INDOOR AIR QUALITY
JOURNAL

Key Strategies to Combat Poor IAQ

There are three key strategies to improving indoor air quality: Eliminating the source, Ventilation and Filtration. It is important to note that all three strategies must be employed to achieve the best indoor air quality possible. Using only one or two methods is generally insufficient.

Eliminate the Sources— With the exception of off-gassing of new building materials, sources of indoor air contaminants can usually be controlled or managed by the homeowner. These include proper use of bathroom and kitchen exhaust fans, discontinuing indoor tobacco smoking, proper ventilation of gas stoves and furnaces, proper storage of cleaning supplies, fuels and chemicals, and adequate cleaning procedures including the indoor air conditioning coil and duct system.

Ventilate the Space— The concentrations of indoor air pollutants are dramatically reduced when they are mixed with fresh outdoor air. Although ventilation can be achieved by simply opening a window, the air coming inside is unfiltered, and enters the home at a generally higher or lower temperature than the indoor air, causing additional heating or cooling requirements.

Filter the Air— Proper filtration using high efficiency filters (unlike the common, inexpensive filters found in hardware stores) is a key strategy to improve air quality. Forced air heating and cooling systems move air within the home constantly during operation. Homeowners who neglect to change or clean the system's filter subject themselves to higher levels of indoor airborne particles, along with higher heating and cooling costs.

Indoor Air Quality— Old Problem, New Focus

Allergies and Asthma on the rise

Most of us spend about 90% of our day indoors - at home, at work or school. According to EPA tests, levels of pollutants are 2 to 5 times higher indoors than outside, regardless of whether the buildings are located in rural or highly industrial areas. Other recent scientific studies have also questioned the quality of air inside our homes and buildings.

Despite this attention, poor indoor air quality is not a new phenomenon. In fact, we can find evidence from more than a century ago documenting IAQ concerns. According to The Health Reformer in 1871: *"In the construction of buildings, whether for public purposes or as dwellings, care should be taken to provide good ventilation and plenty of sunlight . . . schoolrooms are often faulty in this respect. Neglect of proper ventilation is responsible for much of the drowsiness and dullness that make the teacher's work toilsome and ineffective."*

Today's focus on indoor air quality has been the result of years of research on pollutants found in the home and their corresponding health effects, along with development of technologies that can eliminate or reduce the amounts of these potentially harmful contaminants. Individually, some pollutants may not pose a significant risk to our health. However, the combination of multiple sources over extended periods of time can be a serious risk to many people.

Primary indoor pollutants are gasses and particles released into the air. In new homes, many building materials are manufactured with synthetics, glues and chemicals. These materials can emit or "off-gas" minute particles in the form of fumes for several years - sometimes referred to as that "new home smell". To compound the problem, many builders now construct homes tighter and tighter to reduce energy costs, effectively sealing up the building "envelope." This minimizes the natural air movement through walls and around windows that were common in older homes, creating the potential for mold growth.

While older homes may not have off-gassing concerns associated with new materials, air quality problems can be caused by other materials including deteriorating wood, furnishings and fabrics, asbestos-coated insulation, mold from previously wet or damp duct systems or carpet, and radon.

Regardless of whether a home is new or old, other contaminants are often found indoors including pollen, smog, plant spores, tobacco smoke, cleaning supplies, solvents, gasoline fumes, odors from improperly ventilated bathrooms, combustion gasses from fossil fuel appliances, pet dander, soiled carpets, and unfiltered outdoor air entering the building. When not enough fresh outdoor air enters a home these pollutants can accumulate to levels that could pose health concerns.

Exposure to poor indoor air quality can cause health problems that are experienced immediately or over the course of many years depending on the intensity, cause, type of pollutant and the health or susceptibility of the occupants. Adverse health effects include coughing, dizziness, fatigue, asthma, hypersensitivity pneumonitis or irritation of the eyes, nose and throat. More serious cases may induce respiratory diseases, heart disease or cancer. Unfortunately, there is some debate in the medical community over what concentrations are problematic and over what period of exposure is required to produce health related problems. There are simply too many variables to precisely determine the long term effects of indoor pollutants. Therefore, the safest approach is to take reasonable steps to eliminate or minimize the risk.

