

OZONE ENRICHMENT FOR ENVIRONMENTAL CONTROL – MYTHS AND REALITIES

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ABSTRACT

Indoor air pollutants are unwanted, sometimes harmful materials in the air. They range from dusts to chemicals to radon. The strategies generally used to reduce indoor air pollutants are source control, ventilation, and air cleaning. Air cleaning may achieve an additional reduction in the levels of certain pollutants when source control and ventilation do not result in acceptable pollutant concentrations. However, air cleaning alone cannot be expected to adequately remove all of the pollutants present in the typical indoor air environment.

Air cleaners are devices that attempt to remove such pollutants from the indoor air you breathe. Some manufacturers of the ozone generators are claiming ozone as air cleaning agent. However, many federal agencies in the US and other countries are warning people about the use of ozone generators for air cleaning as ozone adversely affects the human health.

1.0 INTRODUCTION

There is a growing concern about the indoor air pollution as more and more people report symptoms or specific diseases in air-conditioned and mechanically ventilated buildings. A growing body of scientific evidence has indicated that the air within homes and other buildings can be more seriously polluted than the outdoor air in even the largest and most industrialized cities. Since people spend approximately ninety percent of their time indoors, the risks to health may be greater for many people due to exposure to air pollution indoors than outdoors. In addition, people who may be exposed to indoor air pollutants for the longest periods of time are often those most susceptible to the effects of indoor air pollution. Such groups include the young, the elderly, and the chronically ill, especially those suffering from respiratory or cardiovascular disease.

Many air-conditioning systems are designed for very little or almost no provision for ventilation as fresh air ventilation means more energy requirement (and thus higher costs). Inadequate ventilation coupled with

recirculation of stale air result in poor Indoor Air Quality (IAQ) due to build up of the

pollutants, causing the phenomenon of “Sick Building Syndrome” (SBS). It is described as the presence of acute non-specific symptoms in a majority of people caused by working in buildings with an adverse indoor environment. The complex symptoms include irritation of the eyes, blocked nose and throat, headaches, dizziness, wheezing, sinus, congestion, dry skin rash, and nausea.

Any sources that actually release particles or gases into the air, or have the potential to do so, are primary causes of indoor air

quality (IAQ) problems. Examples are combustion sources such as oil, gas, kerosene, coal, wood, and tobacco products; building materials and furnishings as diverse as deteriorated, asbestos-containing insulation, wet or damp carpet, and cabinetry or furniture made of certain pressed wood products; products for household cleaning and

- Indoor Air Pollutants
- Indoor Air Quality – Affecting Factors
- Air Cleaners
- Environmental Control
- Strategies for Indoor Environment Control
- Ozone Enrichment for Environmental Control
- Federal Agencies' views on Ozone generators' adverse effects on human health
- Other Applications of Ozone

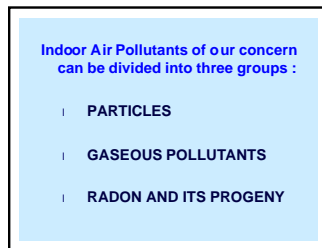
Indoor Air Pollution in mechanically ventilated buildings result in:

- | Irritation of the eyes
- | Blocked nose and throat
- | Headaches
- | Dizziness
- | Sinus
- | Congestion
- | Dry Skin Rash
- | Nausea ...

maintenance, personal care, or hobbies; central heating and cooling systems and humidification devices; and outdoor sources such as radon, pesticides, and outdoor air pollution. These particles or gases could be released either outside the building and be drawn into the building and be dispersed through air handling systems, or they could be generated within the building and be dispersed by air circulation patterns within the facility.

2.0 ENVIRONMENTAL CONTROL: NEED FOR GOOD IAQ

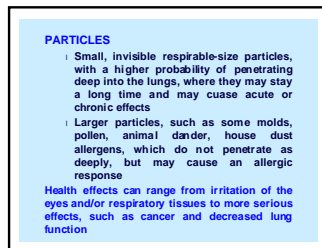
Indoor air pollutants are unwanted materials in the air, which are harmful for human health. The pollutants of our concern can be divided into three groups:



particles, gaseous pollutants, and radon and its progeny.

