



Indoor Air Quality (IAQ)

Introduction

Health of the built environment and those who occupy it is a very important aspect of Green Building. Since North Americans spend about 90% of our time indoors, the quality of the air inside our homes and offices can greatly impact our health and how we feel in those spaces. The EPA has stated that the air inside can be up to 100 times worse than the air outside. Some individuals, such as people with respiratory problems and chemical sensitivities, are more prone to environmental contaminants, though smoke, volatile organic compounds, radon, and other irritants can affect us all. As building materials and techniques are allowing our homes to be built very “tight,” we need to pay increasing attention to the contaminants we bring inside and how we introduce ventilation air.

Discussion

The key to optimizing indoor air quality (IAQ) is to identify problems or potential problems and to take the appropriate steps to minimize their impact on IAQ.

Radon. Radon is an odorless, colorless radioactive gas that can cause negative health effects, including lung cancer. In certain regions, elevated levels of radon is present in soils and can enter into a house through cracks in the foundation. When building in a prone area, construct appropriate radon mitigation and exhaust systems under the foundation or within the crawl space.

Moisture. Excessive interior moisture is one of a home’s worst enemies. It invites pests, dust mites, rot, and mold. Excessive moisture has become a greater problem in our homes because we have been sealing them tighter for energy efficiency, and have thereby made them more prone to holding interior moisture. There are three main causes of excessive moisture.

Roofing or plumbing leaks quickly cause damage to all building materials through saturation, rot, and then mold growth and the attraction of termites and other

pests. Reduce these problems by immediately repairing any leaks within moments or a few days of discovering the leak. Dry out or replace any affected building materials as well. If these problems are not handled quickly there could be severe consequences for occupant health from excessive mold growth and structural damage from termite attack. Make it a practice to inspect your home regularly for good flashing and caulking around roof/wall penetrations and around doors and windows; for effective drainage of gutters, downspouts, and stormwater runoff around the foundation; for excessive moisture buildup within your basement or crawl space due to drainage or plumbing leak issues.

Excessive buildup of moisture from occupants and their activities can cause moisture problems. Occupants release a large amount of humidity in breathing and sweating. They also introduce a lot of moisture from activities such as bathing, washing clothes and dishes, watering plants, boiling water, and using gas stoves and fireplaces (natural gas contains a large amount of water vapor). Reduce the moisture buildup by using exhaust fans in bathrooms, laundry rooms, and kitchens.

Excessive moisture brought in the home through humid outdoor air. This is due to occupants keeping the doors and windows open during humid outdoor periods. It also comes from the forced air heating/cooling system which pulls in outdoor air due to leaky supply or return ducts that are in the walls, attics or crawl spaces. This is a common problem as ducts leak on average 30%. This is remedied by having the ducts professionally leak tested and then repaired via sealing and/or replacement.

To monitor moisture in your home, purchase one or more inexpensive humidistats and operate your home to keep the relative humidity between 40-55%. A dehumidifier can help somewhat in areas such as basements (although you truly need to fix the cause of the moisture). Your air conditioning system also works as a dehumidifier, but it must run at least 10 minutes before it begins to pull any moisture out of the air.

Building Materials and Furnishings. One of the major contributors to poor indoor air quality are the materials, including wood products, paints, adhesives, etc., that are introduced into a home during construction or renovation. Choose products

carefully to minimize the introduction of pollutants, including (but not limited to) volatile organic compounds (VOC), formaldehyde, lead, asbestos, fiberglass, allergens, and microorganisms. Paints, sealants, adhesives, cabinets, insulation and office machines all potentially off-gas VOCs, though low- and no-VOC products are readily available (see fact sheet on Paint). Off-gassing of formaldehyde, which is often found in the binder of many wood products, can be minimized by purchasing materials with formaldehyde-free binders or sealing all six sides of the materials with a low-permeance sealer or paint (see fact sheet no. 3 on *Cabinets*).

Choose products that do not require offgassing adhesives, such as tack strips for carpet, nailing for hardwood floors, mortar for tile, or using the raw material as the finish surface such as stained concrete floors (see fact sheet no. 6 on *Flooring*). Also ensure that absorptive building materials, such as carpet or furniture fabrics are not installed prior to the installation of a product that is likely to off-gas pollutants. These fabrics on their own also offgas VOCs so try to purchase materials that offgas less.

Pests. Utilizing an integrated pest management (IPM) plan will help ensure that pest problems are quickly identified and that the least toxic method of treatment is used to help ensure enhanced indoor air quality. Use preventative measures, including using pest resistant building materials and physical pest controls, such as termite barriers and properly sealing penetrations, into the construction of a new home. The keys to an effective IPM plan are identification, monitoring, action decisions, treatment, prevention, and controls.