FACTOIDS

The EPA has ranked indoor air pollution as a high priority public health risk.

Key conditions that are essential to support biological growth are nutrients and moisture.

A clogged condensate drain in your air conditioning coil can be a potential breeding ground for organisms that cause Legionnaire's Disease.

Secondhand smoke contains about 4,000 chemicals, including 43 carcinogens.

Inexpensive filters found at local hardware stores are only about 10% efficient.

Health Concerns over Indoor Air Quality

Contrary to popular belief, indoor air quality (IAQ) is more than just controlling mold. While mold is indeed a problem, it's not necessarily the only one or the biggest health threat in the home. In order to assess and remediate the problems it is necessary to consider all types of potential indoor air pollution.

Health effects from indoor air pollution vary greatly, depending on the types of pollution present, the concentration of each pollutant, and the relative susceptibility of the person. Some affects are acute such as asthma, hypersensitivity pneumonitis, headaches; while others are chronic such as cancer, heart disease, COPD (Chronic Obstructive Pulmonary Disease), and others.

The Asthma Epidemic

Asthma is a chronic lung disease characterized by sudden, acute attacks. During these attacks, the air passages in the lungs constrict resulting in difficulty breathing that can be life threatening. Attacks are often brought on by certain airborne triggers. Asthma prevalence in children has been on a steep rise since 1980. It has increased more than 70% from 1982 to 1994 and by 2000, asthma was the leading chronic illness in children. Asthma deaths in children have increased to 1500 per year. It's now the third-ranked cause of hospitalization of children.

Allergies

The purpose of the human immune system is to seek and destroy things that are not part of our body. An allergic reaction takes place when the immune system overreacts and produces various chemicals in an effort to eliminate the contaminant. These chemicals are called histamines and are naturally produced during strong allergic reactions. Anti-histamines are drugs designed to reduce the body's over-production of histamines.

There are many causes of allergies including animal dander, food products, chemicals, plants, and many other natural and man-made materials. Potentially, anyone can have an allergic reaction to a variety of stimulants. Allergies can also develop or disappear at any age.

Toxigenic Reactions

Toxins are poisonous substances that are the products of metabolic activities of a living organism like mold or bacteria. They are usually unstable, and when introduced into the body's tissues cause a reaction that induces antibody formation. The symptoms of a toxigenic reaction may include irritation or respiratory problems. Some toxins are released when the organism dies, so it's important to have a method to eliminate the organism, not just kill it.

Pathogenic Reactions

The common name for a pathogenic reaction is an infection. Pathogens (like bacteria) can cause serious illnesses or diseases. Common pathogenic reactions that are associated with air quality include Legionnaire's Disease, Pontiac Fever and various bronchial diseases.

Cleaning the Dirty Ducts

Over time, the duct system in your home may become contaminated with particles of debris, dust and pollen. In addition, the potential for microbiological growth is increased when moisture is present. These contaminants in the duct can be distributed throughout the home, and may cause reactions or other symptoms when exposure occurs.

