DETECTING SULPHUR DIOXIDE

FORMULA: SO_2 | CAS: 7446-09-5

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Sulphur dioxide

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Sulphur dioxide (SO_2) is a colourless gas with a very pungent odour, resulting in the breather feeling like they are choking or suffocating since it is heavier than air. SO_2 is an inorganic substance that is naturally released during volcanic eruptions and in the stratosphere at about 1ppm. The substance is easily dissolvable in water, not naturally unstable and is not very flammable. The substance has the potential to become corrosive when reacting with water as it converts to sulphurous acid. It should be noted though, after prolonged exposure to high heat or fire, SO_2 can erupt violently (hence it's exosphere during volcanic eruptions).

EPA's national ambient air quality standards for SO_2 are designed to protect against exposure to the entire group of sulphur oxides (SO_x). SO_2 is the component of greatest concern and is used as the indicator for the larger group of gaseous sulphur oxides (SO_x). Other gaseous SO_x (such as SO_3) are found in the atmosphere at concentrations much lower than SO_2.

Emissions that lead to high concentrations of SO_2 generally also lead to the formation of other SO_x. The largest sources of SO_2 emissions are from fossil fuel combustion at power plants and other industrial facilities.

How Does SO_2 Leak Into the Atmosphere?

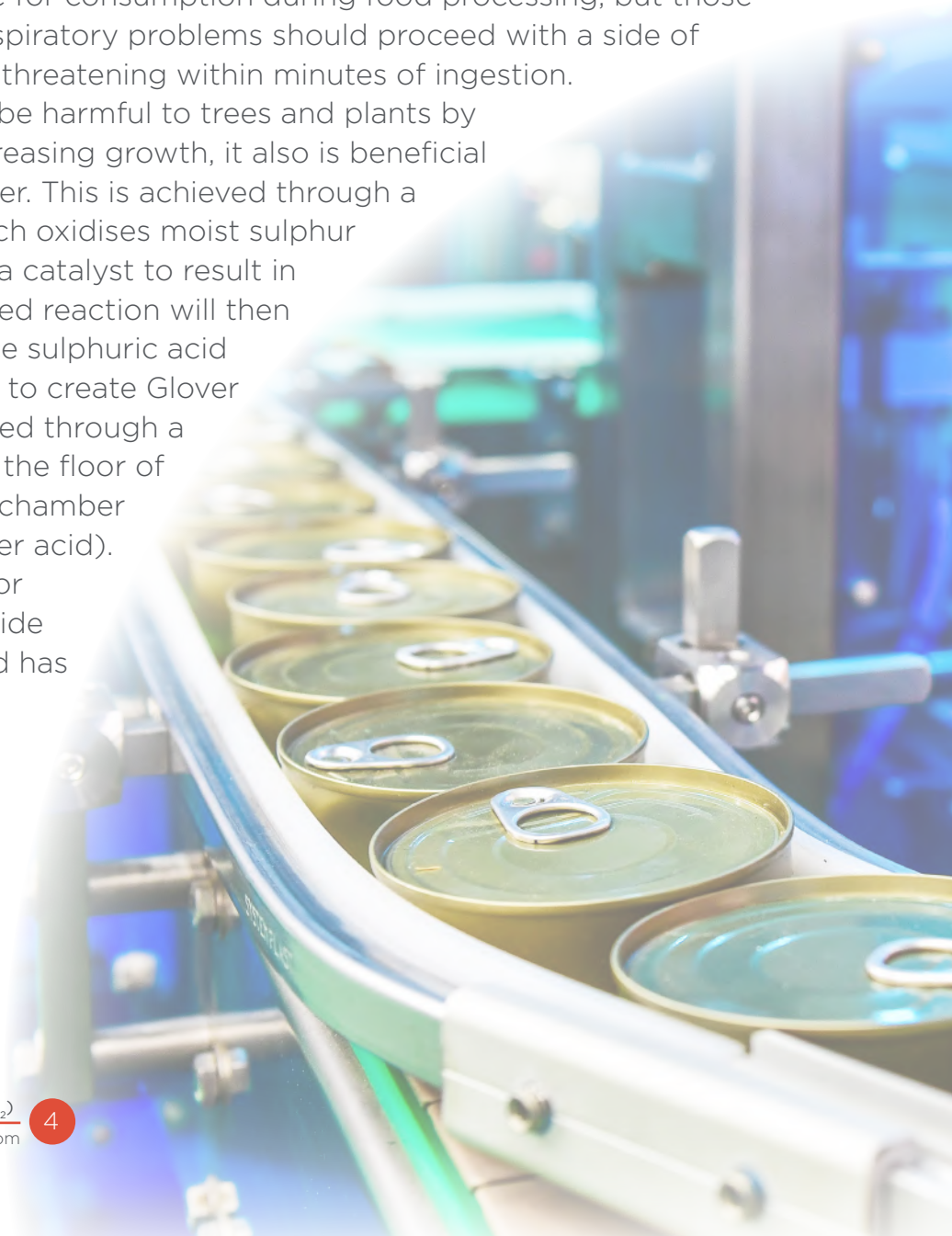
The largest source of SO_2 in the atmosphere is the burning of fossil fuels by power plants and other industrial facilities. Smaller sources of SO_2 emissions include: industrial processes such as extracting metal from ore; natural sources such as volcanoes; and locomotives, ships and other vehicles and heavy equipment that burn fuel with a high sulphur content.

