Ozone & Health

Health Effects of Ozone

CATEGORIES

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Type Information

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What is ozone (O_3)?

Ozone, an important component of smog, is a highly reactive and unstable gas capable of damaging living cells, such as those present in the linings of the human lungs. This pollutant forms in the atmosphere through complex reactions between chemicals directly emitted from vehicles, industrial plants, consumer products and many other sources. Ozone is a powerful oxidant – its actions can be compared to household bleach, which can kill living cells (such as germs or human skin cells) upon contact. It forms in greater quantities on hot, sunny, calm days. In metropolitan areas of California, ozone concentrations frequently exceed existing health-protective standards in the summertime.

Where does ozone come from?

Ozone is formed in the atmosphere through chemical reactions between pollutants emitted from vehicles, factories and other industrial sources, fossil fuels, combustion, consumer products, evaporation of paints, and many other sources. Hydrocarbons and nitrogen oxide gases react in the presence of sunlight to form ozone. Hot, sunny, and calm weather promotes ozone formation. Ozone has a very characteristic pungent odor, and it can sometimes be detected after lightning strikes or during electrical discharges. Individual humans vary in their ability to smell ozone; some people can smell it at levels as low as 0.05 ppm.

What is the difference between ground-level and stratospheric ozone?

The ozone that CARB regulates as an air pollutant is produced close to the ground level, where people live, exercise and breathe. A layer of ozone high up in the atmosphere is called stratospheric ozone. This layer, far away from where people live, reduces the amount of ultraviolet light entering the earth's atmosphere. Without the protection of the stratospheric ozone layer, plant and animal life would be seriously harmed.

Why do CARB and U.S. EPA focus on ozone?

Air quality regulators are concerned about ozone pollution because of its effects on public health and the environment. Ozone can damage the tissues of the respiratory tract, causing inflammation and irritation, and result in symptoms such as coughing, chest tightness and worsening of asthma symptoms. In addition, ozone causes substantial damage to crops, forests and native plants. Ozone can also damage materials such as rubber and plastics.

What kinds of harmful effects can ozone cause?

Inhalation of ozone causes inflammation and irritation of the tissues lining human airways, causing and worsening a variety of symptoms. Exposure to ozone can reduce the volume of air that the lungs breathe in and cause shortness of breath. Ozone in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms. The occurrence and severity of health effects from ozone exposure vary widely among individuals, even when the dose and the duration of exposure are the same.

Who is at the greatest risk from exposure to ozone?

Research shows adults and children who spend more time outdoors participating in vigorous physical activities are at greater risk from the harmful health effects of ozone exposure. While there are relatively few studies of ozone's effects on children, the available studies show that children are no more or less likely to suffer harmful effects than adults.

However, there are a number of reasons why children may be more susceptible to ozone and other pollutants. Children and teens spend nearly twice as much time outdoors and engaged in vigorous activities as adults. Children breathe more rapidly than adults and inhale more pollution per pound of their body weight than adults. Also, children are less likely than adults to notice their own symptoms and avoid harmful exposures. Further research may be able to better distinguish between health effects in children and adults.

Children, adolescents and adults who exercise or work outdoors, where ozone concentrations are the highest, are at the greatest risk of harm from this pollutant.

How does ozone affect the environment?

Ozone's effect on plant life

Ozone exposure reduces the overall productivity of plants, damaging cells and causing destruction of leaf tissue. As a result, ozone exposure reduces the plants' ability to photosynthesize and produce their own food. Plants respond by growing more leaves thereby reducing the amounts of stored carbohydrates in roots and stems. This weakens plants, making them susceptible to disease, pests, cold and drought. Ozone also reduces crop and timber yields, resulting in millions of dollars in economic losses. Additionally, ozone disturbs the stability of ecosystems, leading to sensitive species dying out. Furthermore, ozone exposure reduces the production of roots, seeds, fruit and other plant constituents, reducing the amount of food available for wildlife.

Ozone's effect on materials

Ozone can cause substantial damage to a variety of materials such as rubber, plastics, fabrics, paint and metals. Exposure to ozone progressively damages both the functional and aesthetic qualities of materials and products, and shortens their life spans. Damage from ozone exposure can result in significant economic losses as a result of the increased costs of maintenance, upkeep and replacement of these materials.

Is ozone a problem indoors?

Ozone reacts with surfaces as it penetrates the indoor environment, usually resulting in lower levels indoors than outdoors. However, levels of ozone indoors can approach outdoor levels when windows or doors are open. Moreover, equipment such as photocopiers, laser printers and certain air purifiers can emit ozone indoors as well. Air purifiers that purposely emit ozone, called ozone generators, should not be used in occupied spaces as they can emit unsafe levels of ozone. Once inside, ozone can cause harmful health effects and damage materials, depending on its concentration.

> **CAUTION REGARDING OZONE GENERATORS**
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> The Air Resources Board and the California Department of Health Services advise the public not to use ozone generators in homes or offices. These devices are often marketed for the purposes of aiding allergy sufferers, but actually emit harmful ozone gas.

What are the Ambient Air Quality Standards for ozone?

In 2005, after an extensive review of the scientific literature, CARB approved an eight-hour standard for ozone of 0.070 ppm and retained the one-hour 0.09 ppm standard previously established in 1987. Evidence from the reviewed studies indicates that significant harmful health effects could occur among both adults and children if exposed to levels above these standards. On October 1, 2015, the U.S. EPA lowered the national eight-hour standard from 0.075 ppm to 0.070 ppm.

	1-Hour Average	Annual Average
National Ambient Air Quality Standard	--	0.070 ppm*
California Ambient Air Quality Standard	0.09 ppm*	0.070 ppm*

* A part per million (ppm) refers to one part of a substance dissolved into a million parts of another substance.

RELATED RESOURCES

Selected References: Children's School Bus Exposure and Mitigation Studies

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Haagen-Smit Clean Air Awards 2019 Nomination Information

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