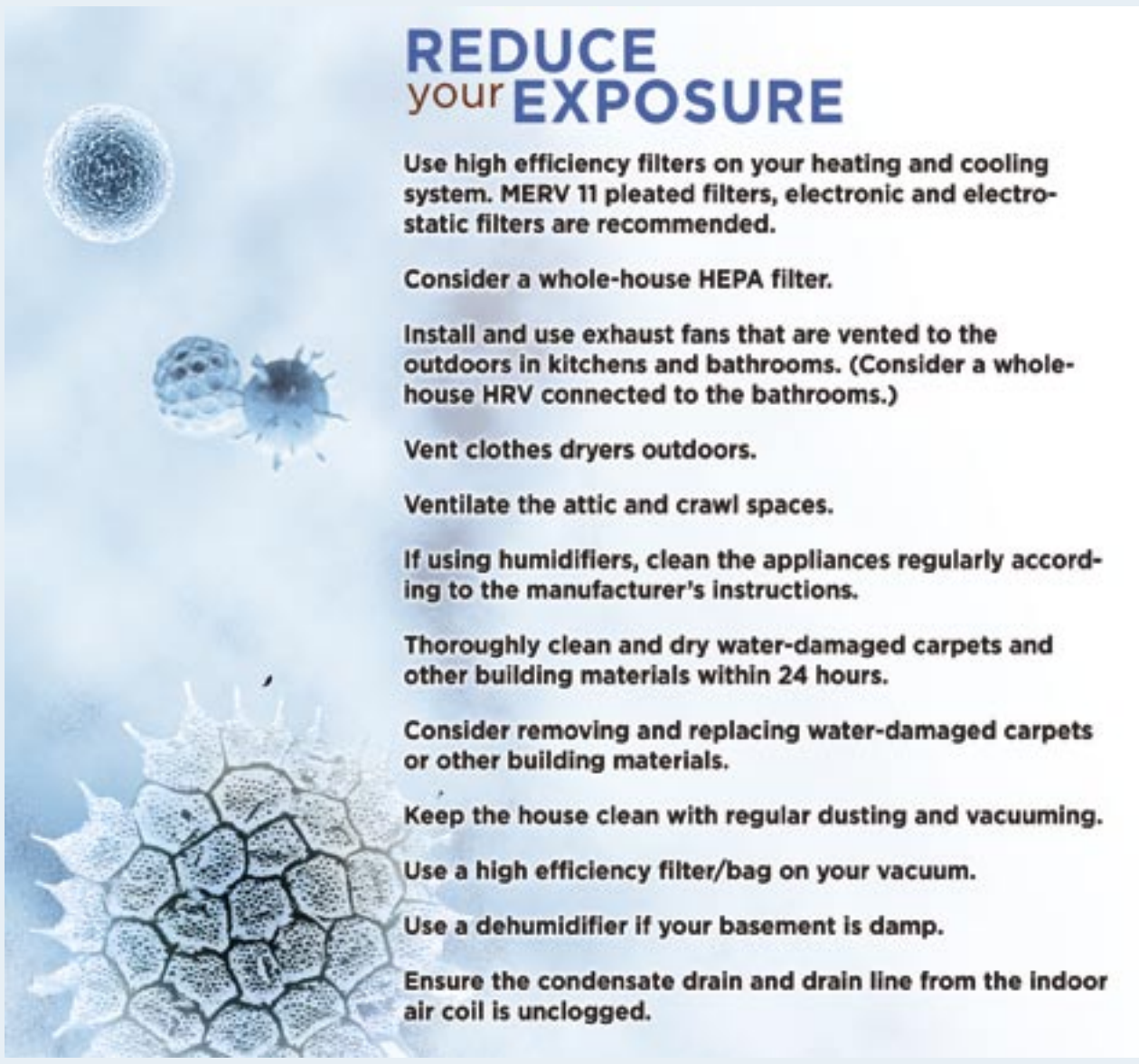
The EPA recommends that you have your duct system cleaned if it is dirty. You should consider having the ducts cleaned if there is visible mold growth inside the surface, ducts are infested with vermin (rodents or insects) or if your ducts are clogged with excessive amounts of dust, debris and particles that can be released into the home.

Various types of duct cleaning machines and technologies are in use by heating & cooling contractors and other service professionals. The entire system, including ducts, plenums, registers, the blower, and the indoor coil should be cleaned during the process. Special chemicals are sometimes used to treat biological growth. In addition, some duct service professionals offer a sealing process, which makes the duct system less prone to contamination, while also eliminating energy-wasting leaks.

Biological Contaminants: Getting Rid of the "Funk"

Biological contaminants include molds, mildew, bacteria, viruses, animal dander, dust mites, pollen, plant debris, and insect waste. These pollutants can cause allergic, toxigenic and even pathogenic reactions, depending on the cause, its concentration, the amount of exposure, and the susceptibility of the occupants.

Adverse health effects from exposure to this funk can be irritation of the eyes, nose and throat, shortness of breath, dizziness, lethargy, digestive problems and fever. Standing water, wet surfaces, and water-damaged material in dark spaces serve as ideal breeding grounds for many of these contaminants, especially in the warm confines of a typical home.