Particles

Particles are very small solid or liquid substances that are light enough to float suspended in air (e.g., mists, dust, or pollen). They are composed of diverse materials including inorganic and organic compounds and dormant and living organisms. Of primary concern from a health standpoint are: 1) small, invisible respirable-size particles, with a higher probability of penetrating deep into the lungs, where they may stay a long time and may cause acute or chronic effects, and 2) larger particles, such as some molds, pollen, animal dander, and house dust allergens, which do not penetrate as deeply, but may cause an allergic response.

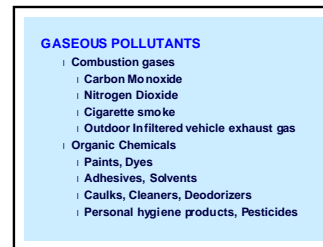


Respirable-size particles include, but are not limited to, those from cigarette smoke; unvented combustion appliances such as gas stoves and kerosene heaters; viruses, bacteria, and some molds; and fragments of materials which, when whole, would be considered larger than respirable size particles. Health effects from exposure to respirable-size particles in the air depend on the types and concentrations of particles present, the frequency and duration of exposure, and individual sensitivity. Health effects can range from irritation of the eyes and/or respiratory tissues to more serious effects, such as cancer and decreased lung function. Biological particles, such as animal and insect allergens, viruses, bacteria, and molds, can cause allergic reactions, infectious diseases, and/or produce toxic products, which may be released into the air.

Gaseous pollutants

Gaseous pollutants include combustion gases and organic chemicals, which are not associated with particles. Hundreds of different

gaseous pollutants have been detected in indoor air. Sources of combustion gases (such as carbon monoxide and nitrogen dioxide) include combustion appliances, cigarette smoking, and the infiltration of vehicle exhaust gases from attached garages or the outdoors.



Gaseous organic compounds may enter the air from sources such as cigarette smoking, building materials and furnishings, and the use of products such as paints, adhesives, dyes, solvents, caulks, cleaners, deodorizers, personal hygiene products, waxes, hobby and craft materials, and pesticides. In addition, organic compounds may originate outdoors or through cooking of foods and human, plant, and animal

metabolic processes.

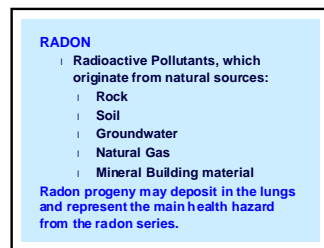
Health effects from exposure to gaseous pollutants in the air may vary widely depending on the types and concentrations of the chemicals present, the frequency and duration of exposure, and individual sensitivity. Adverse effects may include irritation of the eyes and/or respiratory tissues; allergic reactions; effects on the respiratory, liver, immune, cardiovascular, reproductive, and/or nervous system; and cancer.

Radon

Radon and its progeny are radioactive pollutants, which originate from natural sources such as rock, soil, groundwater, natural gas, and mineral building materials. These pollutants have the potential to cause lung cancer in humans.

The risk of lung cancer increases with the

level in the air and the frequency and duration of exposure. Radon itself is a gas, which produces short-lived progeny in the form of particles, some of which become attached to larger particles. Radon progeny may deposit in the lungs and represent the main health hazard from the radon series.



RADON

- | Radioactive Pollutants, which originate from natural sources:
 - | Rock
 - | Soil
 - | Groundwater
 - | Natural Gas
 - | Mineral Building material

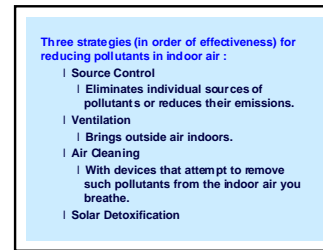
Radon progeny may deposit in the lungs and represent the main health hazard from the radon series.

3.0 STRATEGIES FOR INDOOR ENVIRONMENTAL CONTROL

There are three strategies (in order of effectiveness) for reducing pollutants in indoor air.

1. Source control: Source control eliminates individual sources of pollutants or reduces their emissions, and is generally the most effective strategy. Some sources, like those that contain asbestos, can be sealed or enclosed; others, like combustion appliances, can be adjusted to decrease the amount of

emissions. Unfortunately, not all pollutant sources can be identified and practically eliminated or reduced.



