NADCA Position Paper

on Ozone Applications in HVAC Systems

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Introduction

Awareness of indoor air quality has increased substantially in recent years, and the systems that supply air to our living and working spaces are critical to the maintenance of a healthy indoor environment. As the global industry's leading advocate and trusted resource for reliable information, the National Air Duct Cleaners Association (NADCA) is uniquely qualified to provide guidance for consumers and the industry on the best practices for inspecting, cleaning and restoring HVAC systems.

Source removal of contaminants remains the single best method for cleaning and decontaminating HVAC systems. However, HVAC systems sometimes require treatment for odors or the reduction of microbial contamination. One remedy that has been used for these problems is ozone, a form of oxygen. Currently a broad range of information exists regarding the use and efficacy of ozone. In working with all parties associated with indoor air quality, NADCA recognizes the need to provide direction in this area.

Although the following information reflects the current state of the art for the use of ozone in HVAC systems, readers should recognize that new developments regularly occur and should familiarize themselves with the most current information when determining the appropriate steps to take.

Disclaimer

NADCA recognizes that differences in opinion will exist as to how to manage the use of ozone. NADCA also recognizes that industry professionals will decide whether or not the application of ozone is appropriate for a given HVAC system, based on the unique circumstances surrounding that system. Ultimately, the decision of whether or not to apply ozone to an HVAC system rests with the owner of the system.

This document was written in the United States of America and is intended primarily for use in this country. This material may also prove useful for industry professionals and others operating outside the USA. All users of this document are encouraged to refer to applicable federal, state/provincial, and local authorities having jurisdiction over the subjects addressed within this document.

Ozone

Ozone (O_3) is a molecule consisting of three oxygen atoms. It is much less stable than the more common oxygen molecule, O_2. Ozone in the lower atmosphere will burn sensitive plants and is an air pollutant with harmful effects on the respiratory systems of animals; however, the ozone layer in the upper atmosphere is beneficial, preventing potentially damaging electromagnetic radiation from reaching the earth's surface.

Application method

For treatment purposes, ozone is created by an ozone generator, a machine that converts oxygen in the air to the O_3 form. The ozone generator has a fan that disperses ozone into a room, HVAC system, air handler, or any other contained area that is being treated.

Typical Use

The most common uses of ozone are in the preparation of pharmaceuticals, synthetic lubricants, and many other commercially useful compounds. It is also used commercially for bleaching substances and for killing microorganisms on surfaces and in air and water. Many municipal drinking water systems kill bacteria with ozone instead of the more common chlorine.

Devices generating high levels of ozone are used to sanitize and deodorize uninhabited buildings, rooms, ductwork, woodsheds, and boats and other vehicles. In the U.S., air purifiers emitting low levels of ozone have been sold. This kind of air purifier is sometimes claimed to imitate nature's way of purifying the air without filters and to sanitize both it and household surfaces. The EPA reports that "results of some controlled studies show that concentrations of ozone considerably higher than these [human safety] standards are possible even when a user follows the manufacturer's operating instructions." [1]

Toxicity

At elevated levels, sometimes at levels found in outdoor and indoor air, ozone is a potential health hazard. One U.S. study of 450,000 people found that residents in cities with high ozone levels had a more than 30% increased risk of dying from lung disease.[2] Additionally, ozone can react with paint and other chemicals in a building to create chemical byproducts that may contribute to health concerns.[3]

Potential health hazards must be considered when using ozone.

Pros

- Ozone is effective at removing some organic odors such as smoke and decay and at killing many biological contaminants.
- An ozone generator can make a nearly unlimited supply.
- It can be targeted to specific areas or dispersed broadly.
- It is relatively easy to saturate HVAC ductwork with it.

Cons

- The EPA has declared that there is evidence to show that at “concentrations that do not exceed public health standards, ozone applied to indoor air does not effectively remove viruses, bacteria, mold, or other biological pollutants.”[4]
- If a contractor elects to utilize ozone as a method to break down odor-causing organic compounds or control biological organisms, it would need to be utilized at concentrations that exceed public health standards. Used at these concentrations, ozone can be effective in the control of these problems. When ozone is used at such concentrations, occupants must evacuate the building until the ozone is at safe levels.
- Ozone reacts with other materials such as rubber and wiring insulation and at sufficient levels, ozone exposure can cause breakdown of these materials, releasing decomposition products.
- Removal of occupants and workers from the building and monitoring of ozone levels prior to re-entry requires additional time, money, and effort that may not make the use of ozone cost-effective in routine duct cleaning services.

