OZONE

Characteristics

Ozone is a chemical whose effect on the environment is either beneficial or detrimental depending on where it occurs. Stratospheric ozone protects us from the sun's UV light, but can be toxic in the troposphere. Ozone is a highly reactive, colourless gas that is normally present in the troposphere as a result of naturally occurring photochemical and meteorological processes. It has a sharp, clean odour that can often be detected around running electric motors, after lightning storms, and around new mown hay.

Ground level ozone is formed through complex chemical reactions between precursor emissions of volatile organic compounds (VOCs) like hydrocarbons and nitrogen oxides in the presence of heat and sunlight. Car exhaust is one source of precursor emissions for ground-level ozone. In rural areas, trees and other vegetation naturally emit VOCs. Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Ozone and the precursor substances that cause ozone also can be transported into an area from pollution sources hundreds of miles upwind. The detection limit for measurement in ambient air is typically 1 ppb (2 µg m^{-3}). From 2001 to 2003, the Edmonton Central air quality monitoring station (10225 104 St.) recorded 1-hour average ozone concentrations ranging from 1 ppb to 95 ppb, with an average of 16.9 µg m^{-3}.

Effects

Extensive scientific studies indicate that there can be significant health and environmental effects associated with ozone. Potential short-term effects include pulmonary function reductions, increased airway sensitivities, and airway inflammation. The primary site of short-term exposure injury is the lung, which is characterized by lung congestion, fluid build-up, and bleeding. Inhalation may initiate, accelerate, or exacerbate respiratory tract disease of bacterial or viral origin. Discomfort to individuals may involve coughing, dryness of throat and mucous membranes and of nose and eyes following exposures of high concentrations and short duration. Other potential effects of ozone include crop damage and greater vulnerability to disease in some tree species.

Controlled exposures of heavily exercising adults or children to ozone have been observed to produce decrements in pulmonary function. Air concentrations associated with these symptoms ranged from 80-250 ppb (160-500 µg m^{-3}) for exposure periods ranging from 1-6.6 hours. Field studies in children, adolescents, and young adults have indicated that pulmonary function decrements can occur as a result of short-term exposure (e.g. a few hours) to ozone concentrations of 60-120 ppb (120-240 µg m^{-3}) and higher. Laboratory studies observed changes in pulmonary function in children and asthmatics at concentrations of 140-170 ppb (280-340 µg m^{-3}) with exposures lasting several hours. Respiratory symptoms, especially cough, have been associated with ozone concentrations of 150 ppb (300 µg m^{-3}).

A number of studies evaluating rats and monkeys exposed to ozone for a few hours or days have shown alterations in the respiratory tract in which the lowest-observed-effect levels were in the range 80-200 ppb (160-400 µg m^{-3}). These include the worsening of bacterial lung infections, inflammation, morphological alterations in the lung, increases in the function of certain lung enzymes active in

oxidant defences, and increases in collagen content. Long-term exposure to ozone in the range 120-250 ppb (240-500 µg m^{-3}) causes morphological changes in both the surface and supporting tissue of the lung where the airways meet the gas exchange regions, including changes in the structural fibres.

Canada-Wide Standards

In June 2000, the federal, provincial, and territorial governments except Quebec signed the Canada-wide Standards for Particulate Matter (PM) and Ozone. The Canada-wide Standards for PM and ozone (CWS) are an important step towards the long-term goal of minimizing the risks of these substances to human health and the environment. They represent a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing the substance emissions that contribute to PM and ground-level ozone in ambient air.

The CWS and related provisions for ozone are:

- A CWS of 65 ppb, 8-hour averaging time, by 2010.
- Achievement to be based on the 4th highest measurement annually, averaged over 3 consecutive years.

Also included in the CWS are provisions for "Keeping Clean Areas Clean and Continuous Improvement" that apply at ambient concentrations below the numeric CWS, as well as provisions on monitoring and reporting of progress and activities.

In November 2000, the Alberta's Clean Air Strategic Alliance's board of directors agreed to establish a PM and ozone project team to develop the Alberta implementation plan for the CWS. The project team developed a PM and ozone management framework for Alberta, meeting and in some cases exceeding the provisions of the CWS. The framework recognizes that different implementation strategies may have to be used for areas with different $PM_{2.5}$ and ozone concentrations. The framework also recognizes the importance of being pro-active to ensure that areas with ambient $PM_{2.5}$ and ozone concentrations currently below the CWS remain clean. In addition, the national reporting requirement for the CWS is limited to monitoring stations that fall within population areas of 100,000 or more, the project team recommended that the CWS be applied to the whole province.

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 daily maximum Alberta Ambient Air Quality Objective for ozone is 82 ppb (160 µg m^{-3})

References

Canadian Council Of Ministers of the Environment (CCME). Canada-wide Standard: Particulate Matter and Ground-Level Ozone. www.ccme.ca/initiatives/standards.html.

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U.S. EPA. 1996. Air Quality Criteria for Ozone and Related Photochemical Oxidants: Volume III. U.S.

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