Applications In Which We Commercially Use SO_2

Applications of its use can be found in many industries such as the production of batteries, metal and food processing, textiles, disinfectant, preservation, and more. Most commonly, sulphur dioxide is present when burning coal and oil at power plants or from copper mining and smelting. The second most common use of SO_2 is during the manufacture of other chemicals, most commonly sulphuric acid, but also chlorine dioxide, sodium hydrosulphite, sodium sulfite and as a bleaching agent. About 23.6 million tons of sulphuric acid was produced in 1979 along, following with the combustion of sulphur to roast pyrite and other sulphide ores in the air. Sulphur dioxide can be detected in the process of bleaching papers and pulps, burning fossil fuels at power plants or other industrial facilities, metal from ore extraction, and various transportation methods like cars, ships and other vehicles.

SO_2 is also essential in food and beverage preservation, such as to maintain the state of dried fruits through antimicrobial properties preventing oxidation. This can also be seen in the process of wine making, removing the smell of vinegar during the aging process. It is safe for consumption during food processing, but those with asthmatic or other respiratory problems should proceed with a side of caution since it can be life-threatening within minutes of ingestion.

While sulphur dioxide can be harmful to trees and plants by damaging foliage and decreasing growth, it also is beneficial in the production of fertiliser. This is achieved through a lead chamber process which oxidises moist sulphur dioxide in the presence of a catalyst to result in sulphur trioxide. The resulted reaction will then react with water to produce sulphuric acid and dissolved in acid wash to create Glover acid. After, the acid is passed through a lead chamber, collected at the floor of the chamber, and result in chamber acid (also known as fertiliser acid). There are other methods for implementing sulphur dioxide in fertiliser, but this method has proven to provide the best results.



The Impact Sulphur Dioxide Has On Our Health

Sulphur dioxide affects the upper respiratory system, especially from entry through the nose and into the lungs. In a short amount of time to small concentrations, it can present serious, potentially permanent health injuries. For eye exposure, the best method of practice is to remove the individual(s) from the area, evaluate vitals, remove contaminated clothing, flush eyes with lukewarm water for at least 15 minutes and wash exposed skin areas. Once the necessary procedures have been performed, it's best to transport the personnel to a medical facility as soon as possible. Short-term exposure side effects include difficulty breathing, especially for individuals with upper respiratory problems such as asthma. Exposed personnel should move to fresh air and be evaluated for vital signs before transported to a medical facility. The US Regulation for exposure limits exposure to 0.25 ppm. High concentrations and exposure levels lead to very serious side effects, with potential risk of death. 1,000 ppm causes death in 10 minutes to several hours by respiratory depression. Long-term exposure to lower concentrations is also problematic after a scientific review published confirmed association of pre term birth and other side effects of the baby.