EPA requirements

The EPA web site includes a great deal of information about ozone, its importance in the upper atmosphere, EPA’s concerns about it as a lower atmospheric pollutant, and the use of ozone in air cleaning processes. If an ozone generator makes a pesticide claim such as use of the term "sanitizer" then it is considered to be a pesticide device. Devices are not required to be registered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) section 3. However, they must meet a number of requirements per the Code of Federal Regulations (CFR) 40 part 152.500.

Since the EPA does not register these devices, it does not have data to support sanitizer claims. Even though the law does not require this data to be submitted, the EPA does expect the manufacturer to have data to support the claims of the device just as is expected for a pesticide which is required to be registered. It would be prudent for users to review supporting data for sanitizing claims before using these devices.

The following websites are available to assist the contractor with EPA information about ozone.

- "Ozone Layer Protection": http://www.epa.gov/ozone/strathome.html
- "Ozone Generators That Are Sold as Air Cleaners": http://www.epa.gov/iaq/pubs/ozonegen.html
- "Indoor Air Quality": http://www.epa.gov/iaq/index.html
- "About the Office of Air and Radiation": http://www.epa.gov/aboutepa/oar.html

Best practices

The contractor is urged to use caution prior to undertaking the use of ozone in HVAC systems. Initially, the contractor must take steps in the appropriate training, the use of personal protective equipment, and the application and monitoring processes before ozone is utilized. Additionally, the contractor must assure that applications do not occur in buildings that are inhabited or occupied (humans, pets, etc.) and that the treated areas are well ventilated prior to re-entry.

Currently no regulations exist regarding how to determine when it is safe to re-enter a building after ozone treatment. Instruments exist which measure ozone levels. Some contractors choose not to use these instruments and, instead, rely on the presence or absence of ozone odor as a determining factor. It is the contractor's responsibility to ensure that the building is safe for re-entry and that, at the time of re-entry, ozone levels do not exceed safety standards.

The Food and Drug Administration (FDA 1990) specifically limits the use of ozone in concentrations greater than 50 ppb (parts per billion) in areas intended for continuous occupancy (in buildings they regulate such as drug manufacturing).[5] This is equivalent to .05 ppm (parts per million).

The Occupation Safety and Health Administration's (OSHA's) permissible exposure limit for general industry is 100 ppb (.1 ppm).[6]

OSHA's short-term permissible exposure limit for ozone is 300 ppb (.3 ppm).[7]

Also:

- Use the ozone generator in accordance with manufacturer instructions.
- Little is known about the impact of ozone on the potential damage to building materials and/or residual chemical byproducts left behind after ozone treatment. Rubber, plastic, or other materials may be oxidized by ozone treatment causing chemical breakdown and release of toxic byproducts. It is recommended that extreme care and caution be implemented regarded the use of ozone in interior spaces until further research provides a clearer understanding of the overall efficacy and safety of this practice.[8]

- Use when systemic odor or contamination is present and after the source has been eliminated. Odor may be typically related to past smoke or biological sources.
- Pre-treatment of the impacted area is necessary if pathogenic organisms are present at levels of concern. Ozonation should not typically be used as a "stand alone" method, but rather in conjunction with source removal and other cleaning and disinfecting processes.
- Document that all employees are appropriately trained in personal protective equipment, application methods and procedures.
- Use only in non-occupied areas (humans, pets, etc.), and make certain that the treated area is well ventilated and monitored before re-entry.
- If high levels of ozone are to be used, some post-treatment inspection of basic building components and contents (gaskets, electric wiring, plastic or rubber products, etc.) may be necessary.

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[1] http://www.epa.gov/iaq/pubs/ozonegen.html
[2] Jerrett, M. 2009. "Long-term ozone exposure and mortality." *N. Engl. J. Med.* 360(11):1085-1095
[3] Seyffer, C. 2012. "Ozone and air filters." *ASHRAE J.* 52(2): 82-84
[4] http://www.epa.gov/iaq/pubs/ozonegen.html
[5] ASHRAE 2009. Fundamentals, 11.15; ASHRAE, Atlanta, GA
[6] http://www.osha.gov/dts/chemicalsampling/data/CH_259300.html
[7] http://www.osha.gov/dts/sltc/methods/inorganic/id214/id214.html
[8] http://www.epa.gov/iaq/pubs/ozonegen.html