VAISALA / APPLICATION NOTE

CO_2 Measurements in Breweries and Wineries

Carbon dioxide safety measurement is especially needed in breweries.

Carbon dioxide is used for the carbonation of beverages. CO_2 is the gas that gives the fizz to soft drinks and sparkling wines. In breweries, CO_2 is recovered as a by-product of fermentation. As high concentrations of CO_2 are clearly hazardous, most countries, including the USA, have set workplace exposure limits. Carbon dioxide monitoring is essential for employee safety in the brewing and carbonated drinks industry.

Carbon dioxide can be a safety hazard. When CO_2 rises, people start feeling tired. Very high concentrations can lead to unconsciousness or even death. Occupations where carbon dioxide can rise to dangerous levels include the brewing and carbonated drinks industries, as well as wineries. It is therefore vital to measure the level of carbon dioxide in every place where there is a risk of CO_2 build-up or leakage.

Most countries have set workplace exposure limits for CO_2. For instance, in the United States, OSHA's (Occupational Safety & Health Administration, U.S. Department of Labor) general exposure limit of CO_2 to not exceed 5,000 ppm during an eight hour working shift.

Carbon dioxide safety measurement is especially needed in beverage production, because the fermentation tanks have pressure relief valves. If the pressure in the tanks builds up too high, the gas will exit through these valves. There is also a risk that gas can leak from the tanks or pipelines.

Measuring CO_2 in Breweries

Carbon dioxide is generated as a natural process of fermentation and is found in most brewing tanks and around filler machines, packaging and closer areas. Excessive levels of carbon dioxide can displace oxygen, causing asphyxiation.

Breweries throughout the world therefore pose unique challenges to employee safety. There are various areas within a brewery where fermentation gases may collect, becoming a hazard to employees.

In some breweries, CO_2 is recovered as a by-product of fermentation. It can then be purified and compressed for further use. In beverage production the gas for carbonation is usually delivered by gas suppliers, because it has to be very clean in order not to affect the taste.

Confined spaces are among the most hazardous places in breweries. They include beer storage tanks, brew kettles, vats, sumps, pits and other confined areas where carbon dioxide may be present.

Safe CO_2 Levels in Wineries

Similar problems arise at wineries. During the fermentation process, wine grape sugar is metabolized by yeast which converts the sugar to water, alcohol and carbon dioxide. During the active fermentation process, concentrations of carbon dioxide within the headspace of a fermenting tank may reach levels approaching 100 % by volume.

From the trucking in and crushing of freshly harvested grapes to the final aging and bottling process, care must be taken to protect people from potential hazards. Areas of concern within wineries include pits, sumps and storage tanks, as well as fermentation rooms, barrel cellars and bottling rooms. Carbon dioxide is one of the main gas hazards.

The dangers posed by this type of CO_2 build-up include the displacement of oxygen and the potential asphyxiation of employees, as well as the dangers of being exposed to high concentrations of carbon dioxide for extended periods of time.

In wineries, too, the average exposure limit of CO_2 should be kept below 5,000 ppm during an eight hour working shift. In addition, during the active fermentation process, closed buildings should be monitored for carbon dioxide build-up before entering, as concentrations may exceed safe levels.

CO_2 %	Symptoms
2 – 3	Symptoms of simple asphyxia occur
3 – 8	Increased respiration and heart rate, headache
< 10	Headache, nausea, vomiting, unconsciousness
10 >	Unconsciousness in less than 1 minute, death

Table 1. *Effects of CO_2 overexposures.*
Sources: NIOSH / OSHA and University of California.

The following exposure limits are recommended		
PEL-OSHA 5000 ppm	9000 mg/m³	TWA
TLV-ACGIH 5000 ppm 30000 ppm	9000 mg/m³ 54000 mg/m³	TWA STEL
REL-NIOSH 5000 ppm 30000 ppm	9000 mg/m³ 54000 mg/m³	TWA STEL

Table 2. *Recommended exposure limits.*

PEL	Permissible Exposure Limit
TWA	Time Weighted Average
TLV	Threshold Limit Value
STEL	Short Term Exposure Limits
REL	Recommended Exposure Limit
OSHA	Occupational Safety and Health Administration
ACGIH	American Conference of Governmental Industrial Hygienists
NIOSH	National Institute for Occupational Safety and Health

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