Solutions to Improving Your Indoor Air

Because we spend so much of our lives indoors, and today's houses are designed to keep fresh air out, it's important for homeowners to know about the solutions available for improving indoor air quality.

In fact, because poor indoor air quality has been recognized as a serious health issue, several states in the US, along with Canadian provinces are beginning to require mechanical devices that have a positive impact on the air in the home. The American Lung Association and the EPA are also actively involved in educational and monitoring programs in an effort to improve the indoor air that is so vital to our family's health.

There are a variety of devices that can be used to improve the air in our homes. Several technologies and systems are available that concentrate on two of the key strategies—Ventilation and Filtration. These include heat recovery ventilators, super-efficient HEPA filters and a variety of other high efficiency air cleaners and filters.

Heat Recovery Ventilator (HRV)
An HRV is a device that moves stale contaminated air from baths and kitchens from inside the home to the outdoors. At the same time it draws fresh, oxygen-rich air from outside, filters it and delivers it throughout your home. Stale, polluted air is constantly being replenished by an equal amount fresh, clean air. As the two air streams pass each other through the HRV they do not mix. However, they do pass on either side of an aluminum heat exchange core that transfers the heat from the air exiting the home to the fresh air coming in.

The efficiency (around 83%) is high enough that virtually all of the energy is transferred and little energy is used to condition the incoming fresh air. During cooling the HRV removes the heat from the incoming fresh air and transfers it to the stale exiting air so that the incoming air is "pre-cooled".

The AlpinePure model of HRVs is designed to be connected to bathroom and kitchen exhaust ducts, replacing the bathroom/kitchen fans. Independent switches activated in any bathroom turns on the HRV for a 20-minute period. The HRV can also be activated whenever the heating/cooling unit is operating, or for a 40-minute cycle by activating a separate switch conveniently located in the home. By utilizing the HRV for bathroom ventilation, ordinary noisy exhaust fans are eliminated, and fresh outdoor air is introduced indoors without a major efficiency loss.

With an HRV, the volume of stale discharged air and the amount of incoming fresh air is equal, providing a balanced system. Other ventilation strategies may cause depressurization of the home, causing air infiltration into wall cavities which can lead to moisture damage, rot or harmful mold.

HEPA Filters
For the ultimate in air filtration, the HEPA filter is the best choice. It uses the type of filtration technology required in hospitals and operating rooms. HEPA filters are the most efficient mechanical filters for removing small particles which can be breathed deep into the lungs. The AlpinePure brand of HEPA filter has a 99.97% efficiency for particle sizes 0.30 microns and larger.

HEPA filter technology is the most effective way of removing large numbers of the smallest particles. Other less-efficient filtration technologies rate the efficiency in terms of weight, not volume of particles captured. It's easy to understand that larger-sized particles (more than 5 microns) weigh more than smaller ones. However, the number of large particles in the air may actually account for less than 1% of the total number of particles in the air. The vast majority of the particles in the air are smaller than 5 microns, and these smaller ones are generally more detrimental to your health, so it's important to remove those by using devices like the AlpinePure HEPA.

MERV 11 Disposable Filters
MERV 11 filters are available in 2-inch and 4-inch thicknesses. "MERV" stands for Minimum Efficiency Reporting Value, an industry standard which sets a rated value on the ability of a filter to trap particles ranging in size from 0.3 to 10.0 microns from the air we breathe. The higher the MERV rating, the higher the efficiency. Most ordinary, inexpensive filters found at hardware stores are MERV 4 or lower—they are simply ineffective in capturing smaller particles. MERV 11 filters are much more efficient for both small and large particles including pollens, mold spores, dust, fungal spores, and pet dander. In addition, these filters are pleated to increase the surface area, allowing for more holding capacity and less frequent replacement. Because these filters are disposable, the dirt trapped inside is completely removed from the system when the filter is replaced.

