

Sulfur Dioxide & Health

CATEGORIES

Topics Health, Air Pollution

Programs Outdoor Air Quality Standards, Exposure

Type Information

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What is sulfur dioxide (SO₂)?

Sulfur dioxide (SO₂) is comprised of one atom of sulfur and two atoms of oxygen, and is a gas at ambient temperatures. It has a pungent, irritating odor. SO₂ is a member of a family of chemicals comprised of sulfur and oxygen that are collectively known as sulfur oxides (SO_x).

Where does sulfur dioxide come from?

SO_x, including SO₂, are emitted when sulfur-containing fuel is burned. Some examples of sources include motor vehicles, locomotives, ships, and off-road diesel equipment that are operated with fuels that contain high levels of sulfur. In addition, SO₂ and the other SO_x are emitted from some industrial processes, such as natural gas and petroleum extraction, oil refining, and metal processing. They are also released during volcanic activity and from geothermal fields.

Why do CARB and U.S. EPA focus on sulfur dioxide as a marker for sulfur oxides?



SO₂ is the most prevalent species of gaseous SO_x in the atmosphere, with other species not present at concentrations relevant for human exposures. Because of this, most health studies have focused on SO₂. Many human and animal exposure studies, as well as epidemiological studies, have reported adverse health effects specifically attributable to

SO₂ exposure. For this reason SO₂ is used as the indicator for the group of gaseous SO_x. However, it should be noted that emissions of the SO_x family of air pollutants are involved in a number of chemical reactions in the atmosphere where they are transformed into acids and particulate sulfates, and these pollutants can also contribute to adverse human health and environmental effects. Because the various SO_x species arise from the same sources, control measures that focus on SO₂ also reduce emissions of the other SO_x species.

It should be noted that the California ambient air quality standard is specifically for SO₂ while the national ambient air quality standard is for SO_x as a group, with SO₂ the marker for determining attainment. In both cases, however, the intent is to control SO_x emissions as a group.

What kinds of harmful effects can sulfur dioxide cause?

Controlled human exposure and epidemiological studies show that children and adults with asthma are more likely to experience adverse responses with SO₂ exposure, compared with the non-asthmatic population. Effects at levels near the one-hour standard are those of asthma exacerbation, including bronchoconstriction accompanied by symptoms of respiratory irritation such as wheezing, shortness of breath and chest tightness, especially during exercise or physical activity. Also, exposure at elevated levels of SO₂ (above 1 ppm) results in increased incidence of pulmonary symptoms and disease, decreased pulmonary function, and increased risk of mortality. The elderly and people with cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) are most likely to experience these adverse effects.

How does sulfur dioxide affect the environment?

SO₂ deposition, along with that of other SO_x species, contributes to soil and surface water acidification and acid rain. This acidification causes a variety of effects that harm susceptible aquatic and terrestrial ecosystems, including slower growth and injury to forests and localized extinction of fish and other aquatic species. SO₂ deposition also promotes chemical reactions that facilitate the accumulation of mercury in water and



soil. This can lead to elevated mercury levels in food, which in turn increases risk of adverse health effects in human populations due to mercury ingestion.

Is sulfur dioxide a problem indoors?

The level of SO₂ indoors is largely driven by outdoor concentrations, and is typically lower than outdoors levels. The only known significant indoor source of SO₂ in the U.S. is unvented kerosene heaters, although this is not a common means of indoor heating in most of the country.

What are the Ambient Air Quality Standards for sulfur dioxide?

	1-Hour Average	24-Hour Average	Annual Average
National Ambient Air Quality Standard (SO_x with SO₂ as the marker)	0.075 ppm	0.14 ppm	0.030 ppm
California Ambient Air Quality Standard (SO₂)	0.25 ppm	0.04 ppm	None

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