Q-TRAK™ XP INDOOR AIR QUALITY MONITOR MODEL 7585

IAQ GASES AND WHY MEASURE THEM

APPLICATION NOTE TSI-163 (US)

The following is a brief description of the types of gases that the Q-Trak™ XP Indoor Air Quality (IAQ) monitor is capable of supporting. The purpose of this application note is to provide a general idea of where these gases may be encountered along with potential health risks. The Q-Trak™ XP IAQ monitor supports the following gas sensors:

Carbon Dioxide (CO_2)

What is it?

Carbon dioxide is a colorless, odorless gas that is denser than air and is a by-product of respiration, combustion of fossil fuels and other processes such as the fermentation of sugars used to make beer and wine. It is ever present in our atmosphere, important source of carbon for life, and is considered a greenhouse gas which traps heat in the lower atmosphere. Forest fires, volcanoes and human activity are the primary sources for carbon dioxide while plants absorb CO_2 and sunlight through photosynthesis and produce oxygen as a byproduct.

Where does it come from?

CO_2 occurs naturally in the environment and can be found in lakes, oceans, glaciers, petroleum, natural gas as well as the atmosphere. Carbonated beverages contain carbon dioxide which gives it the bubbles and non-flat taste. Other sources include fire extinguishers, welding, production of chemicals and fuels, refrigeration, and is known as dry ice in solid form.

In indoor environments, human activity is the primary cause of CO_2 concentrations being higher than outdoors levels. Measuring indoor concentrations of CO_2 an indication of the amount of outdoor air being delivered into the HVAC system. If CO_2 is too high in a particular room or space, then there is not enough outdoor air being delivered to dilute the CO_2, or there are too many people in a space that was not designed for that number.

Potential Health Effects

Under normal conditions, even elevated CO_2 levels are rarely a health hazard since levels up to 10,000 parts per million can be tolerated without ill effects by healthy people. However, elevated levels of 1,000 to 2500 ppm in indoor environments can lead to lethargy, decline in cognitive abilities and drowsiness.

Carbon Monoxide (CO)

What is it?

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that is less dense than air. It is a by-product of incomplete combustion which is caused by using low quality fuel, poor air mixing or too little oxygen. Carbon monoxide poisoning can be fatal and is a reason that home CO detectors are mandated in many states in the US and other countries, and why it is known as a silent killer.

Where is it found or used?

Typical examples of outdoor CO sources include forest fires, volcanoes, tobacco smoking, vehicle emissions, and burning of fossil fuels for power generation.

Indoor sources include furnaces, boilers, stoves, gas fireplaces, and kitchens. Outdoor sources can also migrate into the building thru HVAC systems outdoor intake, negatively pressurized buildings close to traffic, parking garages and thru shipping dock doors with trucks present and idling.

Potential Health Effects

When inhaled, it quickly mixes with hemoglobin in the blood, reducing the blood's ability to carry and exchange oxygen. This can cause nausea, exhaustion, headaches, increased breathing, chest pain, impaired judgement and fatal when exposed to high levels by starving the body of oxygen.

Total Volatile Organic Compounds (TVOCs)

What are they?

Volatile organic compounds (VOCs) are organic chemical compounds containing carbon that evaporate in indoor air at room temperatures. These compounds have a low boiling point due to their high vapor pressures which causes them to evaporate or off-gas molecules in normal indoor environments. VOC gasses can be emitted from solids and liquids.

Where do they come from and what are they used for?

VOCs are both manmade and naturally occurring in the environment. Indoor sources include building materials, air fresheners, nail polish, glues, and varnishes, paints, cleaning products, personal hygiene products, solvents, aerosols and that new car smell.

Other sources of VOCs include gasoline, jet fuel, heating oil and diesel fuels as both a liquid and exhaust emission.

Potential Health Effects

The symptoms VOCs can vary due to the large number of different compounds. Common symptoms include eye, nose and throat irritation, headaches, nausea, allergic skin reactions and fatigue. Depending on an individual's sensitivity along with the concentration and length of exposures, some people may have a reaction whereas others do not.

Formaldehyde (CH_2O)

What is it?

As a gas, formaldehyde is a colorless, flammable, and strong-smelling gas at room temperatures. It is VOC that off gases or vaporizes from materials made from it at room temperatures. Indoor levels can change depending on the temperature, humidity and air exchange rates. Emissions from substances can rise with an increase in temperature and humidity along with a decrease in air exchange rate change. Emissions are reduced at lower temperatures and humidity along with a higher air exchange rate.

Where does it come from and what is it used for?