Inhaling sulphur dioxide causes irritation to the nose, eyes, throat, and lungs. Typical symptoms include sore throat, runny nose, burning eyes, and a cough. Inhaling high levels can cause swollen lungs and difficulty breathing. Skin contact with sulphur dioxide vapour can cause irritation or burns. Liquid sulphur dioxide is very cold and can severely injure the eyes or cause frostbite if it touches the skin. Some people with asthma who are sensitive to sulphites might have an asthma attack if they eat foods preserved with sulphur dioxide or other sulphur-containing chemicals.

A Key Ingredient To The Pharmaceutical & Laboratory Industry

Another benefit of sulphur dioxide is its use in the biochemical and biomedical industries. SO_2 blocks nerve signals from the pulmonary stretch receptors and abolishes the Hering-Breuer inflation reflex. Sulphur dioxide can also regulate cardiac and blood vessel duction to prevent deficiencies resulting in several cardiovascular disease like arterial hypertension, stenocardia, and more. The substance also lowers the proliferation rate of endothelial smooth muscles cells in blood vessels, once of the most important pathogenetic mechanisms of hypertensive remodelling of blood vessels and their stenosis.

Laboratories use SO_2 as a reagent and solvent to dissolve highly oxidised salts and use it as a source of sulfonyl group in organic synthesis. Before the creation of chlorofluorocarbons, sulphur dioxide used to be the main refrigerant in home refrigerators. Lastly, sulphur dioxide is used to engineer climates through injections into the stratosphere to create a cooling effect similar to observations after large explosives (like Mount Pinatubo's volcanic eruption). This method however is not recommended due to the uncertain regional consequences, such as toxic rainfall patterns since it is admitted into the atmosphere and brought back down due to weather patterns.

What Causes Acid Rain?

Acid rain results when sulphur dioxide (SO_2) and nitrogen oxides (NO_X) are emitted into the atmosphere and transported by wind and air currents. The SO_2 and NO_X react with water, oxygen and other chemicals to form sulphuric and nitric acids. These then mix with water and other materials before falling to the ground.

While a small portion of the SO_2 and NO_X that cause acid rain is from natural sources such as volcanoes, most of it comes from the burning of fossil fuels. The major sources of SO_2 and NO_X in the atmosphere are:

- Burning of fossil fuels to generate electricity. Two thirds of SO_2 and one fourth of NO_X in the atmosphere come from electric power generators.
- Vehicles and heavy equipment.
- Manufacturing, oil refineries and other industries.

Winds can blow SO_2 and NO_X over long distances and across borders making acid rain a problem for everyone and not just those who live close to these sources.

