRED?	
The number of gas detectors will depend on the size of the storage room and the location of the chlorine cylinders and equipment inside the room. CETCI's chlorine gas detectors have a sensor range of approximately 279 m^2 / 3000 ft^2.	The number of gas detectors will depend on the size of the ozone room and the number of generators/destructors there are inside the room. CETCI's ozone gas detectors have a sensor range of approximately 465 m^2 / 5,000 ft^2.

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CHLORINE (Cl_2)	OZONE (O_3)

SUGGESTED FACTORY SET ALARM LEVELS

Low Alarm: 0.5 ppm Mid Alarm: 0.7 ppm High Alarm: 1 ppm	Low Alarm: 0.1 ppm Mid Alarm: 0.2 ppm High Alarm: 0.3 ppm

WHAT IS A BUMP TEST AND WHY SHOULD THEY BE DONE?

A bump test is a brief exposure of the sensor to gas. A bump test verifies if the sensor is responding and the alarm is functioning.

HOW OFTEN SHOULD A CHLORINE OR OZONE GAS DETECTOR BE BUMP TESTED?

At a minimum, the gas detector should be bump tested once a month as part of the monthly maintenance plan for the device. There is no limit on the number of bump tests; they may be done more often depending on the application and the comfortability/confidence level one has in the device and how it responds. If a bump test fails, a full calibration should be done. Bump test dates and results should be written down in a log book.

WHAT IS CALIBRATION AND WHY SHOULD IT BE DONE?

Calibration is the exposing of the sensor to a certified concentration of gas for a particular length of time. Calibration verifies that the gas detector is providing an accurate reading.

HOW OFTEN SHOULD A CHLORINE OR OZONE GAS DETECTOR BE CALIBRATED?

At a minimum, the gas detector should be calibrated every 6 month. More frequent calibrations may be required depending on application, regulatory laws, sensor response and exposure levels to the gas. If a bump test fails, a full calibration should be done. Calibration dates and results should be written down in a log book.

WHAT IS THE LIFESPAN OF THE SENSOR?

The lifespan of an electrochemical chlorine sensor is around 3 years (application dependent).	The lifespan of an electrochemical ozone sensor is around 2 years (application dependent).

WHAT SHOULD THE GAS DETECTOR BE DOING WHEN THERE ISN'T A LEAK?

24 hour continuous monitoring, displaying gas level readings inside the room and communicating with the controller to display the same readings outside the room (at all entrances).

WHAT SHOULD THE GAS DETECTOR DO WHEN THERE IS A LEAK?

Upon detection of chlorine gas at or above the low alarm set point, the gas detector will sound its internal alarm, trigger the controller to go into alarm, which in turn will activate the relays to set off all visual and audible alarms throughout the facility and in most circumstances will it automatically shut down the active ventilation system (or in some circumstances may trigger the emergency ventilation/exhaust system).	Upon detection of ozone gas at or above the low alarm set point, the gas detector will sound its internal alarm, trigger the controller to go into alarm, which in turn will activate the relays to set off the visual and audible alarms outside all entrances to the room and shut down the ozone generator and activate the emergency ventilation system.

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ADDITIONAL INFORMATION

Both chlorine and ozone are considered sticky gases, meaning the gas adheres to surfaces like calibration tubing. Use a Teflon lined tube no longer than 1 m / 3 ft during calibration so the gas doesn't saturate and adhere to the tubing, weakening the concentration of gas that reaches the sensor.

A chlorine and ozone gas detector should never have a splash guard installed on it. The splash guard would interfere with the sensor being able to accurately read the gas levels because of the sticky properties of the gas.

When calibrating a chlorine sensor, it is best to use a chlorine gas generator instead of a cylinder of chlorine gas. Our tests have shown chlorine cylinder gas to be unstable and it is difficult to get an accurate reading from that source. The quality of the chlorine gas is much higher from a generator, making calibration easier and accurate.	When calibrating an ozone sensor, you can use a chlorine gas generator or an ozone gas generator.
Chlorine reacts with water and moisture in the air to form highly corrosive hydrochloric and hypochlorous acids.	Ozone is a very reactive gas and will corrode most metals and damage most plastics and cause rubber to go brittle and crack.

NEED MORE INFORMATION ABOUT CHLORINE OR OZONE SAFETY STANDARDS AND REGULATIONS?

WorkSafe BC https://www.worksafebc.com
Canadian Standards Association (CSA Group) https://www.csagroup.org
Canadian Center for Occupational Health and Safety (CCOHS) https://www.ccohs.ca

Additional Resources:
American Society of Heating Refrigeration and Air Conditioning (ASHRAE®) https://www.ashrae.org
Occupational Safety and Health Administration (OSHA) https://www.osha.gov
The Chlorine Institute https://www.chlorineinstitute.org

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