Electrostatic Air Filters
Electrostatic Air Filters provide up to 90% arrestance of dusts, pollens and molds. As the air moves through a configuration of polypropylene filtration media, static electric charges are naturally created to attract and hold particles. This 1" thick filter fits easily into the existing filter rack. The AlpinePure model electrostatic air filter is designed for permanent use—there is no media to replace. Because the AlpinePure ES creates its own static electrical charge, there are no wires to connect or reconnect for cleaning, and no additional cost of operation. Periodic cleaning is simply accomplished using a mild household cleaner and a garden hose.

Common Indoor Pollutant	**Typical Particle Size** (microns)	
Pollen, mold, plant spores	7 - 70	Larger
Dust mites	3 - 10	
Hairspray	3 - 10	
Large bacteria	1 - 20	
Auto emissions	1 - 3	
Lead dust	1 - 3	
Fungal spores	0.50 - 7	
Cooking smoke/odors	0.30 - 1	
Paint pigments	0.30 - 1	
Dust	0.20 - 8	
Pet dander	0.15 - 8	
Small bacteria	0.08 - 1	
Tobacco smoke	0.008 - 0.6	
Viruses	0.005 - 0.01	Smaller
Volatile organic compounds	less than 0.001	

Electronic Air Cleaners
Electronic air cleaners operate by using a non-ionizing polarized media, creating an active electric field to capture airborne particles with efficiencies of 97% at 0.30 microns. Electronic media air cleaners do an excellent job of removing submicron particles by the process of agglomeration—polarized particles bond with other polarized particles in the air, forming larger particles which are easily removed through the filter. Carbon center screens are included to trap odors and volatile organic compounds. The AlpinePure brand of electronic air cleaner is easily cleaned and the media is easy to replace. Unlike some other electronic air cleaners, the AlpinePure ET creates no harmful ozone or nuisance zapping noises.

From left to right: Electrostatic Air Filter, MERV 11 Disposable Filters, AlpinePure HEPA, AlpinePure Electronic Air Cleaner, AlpinePure HRV

Several popular brands of ionizing air cleaners are available today like the Sharper Image Ionic Breeze, Brookstone Pure-Ion, Ionic Pro, IonizAir, and others. These portable devices are ion generators that use static charges to remove particles from indoor air. They function by charging the particles in a room, causing an attraction of pollutants to walls, floors, table tops, draperies, occupants, etc. Some of these devices contain a collector plate to attract and collect the charged particles inside the unit.

Studies by the scientific community and a leading consumer publication have demonstrated that these devices do a poor job of filtering and cleaning the air, and even worse, they can generate possibly unhealthy levels of ozone.

Ozone Chemistry
Ozone is an unstable molecule composed of three oxygen atoms (in contrast to the air we breathe which contains two oxygen atoms). The third oxygen atom in ozone can detach from the ozone molecule, reattaching to molecules in other substances, altering their chemical composition.

While the ozone layer in the upper atmosphere is beneficial and protects us from harmful ultraviolet rays, at ground level, ozone is an irritant that can cause decreased lung function and aggravate asthma. In fact, the EPA refers to ozone as "Good up high— bad nearby".

Effective Air Cleaners?
Independent studies have shown that ionizing air cleaners are not effective in cleaning the air and improving indoor air quality. Despite the manufacturer's claims, all the models listed above received ratings of "Poor" for removal of dust, smoke and pollen. The ionization process (which generates ozone) is often touted as the key to removing indoor air contaminants. There is considerable scientific evidence that demonstrates that ozone has little potential to remove contaminants at concentrations that do not exceed public health standards. These units lack the ability to move adequate amounts of air for thorough filtration, in contrast to a typical geothermal unit that circulates and filters the entire volume of air in a 2500 sq. ft. home in about 15 minutes.

Dangerous Levels of Ozone
Manufacturers of ionizing air cleaners often make statements leading the public to believe that these devices are always safe. Some even use terms like "energized oxygen", "super activated oxygen" or "pure air" to suggest that ozone is a healthy kind of oxygen. In fact, ozone is a toxic gas with vastly different chemical and toxicological properties from oxygen. Several federal agencies have established health standards and recommendations to limit exposure to ozone.

Ionizing air cleaners are not regulated by the EPA (which regulates outdoor air) or the Food and Drug Administration because they are not classified as medical devices. Therefore, potentially harmful levels of ozone generated are not within the scope of programs designed to protect consumers.