Carbon Monoxide. Carbon monoxide is caused by the fuel combustion activities in fireplaces, automobiles, stoves, water heaters, and furnaces. Tight homes and leaky ducts have also exacerbated carbon monoxide dangers to occupants by containing the gas indoors and by bringing it in from outdoors. Monitor the danger with a carbon monoxide detector just like you do with smoke detectors. Make sure to vent your gas stove to the outside. Install fireplaces, water heaters, and furnaces that are sealed appliances and use outdoor air for combustion. Take great care to seal your garage door and the walls that connect the garage to the home, and install a garage ventilation fan. Have your ducts tested to make sure they are not leaking and therefore depressurizing your home to the point where they could reverse the flow of the vents on the combustion appliances.

Air Ventilation and Filtration. Tighter building systems have also brought many homes to the point of requiring additional mechanical ventilation to help flush pollutants to the outside as well as bring in fresh air. As exhaust fans discharge air, the home is depressurized and replacement air needs to come from the outdoors. It typically comes in through holes in the home such as cracks/leaks in the walls, floors, ceilings, windows, and doors, which results in introducing unconditioned, unfiltered, uncontrolled and possibly humid outdoor air. Replacement air may also come in through vent pipes for the furnace, water heater and fireplace, which can introduce carbon monoxide and other dangerous gases and particulates. Therefore, it is best to have a mechanical ventilation system that allows the occupants to control the rate of exhaust of indoor air and the rate of return and filtration of outdoor replacement air.

Proper air filtration should also be an integral part of the home's heating/cooling system. Filters remove dust, pollen, and other particles from the air that is circulated through the system. This helps keep the blower and heating/cooling coils clean so they can operate efficiently and not wear out prematurely. When choosing a filter, choose one that has a high MERV rating (Minimum Efficiency Reporting Value) of 8-12 (see fact sheet no. 1 on *Air Filters*) and replace them as often as is necessary.

Pollution Prevention. Leave the outside, outside. Many pollutants and contaminants (dust, road grime, pesticides, fertilizers, etc.) are tracked into the home on the bottom of shoes and deposited on the floors and carpets. Imagine small children crawling over all of this and putting their fingers in their mouths afterwards. Minimize the impacts tracking with a sturdy welcome mat or by offering a space for visitors to take off their shoes.

Other pollutants are brought in through the air from depressurization issues or ventilation. Seal or separate the garage/home connection as mentioned earlier. Consider outside pollutants, such as high traffic roadways, neighbors, trash bins, and car exhaust when locating fresh air intakes and operable windows.

“Cleaning” products pose a major threat to good indoor air quality because they contain numerous harmful chemicals that offgas and are inhaled by occupants. To reduce this danger, install materials and furnishings in your home that can be cleaned and maintained using least-toxic methods and choose cleaning chemicals that minimize their impact on

indoor air quality, the environment, and the health of occupants. Reduce the use of dry cleaning, pesticides, candles, perfumes, moth balls, air fresheners, and “air purifiers” that produce ozone. Try to store cleaners, paints and fuels in a closet, in the garage, that is ventilated to the outdoors.

For More Information

- **Energy Star:** (www.energystar.gov) This EPA/DOE program provides good information on ducts, air infiltration and ventilation.
- **EPA Indoor Air Quality Program:** (www.epa.gov/iaq) has good information on all types of indoor air quality issues including mold, asthma, and radon
- **Canada Mortgage and Housing Corporation:** (www.cmhc-schl.gc.ca/en/index.cfm) has excellent resources on all aspects of home ownership such as indoor air quality, healthy building materials, moisture, radon, carbon monoxide, etc.
- **Energy and Environmental Building Association (EEBA) Builder’s Guides (for various climates):** (www.eeba.org) Easy to use book for construction professionals showing exact details of window, door, siding flashing installation. Books by Joe Lstiburek and Betsy Pettit.
- **Building Science Corporation:** (www.buildingscience.com) This website is the absolute best and most up to date source of information on moisture control, flashing, filtration, ductwork, and ventilation, as well as many other construction details that will help reduce problems with water leaks and moisture problems in the home.
- **The Healthy House Institute:** (www.hhinst.com) information and tools to improve and protect indoor air quality
- **Building Green:** (www.buildinggreen.com) An independent company committed to providing accurate and unbiased information designed to improve the environmental performance, and reduce the adverse impacts of buildings. Publishers of Environmental Building News.
- **Southface Energy Institute:** (www.southface.org) A number of great fact sheets, technical bulletins, and more information on insulation, air sealing, combustion appliances, and testing.
- **University of California Statewide Integrated Pest Management Program:** (www.ipm.ucdavis.edu) provides good information on integrated, ecologically sound pest management practices
- **National Pesticide Information Network:** (npic.orst.edu) provides good consumer information on pesticides
- **American Lung Association, Healthy House:** (www.healthhouse.org) Homeowner and builder information on how to build a healthy home
- For more information about Green Building, visit our website at: www.greenaffordablehousing.org or call Bruce Mast at 510-271-4785.

Disclaimer

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