Three strategies (in order of effectiveness) for reducing pollutants in indoor air :

- | Source Control
 - | Eliminates individual sources of pollutants or reduces their emissions.
- | Ventilation
 - | Brings outside air indoors.
- | Air Cleaning
 - | With devices that attempt to remove such pollutants from the indoor air you breathe.
- | Solar Detoxification

2. Ventilation: Ventilation brings outside air indoors. It can be achieved by opening windows and doors, by turning on local bathroom or kitchen exhaust fans, or, in some situations, by the use of mechanical ventilation systems, with or without heat recovery ventilators (air-to-air heat exchangers). However, there are practical limits to the extent ventilation can be used to reduce airborne pollutants. Costs for heating or cooling incoming air can be significant, and outdoor air itself may contain undesirable levels of contaminants.

3. Air cleaning: Air cleaning may serve as an adjunct to source control and ventilation. However, the use of air cleaning devices alone cannot assure adequate air quality, particularly where significant sources are present and ventilation is inadequate.

Air cleaners are devices that attempt to remove such pollutants from the indoor air you breathe. Basic filtering system may sometimes be upgraded by using another filter to trap additional pollutants or by adding additional air-cleaning devices. An alternative to upgrading the induct air cleaning system is using individual room, portable air cleaners. Air cleaners generally rely on filtration, or the attraction of charged particles to the air-cleaning device itself or to surfaces within the home, for the removal of pollutants.

4. Ozone enrichment: Ozone enrichment of air can be accomplished by using an ozone generator for the purpose of cleaning the air. It is claimed that ozone reacts with the pollutants and can therefore remove them from the air. Ozone generators are being sold in the

market, but their use as air cleaners has generated some discussion due to the toxic nature of this gas.

5. Solar detoxification: Ongoing laboratory studies have shown the feasibility of using solar photocatalytic process along with microbiological techniques for the treatment of industrial wastewater. The results show that a combination of these techniques can clean-up wastewater where all conventional techniques fail, especially for removing color and reducing chemical oxygen demand. During the past year, research was also conducted on photocatalytic disinfection of water and wastewater. The results from these studies are applicable to disinfection of water, air, and hospital wastes. Solar detoxification to purify water has been already been applied in use at a few places, and the use of this technology is expected to grow soon. The purification of air using solar detoxification is also expected to move soon from laboratory testing phase to mature commercial use.

4.0 WHAT TYPES OF AIR CLEANERS ARE AVAILABLE?

Air cleaners are usually classified by the method employed to remove particles of various sizes from the air. There are three general types of air cleaners on the market:

Mechanical filters

Mechanical filters may be installed in ducts in homes with central heating and/or air-conditioning or may be used in portable devices, which contain a fan to force air through the filter. Mechanical filters used for air cleaning are of two major types.

Flat or panel filters generally consist either of a low packing density of coarse

glass fibers, animal hair, vegetable fibers, or synthetic fibers often coated with a viscous substance (e.g., oil) to act as an adhesive for particulate material, or slit and expanded aluminum. Simple filters may efficiently collect large particles, but remove only a small percentage of respirable-size particles. Flat filters may also be made of "electret" media, consisting of a permanently charged plastic film or fiber. Particles in the air are attracted to the charged material.

Pleated or extended surface filters generally attain greater efficiency for capture of respirable size particles than flat filters. Their greater surface area allows the use of smaller fibers and an increase in packing density of the filter without a large drop in airflow rate.

Electronic air cleaners

Electronic air cleaners use an electrical field to trap charged particles. Like mechanical filters, they may be installed in central heating and/or air-conditioning system ducts or may be portable units with fans. Electronic air cleaners are usually electrostatic precipitators or charged-media filters. In electrostatic precipitators, particles are collected on a series of flat plates. In charged-media filter devices, which are less common, the particles are collected on the fibers in a filter. In most electrostatic precipitators and some charged-media filters, the particles are deliberately ionized (charged) before the collection process, resulting in a higher collection efficiency.

Ion generators

Ion generators also use static charges to remove particles from indoor air. These devices come in portable units only. They act by charging the particles in a room, so they are attracted to walls, floors, tabletops, draperies, occupants, etc. In some cases, these devices contain a collector to attract the charged particles back to the unit.

There is currently some controversy about how effectively air cleaners

