TECH brief PRODUCT EVALUATIONS

AIR QUALITY SCIENCES

# Myths and Facts About Ozone in Indoor Environments

Vol. 10, Issue 3

The U.S. Environmental Protection Agency's (US EPA) tagline about ozone, "good up high, bad nearby," offers a helpful distinction between stratospheric ozone that filters out damaging ultraviolet radiation from the sun and atmospheric ozone, which is in the air people breathe. While this phrase focuses on outdoor air pollution, it also is relevant to indoor environments — especially in homes where ozone-generating room air cleaners are used. (Note: there are other types of residential room air cleaners that do not generate ozone or use it to clean the air.)

Despite efforts by federal and state agencies to educate people about the dangers of ozone in indoor air, there is still confusion and misinformation circulating around the marketplace about this type of air cleaner. Marketing claims, for example, refer to ozone generated by these air cleaners as "activated oxygen," "super oxygenated" or "energized oxygen," and thus imply that ozone is a healthy kind of oxygen (California ARB 2006). These claims can be confusing — and the lack of disclosure as to the potential health effects associated with exposure to ozone may put unsuspecting consumers at risk. This Tech Brief addresses some of the most prevalent myths about ozone, and reviews federal and state efforts to protect human health through regulating indoor ozone levels.

**MYTH**: Inhaling ozone is only harmful in high amounts.

**FACT**: Regardless of whether exposure occurs outdoors or indoors, inhaling ozone can be harmful at any level. Ozone is a very strong lung irritant and can cause lung inflammation, tissue damage and impaired lung function. As a result, ozone exposure can be particularly dangerous to people with lung and heart problems. In addition, unreacted ozone at low concentrations around 120 ppb (0.12 ppm) can cause eye irritation, visual disturbances, headaches, dizziness, dry mouth and throat, chest tightness and coughing (Sittig 1991).

Even though there is no scientific evidence to suggest that children are more or less susceptible to the harmful effects of ozone than adults, there are still reasons to be cautious. Because of their lower body weight, children breathe in a relatively greater volume of air than adults; for example, newborns breathe through their mouths, as do many older infants and children — more so than adults. Children's breathing zones are also lower to the ground, possibly closer to an ozone source such as an ozone-generating air cleaner, thus allowing them to breathe in more ozone than adults (California ARB 2008).

**MYTH**: Ozone-generating room air cleaners are the only source of ozone in residential indoor air.

**FACT**: The primary source of ozone indoors is air brought in from outdoors. As a result, days with higher outdoor levels of ozone, such as during the summer, also lead to higher ozone levels indoors. Although indoor ozone concentrations may be lower than outdoor concentrations, this is somewhat offset by the amount of time people spend indoors.

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**MYTH**: Ozone generated by room indoor air cleaners is safe and effective for cleaning indoor air.

**FACT**: Some manufacturers of ozone-generating room air cleaners suggest that ozone will render almost every chemical contaminant harmless by producing a chemical reaction that generates only carbon dioxide, oxygen and water as by-products. A review of scientific literature, however, shows that at concentrations which do not exceed public health standards, ozone is generally ineffective in controlling indoor air pollution. Ozone does not react with every chemical contaminant — or it takes many years for the reaction to occur. Regardless, it's important to note that ozone (generated indoors or brought in from outdoors) can react with volatile organic compounds (VOCs), such as terpenes, from indoor sources. This interaction produces additional VOCs, such as formaldehyde and aldehydes, which have unpleasant odors and are far more irritating and more toxic than the VOCs from which they were derived (Boeniger 1995, Weschler 2006). Thus, the use of low-emitting products becomes an important strategy for minimizing adverse impacts of ozone in indoor air. Also, ozone-generating air cleaners are not effective in removing carbon monoxide or formaldehyde. In addition, ozone does not remove particles, such as dust or pollen, from the air (US EPA 2009).

Some data suggest that low levels of ozone may reduce airborne concentrations and inhibit the growth of viruses, bacteria and mold, but to fully decontaminate the air, concentrations would have to be 5 to 10 times higher than public health standards allow. The scientific data also demonstrate that ozone has no effect on biologic contaminants embedded in porous materials, such as duct lining and ceiling tiles, nor is it considered to be effective at removing odors at levels that do not exceed public health standards (US EPA 2009).

**Federal and State Efforts to Regulate Indoor Ozone Levels**. Several federal agencies have established health standards or recommendations to limit exposure to ozone. These mostly apply to occupational settings or outdoor air, but are useful for residential exposure as well. These standards include the following:

- The Federal Drug Administration (FDA) requires ozone output from indoor medical devices to not be more than 50 ppb (0.05 ppm).
- The Occupational Safety and Health Administration (OSHA) requires that workers be exposed to an average concentration of no more than 100 ppb (0.10 ppm) for 8 hours.
- The National Institute of Occupational Safety and Health (NIOSH) recommends an upper limit of 100 ppb (0.10 ppm) not to be exceeded at any time.
- As of 2008, the US EPA National Ambient Air Quality Standard has a maximum 8-hour outdoor concentration of 75 ppb (0.075 ppm). In January 2010, the US EPA announced proposed standards at a level between 60 and 70 ppb (0.060 and 0.070 ppm) measured over 8 hours (US EPA 2010).

In October 2008, the California Air Resources Board (CARB) took its ongoing efforts to ensure the safety and effectiveness of indoor cleaning products further by regulating the concentration limits of ozone emissions from these devices. It requires that manufacturers have compliant products, which do not contribute more than 50 ppb (0.05 ppm) ozone, on the store shelves within two years of the regulation effective date or risk losing retail shelf space and perhaps face citations and fines for noncompliance. Whole-house ("in-duct") models, which attach to forced-air heating/cooling systems, are not restricted as part of the regulation — neither are devices made, sold and used only for industrial use. Applicable devices for sale in California must meet the regulation requirements by October 18, 2010. For more information about which air cleaners must be tested, visit the CARB Web site: http://www.arb.ca.gov/research/indoor/aircleaners/aircleaners.htm.

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Air Quality Sciences (AQS) is a renowned expert in this area, with a special large chamber ozone test facility to assist manufacturers with compliance with the CARB regulation, which uses the ANSI/UL Standard 867 ozone emissions test method. This test facility and associated test protocols have been audited and approved by the state of California. AQS also is an expert at testing products for VOC emissions and advising manufacturers on how to minimize VOC emissions in their products. The company's testing facility features environmental chamber technology, the most reliable and scientifically proven way to test for product emissions, including ozone, VOCs, formaldehyde and other aldehydes and particles.

Visit www.aqs.com to learn more about how we can assist you or call us at (770) 933-0638 and ask for Product Evaluations. Also visit the AQS Aerias IAQ Resource Center to learn more about VOCs and other indoor contaminants. For more information on indoor air cleaners and how they work, see the AQS white paper, Clearing the Air on Indoor Air Cleaners/Purifiers, which is available free of charge from the Aerias Web site, under the Premium Content tab. You can access Aerias from the AQS Web site or at www.aerias.org. For a listing of products that are certified to emit low levels of VOCs, visit the GREENGUARD Environmental Institute site at www.greenguard.org.

**Citations**

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