Formaldehyde is a naturally occurring substance and can be released into the air from vehicle emissions, burning wood, kerosene and natural gas. It is also a manufactured chemical used to make textiles, paints, varnishes, pressed wood furniture products, plywood and particle board, adhesives, and Urea-formaldehyde foam insulation (UFFI). It has also been used as a fire retardant in inexpensive couches and mattresses, and as disinfectant and preservative.

Potential Health Effects

Depending on an individual's sensitivity to formaldehyde along with the concentration and length of exposures, some people may have a reaction whereas others do not. Reactions to exposure may include stinging or itchy eyes, nose and throat, chest tightness, allergic reactions, skin rashes and headaches. Formaldehyde known to be a cause of cancer.

Ozone (O_3)

What is it?

Ozone is a pale blue gas at 32°F (0°C) with an absolute pressure of 1 bar (100 kPa) and has a distinctive, "fresh" smell. During thunderstorms, ozone is generated from O_2 and the electrical discharge from a bolt of lightning. It is most abundant in the ozone layer of the stratosphere which protects us from the sun's harmful ultraviolet radiation. At ground level, ozone is produced by the sunlight reacting with air that includes VOCs and nitrogen oxides (emissions from motor vehicles, industrial facilities and power plants) which are the main components of smog.

Where does it come from and what is it used for?

High voltage equipment such as air purifiers, laser printers, photocopiers and arc welding are common sources for generating high levels of ozone along with large electric motors using brushes.

Ozone has been used for killing microorganisms to treat drinking water in place of bleach since it can be generated on demand and does not need to be stored or transported which reduces cost. It has also been used to disinfect cooling towers for control of legionella, laundry in hospitals and other patient care facilities. Other applications for the use of ozone include:

Post fire remediation to deodorize the air and materials:

- Kill bacteria on food and surface other materials
- Remove mold and yeast in the air in food processing facilities
- Kill insects in grain storage
- Manufacture chemical compounds
- Plastics processing

Potential Health Effects

Breathing in ozone can cause chest pain, burning eyes, throat irritation, coughing, and airway inflammation. Symptoms may be more severe with people suffering from asthma, bronchitis, and emphysema since it is more difficult to breathe deeply since ozone reduces lung function and damages lung tissue.

Chlorine (CL_2)

What is it?

Chlorine is a yellow green gas with a harsh smell that is poisonous at high concentrations. It is about 2.5 times heavier than air which means it will settle or accumulate in low-lying areas with little ventilation or air movement. Chlorine gas was used in World War 1, and is considered the first chemical weapon.

What is it used for?

Chlorine has a distinct odor we are all familiar with since it is commonly used in cleaning products such as household bleach to kill bacteria. It is also very effective to treat swimming pools and drinking water from bacteria such as E-coli.

It is widely used in the manufacture of plastics and synthetic rubber which can be found in common, everyday products such as vinyl flooring, storage bins, seat cushions, plastic foam and automotive interiors. Elements of chlorine can be found in sodium chloride, which is more widely known as table salt.

Pharmaceutical companies use chlorine compounds as an oxidizing agent in the manufacture of medicines. Examples include potassium chloride for treating low potassium levels in the blood stream and magnesium chloride to treat magnesium deficiencies.

Potential Health Effects

Chlorine can aggravate the respiratory system when inhaled and may cause a buildup of fluid in the lungs that can lead to breathing difficulties and chest pain. Exposure may also cause skin irritations, burning eyes, choking and coughing. In liquid form, exposure can result in frostbite.

Ammonia (NH_3)

What is it?

Ammonia is a colorless gas lighter than air with a distinct, pungent odor. It is comprised of hydrogen and nitrogen which occurs naturally in the air, soil, and water as well as being produced by human activity. It also happens to be a key source of nitrogen for plants and animals.

What is it used for?

It is commonly used for cleaning windows, stainless steel, glass and porcelain due to its anti-streaking properties. It is also used in smelling salts and industrial and residential cleaners. Other industries that use or produce ammonia as a by-product include petroleum refining, manufacturing plastic, rubber, synthetic resin and nitic acid.

In agriculture, ammonia is applied directly to the soil on farms, used as a pesticide, and is a component in manufacturing fertilizer for plants, lawns, farm fields and crops. The majority of global ammonia production is used to make fertilizer. Livestock farms for pigs, chickens and cows with manure pits are also a source of ammonia.

The properties of ammonia have also made it useful for industrial refrigeration (R717) for foods, cold storage warehouses, ice production and indoor ice hockey rinks due to its high energy efficiency and low cost. However, ammonia is highly toxic which restricts its usage as a refrigerant in consumer products.

