

SULPHUR DIOXIDE

Characteristics

Sulphur dioxide (SO₂) is a colourless, non-flammable gas with a sharp, pungent odour. Natural sources include volcanoes, decaying organic matter and solar action on seawater. Human activities that lead to the release of SO₂ are fossil fuel combustion, petroleum refining, and smelting sulphide ores. Sulphur dioxide is used: in the production of sulphuric acid; in the pulp and paper industry; as a food preservation agent; as a disinfectant; and as a solvent.

According to the National Pollutant Release Inventory, SO₂ emissions in Alberta have declined from 608 kilotonnes in 1995 to 453 kilotonnes in 2005. Annual average ambient levels across Alberta in 2006 were below 7.5 µg m⁻³. Sulphur dioxide is measured continuously by pulsed fluorescence (detection limits of 2 – 5 µg m⁻³).

Effects

Exposure to SO₂ results in numerous effects to the pulmonary system. Healthy subjects exhibit increased airway resistance and bronchoconstriction, decreased maximum expiratory flow and decreased pulmonary function. Asthmatic subjects exhibit similar symptoms but also report increases in asthma symptoms, wheezing, chest tightness, and difficulty breathing. Exercise increases the severity of response to SO₂ in both healthy and asthmatic individuals. In addition, cold and/or dry air increases the asthmatic response.

Vegetation

Sulphur dioxide injury to vegetation is characterized as being a result of either acute (exposures of a few minutes to hours to a concentration that results in visible injury within a few hours or days) or chronic (long-term, weeks to years, to low concentrations that result in metabolic injury). Long term exposures (growing season or longer) to low SO₂ levels have been shown to increase foliar sulphur levels and affect metabolic activity.

Objectives in Other Jurisdictions

The short term objectives in other jurisdictions are generally designed to protect human health while annual objectives are used to protect vegetation and ecosystems. The one hour objective for sulphur dioxide ranges from 350 µg m⁻³ (New Zealand and the European Union) to 1,310 µg m⁻³ (Quebec). Twenty-four hour averages vary from 105 µg m⁻³ (California), 120 µg m⁻³ (New Zealand), 125 µg m⁻³ (European Union) to 365 µg

m^{-3} (US EPA). Annual objectives range from $10 \mu\text{g m}^{-3}$ (New Zealand), $20 \mu\text{g m}^{-3}$ (European Union), $25 \mu\text{g m}^{-3}$ (British Columbia) to $80 \mu\text{g m}^{-3}$ (United States).

Alberta Ambient Air Quality Objectives

Alberta ambient air quality objectives are issued by Alberta Environment, under Section 14 (1), the *Environmental Protection and Enhancement Act, 1992* (EPEA). Based upon the available information:

- The 1-hour average Alberta Ambient Air Quality Objective for sulphur dioxide is $450 \mu\text{g m}^{-3}$ (172 ppb) based on pulmonary effects.
- The 24-hour average Alberta Ambient Air Quality Objective for sulphur dioxide is $125 \mu\text{g m}^{-3}$ (48 ppb) adopted from the European Union, which based its objective on human health.
- The 30-day average Alberta Ambient Air Quality Objective for sulphur dioxide is $30 \mu\text{g m}^{-3}$ (11 ppb) based on vegetation effects.
- The annual average Alberta Ambient Air Quality Objective for sulphur dioxide is $20 \mu\text{g m}^{-3}$ (8 ppb) adopted from the European Union, which based its objective on the protection of ecosystems.

References

Alberta Environment 2003. Sulphur Dioxide: Environmental Effects, Fate and Behaviour

Alberta Environment 2004, Assessment Report on Sulphur Dioxide for Developing Ambient Air Quality Objectives: Effects on Vegetation

Alberta Health and Wellness 2006. Health Effects Associated with Short-term Exposure to Low Levels of Sulphur Dioxide (SO_2) – A Technical Review

California Air Resources Board accessed March 5, 2008 <http://www.arb.ca.gov/research/aaqs/aaqs2.pdf>

New Zealand Ministry for the Environment accessed March 5, 2008

<http://www.mfe.govt.nz/laws/standards/when-standards-come-into-effect.html>

<http://www.mfe.govt.nz/publications/air/ambient-air-quality-may02/html/page6.html>

U.S Environmental Protection Agency accessed March 5, 2008 <http://www.epa.gov/air/criteria.html>
