

**Criteria Pollutants: Sulfur Dioxide (SO<sub>2</sub>)**

Office of Air Quality - Air Programs Branch

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**Description:**

- Sulfur dioxide (SO<sub>2</sub>) is one of a group of highly reactive gases known as sulfur oxides (SO<sub>x</sub>). Highly reactive gases are those that have a high potential to change in composition under certain conditions of pressure, temperature or light, or upon contact with another chemical.
- SO<sub>2</sub> is emitted from fossil fuel combustion at power plants and other industrial facilities.
- Other sources of SO<sub>2</sub> include industrial processes such as extracting metal from ore and the burning of high sulfur fuels by locomotives, large ships, and non-road equipment.
- SO<sub>2</sub> can be carried by the wind and affect air quality in downwind locations. This is known as regional transport.
- Federal and state programs such as the Acid Rain Program and federal vehicle engine and fuel standards (*Tier 2 Tailpipe and Fuel Standards and Diesel Fuel Sulfur Standards*) have resulted in a substantial reduction of SO<sub>2</sub> emissions over the past 30 years.

**National Ambient Air Quality Standards (NAAQS) for SO<sub>2</sub>:**

- The federal Clean Air Act (CAA) requires United States Environmental Protection Agency (U.S. EPA) to set National Ambient Air Quality Standards (NAAQS) for six criteria pollutants that are considered harmful to public health and the environment. The six criteria pollutants include SO<sub>2</sub>, as well as carbon monoxide, lead, nitrogen dioxide (NO<sub>2</sub>), ozone at ground level, and particulate matter.
- The NAAQS set limits for the criteria pollutants in the ambient air. Limits established to protect human health are referred to as “primary standards.” Limits established to prevent environmental damage are referred to as “secondary standards.”
- The CAA requires periodic review of the science upon which the NAAQS are based, as well as the standards themselves. NAAQS were first established for SO<sub>2</sub> in 1971 and included primary annual and 24-hour standards and secondary three-hour and annual standards. The secondary annual standard was revoked in 1973. In June 2010, U.S. EPA established a new primary one-hour standard and revoked the primary annual and 24-hour standards.
- To attain the primary one-hour SO<sub>2</sub> NAAQS, the three-year average of the 99<sup>th</sup> percentile of the daily maximum one-hour concentrations cannot exceed 75 parts per billion (ppb).
- In December 2024, U.S. EPA replaced the secondary three-hour SO<sub>2</sub> standard with an annual secondary standard.
- To attain the secondary annual standard, the three-year annual average daily mean value cannot exceed 10 ppb.
- U.S. EPA designates areas that meet the standards as “attainment” and areas that violate the standards as “nonattainment.” Nonattainment areas must take steps to attain the standards.
- The NAAQS for SO<sub>2</sub> is designed to protect against exposure to the entire group of SO<sub>x</sub>.

**Environmental Impacts:**

- Breathing SO<sub>2</sub> has been linked to an array of adverse respiratory effects including:
  - Narrowing of the airways leading to breathing difficulty (bronchoconstriction).
  - Increased asthma symptoms, especially during exercise.
  - Increased emergency department visits and hospital admissions for all respiratory illnesses and asthma.

- $\text{SO}_2$ , along with nitrogen oxides ( $\text{NO}_x$ ), is a primary contributor to acid rain. Acid rain is a term for rain, snow, fog, and hail that contain sulfuric and nitric acids formed by the chemical reaction of  $\text{SO}_2$  and  $\text{NO}_x$  with water, oxygen, and other chemicals in the atmosphere. Acid rain causes acidification of lakes and streams, damages trees at high elevations, and damages sensitive forest soils.  $\text{SO}_2$  and  $\text{NO}_x$  gases can be transformed into sulfate and nitrate particles that contribute to impaired visibility and regional haze. Acid rain and particles that fall to the ground can land on statues, monuments, buildings, and manmade structures, causing damage to surfaces and paints.

#### **IDE�'s Role:**

The Indiana Department of Environmental Management (IDEM) is responsible for protecting human health and the environment while providing for safe industrial, agricultural, commercial and governmental operations vital to a prosperous economy. IDEM works in many ways to improve air quality and protect public health:

- Implements federal, regional and state control measures and regulations.
- Operates an extensive monitoring network to gather data on levels of criteria pollutants in the ambient air, identify air quality trends and provide quality assured data to U.S. EPA for air quality designations.
- Issues air permits to regulated businesses that detail restrictions on  $\text{SO}_2$  emissions.
- Works with communities in nonattainment areas to implement programs to achieve the standards as quickly as possible.
- Educates citizens and businesses about their roles in improving air quality.

#### **Citizen's Role:**

There are many actions citizens can take to reduce contributions and impacts of  $\text{SO}_2$ :

- Reduce home energy consumption by turning off lights, televisions, and other appliances when not in use to reduce emissions from energy production. Set your thermostat lower in the winter and higher in the summer. Insulate your home as best as you can. Use energy efficient lighting and appliances, such as those with the ENERGYSTAR® label.
- Carpool, use public transit, bike, or walk whenever possible.

#### **Additional Information:**

- IDEM's website provides additional information concerning air quality including:
  - Overviews for the criteria pollutants including  $\text{SO}_2$ , and state implementation plans for attaining the NAAQS: [idem.IN.gov/sips/common-criteria-pollutants/IN.gov/idem/sips/common-criteria-pollutants](http://idem.IN.gov/sips/common-criteria-pollutants/IN.gov/idem/sips/common-criteria-pollutants).
  - Air quality monitoring data and reports: [idem.IN.gov/airmonitoring/air-quality-data/IN.gov/idem/airmonitoring/air-quality-data](http://idem.IN.gov/airmonitoring/air-quality-data/IN.gov/idem/airmonitoring/air-quality-data).
  - The nonattainment status for Indiana counties or townships: [idem.IN.gov/sips/nonattainment-status-of-counties/IN.gov/idem/sips/nonattainment-status-of-counties](http://idem.IN.gov/sips/nonattainment-status-of-counties/IN.gov/idem/sips/nonattainment-status-of-counties).
- U.S. EPA provides further information on the NAAQS process at: [epa.gov/naaqs](http://epa.gov/naaqs).
- ENERGY STAR® information is online at: [energystar.gov/energystar.gov](http://energystar.gov/energystar.gov).
- For questions and concerns, feel free to call IDEM's Office of Air Quality at 317-233-0178 or 800-451-6027, option 4