Potential Health Effects

Elevated concentrations of ammonia can aggravate and burn the eyes, throat, lungs, mouth and skin. Very high concentrations can damage the lungs or cause death.

Hydrogen Sulfide (H_2S)

What is it?

Hydrogen sulfide is a colorless, toxic and flammable gas with a distinct rotten egg odor. It is heavier than air which tends to make it sink or settle to the bottom of low-lying areas with little ventilation which increases the danger to workers or occupants.

Where does it come from and what is it used for?

It is found in naturally in hot sulfur springs, landfills, natural gas wells, some well water, and volcanic gas. Electric power plants that burn coal or fuels with sulfur, oil and gas extractions, animal farms with manure pits and oil refining are sources of H_2S emissions.

It is also produced when organic material breaks down in a low oxygen environment such as swamps, sewers and drains. In a building or home, dry water traps, drains, and loose toilets can be the primary source for the rotten egg odor which is primarily hydrogen sulfide along with ammonia, carbon dioxide and methane.

The textile industry uses H_2S in the manufacture of rayon, and it is also used in the manufacture of wood pulp and paper.

Potential Health Effects

It initially has a very strong odor, but quickly deadens the sense of smell so that a person in such an environment may be unaware of ongoing danger. Exposure to low concentrations can irritate the eyes, nose and throat with long term exposure to low concentrations causing headaches, fatigue, dizziness and effect cognitive functions (making decisions, poor memory). Workers in confined spaces where hydrogen sulfide concentrations may be quite high use respirators since to do otherwise can result in immediate death with only a few breathes.

Nitric Oxide (NO)

What is it?

Nitric oxide is a colorless nonflammable gas at room temperatures with a sweet, pungent odor formed by the oxidation of nitrogen. In humans and animals, nitric oxide is produced and plays an important part in the body by transmitting signals between cells in the immune, cardiovascular, and nervous systems along. In the environment, it is an air pollutant.

Where does it come from and what is it used for?

In the medical industry, nitric oxide is used to relax muscles to widen blood vessels such as the lungs to increase blood flow while decreasing blood pressure. It is widely used to treat respiratory failures in premature babies and is administered as a gas in conjunction with a ventilator (breathing machine). Nitric oxide is also used as a supplement in pill form by aging adults to increase the levels in the human body that otherwise decrease with age.

In the environment, nitrogen oxides, principally nitric oxide (NO) and nitrogen dioxide (NO_2), are pollutant gases that contribute to the formation of acid rain, ozone and smog. In power plants that burn fossil fuels, nitrogen oxides result when oxygen combines with nitrogen in the air or in the fuel. NO is generated first at high flame temperatures, then oxidizes further to form NO_2 at cooler temperatures in the stack or after being exhausted.

Burning fossil fuels and exhaust emissions from trucks, cars, ships, and the burning of coal, oil and natural gas for power generation are the main sources of nitric oxide. Natural sources include lightning and volcanic activity.

Potential Health Effects

Inhalation of nitric oxide gas can affect respiratory and central nervous systems. Exposure can also irritate the nose, throat, eyes, and wet skin of an individual. Symptoms include drowsiness, disorientation and unconsciousness which is caused by too little oxygen in the blood stream to deliver to the cells (methemoglobinemia).

Nitrogen Dioxide (NO_2)

What is it?

Above 70°F (21.1°C), nitrogen dioxide gas is a red-brown gas with a harsh, bitter odor. Nitrogen oxides, principally nitric oxide (NO) and nitrogen dioxide (NO_2), are pollutant gases that contribute to the formation of acid rain, ozone and smog. In power plants that burn fossil fuels, nitrogen oxides result when oxygen combines with nitrogen in the air or in the fuel. NO is generated first at high flame temperatures, then oxidizes further to form NO_2 at cooler temperatures in the stack or after being exhausted.

Where does it come from and what is it used for?

Natural sources include volcanic activity and lightning, however the burning of fossil fuels and vehicle emissions from internal combustion engines are the main source of NO_2 that people are mostly exposed to, especially in congested roadways with stop and go traffic.

NO_2 is also used in the manufacture of fertilizers and explosives, and is widely used in the medical industry to sterilize tools and equipment from microorganisms such as viruses, bacteria and fungi.

Potential Health Effects

Breathing in air with elevated levels of NO_2 can be irritating to the respiratory system, eyes and skin. The elderly, children and people with asthma are at a greater risk of potential health effects.

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