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AIR

Sulfur Dioxide

General

Sulfur dioxide (SO_2) is a colorless, nonflammable gas with a pungent odor that is detectable by the human nose. On a worldwide basis, SO_2 is considered one of the major pollution problems. Man-made emissions of SO_2 account for about one-third of the total emissions of sulfur compounds in the atmosphere. At concentrations from 0.3 to 1.0 parts per million (ppm), SO_2 causes a taste sensation. At concentrations above 3.0 ppm the gas has a pungent, irritating odor. SO_2 is highly soluble in water and forms sulfurous acid. In the atmosphere, sulfurous acid is easily converted to sulfuric acid, which is the major acidic component of acid rain. SO_2 is emitted primarily from stationary sources, power plants, and refineries that burn fossil fuels. Other sources are smelters, steel mills, and pulp and paper mills. Wood, natural gas, propane, and other common fuels used for home heating do not contain significant quantities of sulfur and, therefore, are not considered to be major sources of SO_2. Diesel fuel, and to a lesser extent gasoline, contain sulfur and contribute to SO_2 in the ambient air.

Natural sources, such as volcanic eruptions, emit significant amounts of SO_2; however, they rarely play an important role in the urban SO_2 problem. Of the natural emissions, most are in the form of hydrogen sulfide released from the decay of organic matter or sulfate particles released in sea spray. In the presence of small concentrations of SO_2 in the atmosphere, hydrogen sulfide is oxidized to SO_2 and subsequently to sulfuric acid or sulfate particles. The sulfate particles released in sea spray are of a larger size than the sulfate particles formed by the oxidation of SO_2 and are therefore of less significance for human health.

Effects

SO_2 is a pulmonary irritant and contributes to respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. In addition to children and the elderly, individuals with asthma, cardiovascular disease, or chronic lung diseases are more susceptible to the effects of high SO_2 concentrations. An exposure to 1.5 ppm of SO_2 for a few minutes may produce, in healthy persons, a temporary inability to breathe normally due to increased airway resistance.

Sulfate particles irritate the lower respiratory system. SO_2 that is adsorbed onto the surface of inhalable particles can be carried deep into the lung where conditions favorable for the formation of sulfuric acid exist. Studies indicate that sulfuric acid droplets and metallic sulfates are much more potent lung irritants in humans and animals than SO_2 at the same ambient concentration of sulfur.

DEQ OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

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SO_2 can also damage plants and nonliving materials. High levels of SO_2 may injure the leaves of some plants, including trees and agricultural crops. Sulfur oxides can accelerate the corrosion of metals by first forming sulfuric acid, either in the atmosphere or on the metal's surface. Sulfuric acid is also capable of attacking a wide variety of building materials including limestone, marble, roofing slate, and mortar. SO_2 and NO_2 are the major precursors to acid rain. Acid rainfall can increase the susceptibility of aquatic and terrestrial ecosystems to various forms of environmental stress. Changes in the acidity of water bodies can produce physiological changes in various types of aquatic life.

The sulfuric acid and sulfate particles that form in the atmosphere as a result of SO_2 emissions are typically less than 1.0 µm in diameter. These small particles are effective in scattering visible light and producing haze.

Standards

There are two National Ambient Air Quality Standards (NAAQS) for SO_2:

- one hour average 75 ppb primary standard
- a three-hour level of 0.50 ppm secondary standard

For a site to be considered in attainment, the 3-year average of annual 99th percentile one hour average daily maximum concentrations must not exceed 75 ppb. The secondary standard must not be exceeded more than once per year.