## Is Ozone from Air Purifiers Harmful or Helpful for Indoor Air Quality?

## Introduction

Indoor air quality significantly influences human health, prompting consumers to seek effective air purification methods. One controversial method involves ozone-generating air purifiers, devices marketed as solutions to neutralize pollutants, bacteria, and odours. Despite these claims, major health organizations consistently highlight the potential hazards associated with ozone generation indoors (EPA, 2023; WHO, 2022). This article critically examines how ozone air purifiers operate, evaluates their purported benefits, explores associated health risks, reviews regulatory guidance, and assesses safer alternatives.

## **Mechanism of Ozone Generation**

Ozone  $(O_3)$ , composed of three oxygen atoms, is generated by air purifiers through corona discharge or ultraviolet (UV) radiation, causing diatomic oxygen  $(O_2)$  to split and recombine. Theoretically, ozone oxidizes pollutants, potentially neutralizing certain airborne contaminants and odours (Boeniger, 1995). Despite this plausible mechanism, the process is often misrepresented, with ozone incorrectly portrayed as beneficial or "energized" oxygen. In reality, ozone possesses toxicological properties fundamentally different from breathable oxygen, categorizing it as a harmful pollutant at ground level (EPA, 2023).

## **Evaluating Purported Benefits**

Manufacturers of ozone-generating purifiers frequently claim effectiveness in removing airborne pathogens, odors, and volatile organic compounds (VOCs). While high-concentration ozone can disinfect surfaces effectively, eliminating pathogens like SARS-CoV-2, these concentrations exceed safe human exposure limits dramatically (Hudson & Sharma, 2020). Real-world applications in occupied spaces fail to achieve these disinfectant levels, rendering these devices largely ineffective for pathogen control at safe concentrations. Studies consistently demonstrate that ozone has minimal effectiveness at neutralizing common household odours and chemicals at recommended safe levels (EPA, 2023).

# **Health and Safety Risks**

Exposure to ozone indoors can significantly compromise respiratory health. Even low-level ozone exposure can trigger respiratory symptoms such as coughing, chest pain, wheezing, throat irritation, and exacerbation of asthma (CDC, 2022). Chronic exposure may lead to permanent lung damage, reduced lung function, and heightened vulnerability to respiratory infections (WHO, 2022). Populations particularly vulnerable to ozone exposure include children, elderly individuals, and those with pre-existing respiratory conditions (EPA, 2023; CDC, 2022).

Furthermore, ozone reactions with indoor VOCs, like cleaning agents containing terpenes, can produce secondary pollutants such as formaldehyde and ultrafine particulate matter (Weschler, 2006). These secondary pollutants often pose equal or greater health risks than original contaminants, exacerbating indoor air quality problems rather than mitigating them.

# **Regulatory Guidance**

Due to the documented health hazards, regulatory bodies strictly limit ozone exposure. The U.S. Environmental Protection Agency (EPA) sets the maximum outdoor ozone exposure at 0.08 ppm for an 8-hour average, highlighting that typical indoor ozone-generating devices frequently exceed these standards (EPA, 2023). Similarly, the California Air Resources Board (CARB)

explicitly bans certain ozone-generating air cleaners for household use and warns strongly against using such devices in occupied spaces due to serious health risks (CARB, 2023).

The World Health Organization (WHO) and the Centres for Disease Control and Prevention (CDC) echo these concerns, emphasizing that indoor ozone exposure poses significant respiratory health risks without corresponding benefits in pollutant removal (WHO, 2022; CDC, 2022).

#### Why are ozone generators still on the market?

The unfortunate answer is that misleading advertising by manufacturers is very effective, and no government agency has the authority to fully regulate these devices. Thus, CARB is actively working to educate professionals and the public about the dangers of using ozone generators. *(California Air Resources Board)* 

#### What does CARB recommend?

CARB strongly advises against the use of ozone generators in spaces occupied by people or animals. Other governmental agencies agree with this advice. CARB provides a list of potentially hazardous ozone generators sold as "air purifiers", which is periodically updated. If an ozone generator is not on this list, it does not mean that it is safe for use.

Better Living	Sun Aire Air Purifier
BioTech Research	EdenPURE Area Air Purifier, EdenPURE Deluxe Air Purifier
Biozone (All models)	50, 100, 102, 500, 1000, 2000, 3000, 4000, 5000, Travel Aire 50V, Travel Aire 250T
Breathe Pure	Q0Z0-100, Q0Z0-500
Capital Vanguard Co., Ltd	HV-(107, 109, 202, 202A, 203A, 205, 206A, 207, 207A, 210A, 217A, 308), HV-202I+O3

https://ww2.arb.ca.gov/our-work/programs/air-cleaners-ozone-products/potentially-hazardous-ozone-generators-sold-air

## **Comparison with Alternative Air Purification Technologies**

Compared to ozone generators, HEPA filters and activated carbon systems offer safer and more reliable alternatives for indoor air purification. HEPA filters effectively remove particulate matter such as dust, pollen, smoke, and microorganisms, capturing over 99.97% of particles sized 0.3  $\mu$ m or larger (EPA, 2023). However, HEPA filters don't remove any odours and can release captured contaminants back into the air when they become saturated or improperly maintained, necessitating regular maintenance and careful handling to ensure continued effectiveness (EPA, 2023).

Activated carbon filters efficiently absorb odours and VOCs without harmful by-products, enhancing indoor air quality without emitting ozone (CARB, 2023). NASA's Clean Air Study further emphasizes activated carbon's effectiveness, indicating it as a natural and highly efficient alternative for removing VOCs and other harmful gases from poorly ventilated spaces (Wolverton et al., 1989).

Unlike ozone generators, activated carbon filters pose no direct health risks or generation of secondary pollutants, making them particularly suitable for enclosed, unventilated spaces

(CDC, 2022). Regulatory and health bodies widely recommend activated carbon filtration systems, often combined with HEPA filters, for comprehensive indoor air purification (EPA, 2023).

### Conclusion

Extensive scientific evidence and regulatory guidance strongly indicate that ozone-generating air purifiers are harmful rather than beneficial for indoor air quality. While ozone at very high concentrations can disinfect surfaces, such conditions are hazardous and impractical for occupied indoor environments. Low-level ozone exposure poses well-documented respiratory risks and can generate harmful secondary pollutants. Health organizations including the EPA, WHO, CDC, and CARB consistently advise against the use of ozone generators in occupied spaces, recommending instead safer, proven alternatives like HEPA and activated carbon filters.

Given these findings, consumers are strongly advised to avoid ozone-generating air purifiers in favor of effective, health-safe methods for improving indoor air quality.

## **Reference List**

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