Independent tests have confirmed that ionizing air cleaners can produce levels of ozone 5-10 times higher than public health limits. Not only can the levels of ozone be a health issue, but reactions between ozone and other chemicals may also produce harmful health effects. In one laboratory experiment, chemicals from new carpet were mixed with ozone. Although the ozone did in fact reduce the chemicals, the resulting reaction produced a variety of aldehydes, and the total concentration of organic chemicals in the air actually increased. Aldehydes are known to be an irritant to the lungs.

Recommendation
Based on the available scientific evidence and independent reports in noted consumer publications, the ability of these devices to clean air is very low, and much less effective than other filtration products on the market today. Further, the potential health risks associated with the high levels or ozone generated make these products questionable at best, and possibly even detrimental to human health. The American Lung Association suggests that ozone generators should not be used.

Glossary of IAQ Terms

Allergen— A biological or chemical substance that causes an allergic reaction. Common allergens include pollen, animal dander, dust mites.

Asbestos— The group of microscopic mineral fibers. They are light enough to remain airborne and can cause lung related illnesses.

ASHRAE Standard 52— A standard established by the American Society of Heating, Refrigerating and Air Conditioning Engineers, describing methods of testing and rating performance of air filters. Includes weight arrestance tests, dust holding capacity and dust spot efficiency.

Asthma— A usually chronic inflammatory disorder constricting the airways characterized by difficulty in breathing.

Carbon Monoxide— An odorless, colorless gas that is the chemical result of the combustion process. Interferes with distribution of oxygen to the body. Low levels of carbon monoxide poisoning result in flu-like symptoms. High levels are deadly.

Dander— Small scales of animal skin.

ERV— Energy Recovery Ventilator. A device which brings in fresh air into the home, simultaneously exhausting the same volume of air from the home. Removes humidity from the incoming air during cooling.

ETS— Environmental Tobacco Smoke. Second-hand smoke.

Formaldehyde— A common chemical found in adhesive or bonding agents for many building materials including carpets, upholstery, particle board, and plywood paneling. The release of formaldehyde into the air can be a cause of respiratory problems.

HEPA— High Efficiency Particulate Air filter. An extremely effective filtration system. Certified HEPA filters must meet an efficiency of 99.97% down to a particle size of 0.3 microns.

HRV— Heat Recovery Ventilator. Heat from the outgoing air is transferred to the incoming air.

HVAC— Heating, Ventilation and Air Conditioning.

MERV— Minimum Efficiency Reporting Value. The new industry standard which sets a rated value on the ability of a filter to trap particles. The higher the MERV rating, the higher the filter's efficiency. A MERV 11 is high, 2-4 is low.

Micron— One millionth of a meter. There are 25,400 microns per inch. (See table for micron sizes of typical household pollutants.)

Nitrogen Dioxide— Colorless, odorless gas that irritates mucous membranes in the eye, nose and throat. Causes shortness of breath in high concentrations. Prolonged exposure can damage respiratory tissue. Can originate from kerosene heaters, stoves or fuel oil heaters.

Organic Gasses— Originate from paints, paint strippers, solvents, air fresheners, dry-cleaned clothing, etc. Can cause detrimental health effects.

Ozone— Molecule composed of three oxygen atoms (in contrast to the air we breathe which contains two oxygen atoms).

Particles— Very small solid or liquid substances that are light enough to float suspended in the air.

Radon— Radioactive pollutants which originate from natural sources such as rock, soil, or groundwater.

Respirable Particulates— Pollutants in the air that can be inhaled, including those from smoking, fireplaces, industrial/agricultural process. Health effects include irritation of the eyes, nose and throat and respiratory infections.

Rhinitis— Inflammation of the lining of the nose.

Sinusitis— Inflammation of the sinus membrane, especially in the nasal region.

UV Lights— Appliances that emit light energy in the ultraviolet wave length. Effective for killing bacteria. Less effective for killing mold. UV lights will kill (or render sterile) microorganisms. An effective filtration system is still required. Should be used with discretion.