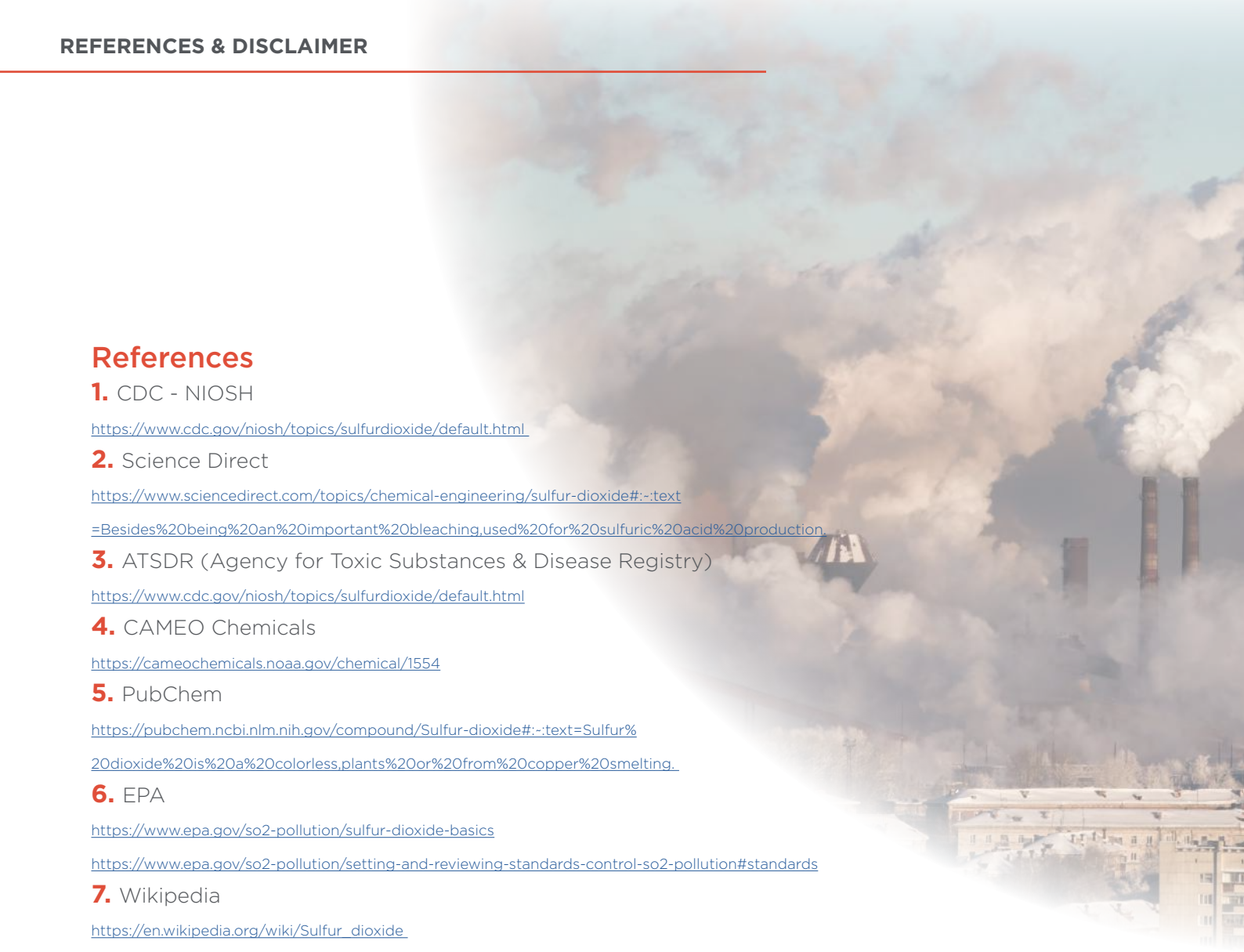
Detection Of Sulphur Dioxide (SO_2)

SO_2 gas detectors such as ION Science ARA SO_2 detector should be considered as they alert the personnel of dangerous levels of gas exposure. Devices with a fast response time and sturdy construction are important for use in harsh environments where SO_2 may occur. ARA SO_2 detectors help to protect yourself/your employers from this potentially lethal gas with a personal SO_2 alarm.

The ARA SO_2 single gas detector is a cost-effective personal detector with 24 months of continuous operation. This wearable gas detector has a single button operation to make things quick and easy and also alerts workers when concentration levels exceed set safety levels. The product is available from ION Science. Visit **www.ionscience.com/products/ara-so2-single-gas-detector/** for more information.

Specification	Value/Information
Formula	SO2
CAS no.	7446-09-5
Gas Response Factor, 11.7 eV	ZR
Gas Response Factor, 10.6 eV	ZR
Gas Response Factor, 10.0 eV	ZR
ppm per mg/m^{-3}, (20 °C, 1 bar)	0.375
Molecular Weight, g/mole	64.0
Melting point, °C	-76
Boiling point, °C	-10
Flash point, °C	-
Lower Explosive Limit, %	-
Density, g.cm^{-3}	1.25

Specification	Value/Information
Ionisation Energy, eV	12.3
EH40 TWA, ppm	2
EH40 TWA, mg.m^{-3}	5.3
EH40 STEL, ppm	5
EH40 STEL, mg.m^{-3}	13
NIOSH ST, ppm	3
NIOSH TWA REL, ppm	2
NIOSH ST, mg.m^{-3}	13
NIOSH TWA REL, mg.m^{-3}	5
NIOSH IDLH, ppm	100
OSHA TWA PEL, ppm	5
OSHA TWA PEL, mg.m^{-3}	13



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