

Indoor Air Quality (IAQ)

Introduction

The health of the built environment and those who occupy it is a very important emphasis of green building. Since North Americans spend about 90% of their time indoors, the air quality inside our homes and offices can greatly impact health and how one feels in those spaces. The EPA has stated that the quality of indoor air can be up to 100 times worse than that outside. People with respiratory problems and chemical sensitivities are more prone to direct suffering from such environmental contaminants, though smoke, volatile organic compounds, radon, and other irritants that contaminate indoor air can affect us all. Fueled by energy-efficiency concerns, improved building materials and techniques have made our homes increasingly airtight over the past 30 years. Such “tight” envelopes increase the need for attention to adequate ventilation and to tracked-in contaminants.

Discussion

The key to optimizing indoor air quality (IAQ) is to identify the sources of potential contaminants and to then take the appropriate steps to minimize their impact. Common contaminants include the following:

Radon

Radon is an odorless, colorless, radioactive gas that can cause negative health effects, including lung cancer. In certain regions, elevated radon levels are naturally present in soils and can enter a house through cracks in the foundation. When building in these regions, 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, inviting pests, dust mites, rot, and mold. Excessive moisture has become a greater problem in our homes as they are sealed increasingly tighter, which results in them more prone to harboring interior moisture. There are three main causes of excessive moisture:

Roofing or plumbing leaks quickly cause damage to all building materials first through saturation and rot, and then through mold growth and the attraction of termites or other pests. Reduce these problems by immediately repairing any leaks. Dry out or replace any affected building materials as well. If not handled quickly leak problems can result in severe consequences for occupant health from excessive mold growth and structural integrity 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; effective drainage of gutters, downspouts, and stormwater runoff around the foundation; and excessive moisture buildup within your basement or crawl space due to drainage or plumbing leak issues.

Excessive moisture buildup from occupants and their activities can also cause moisture problems. Occupants release a large amount of humidity through breathing and sweating, as well as 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 can also enter the home with humid outdoor air. This is typically due to occupants keeping the doors and windows open during humid outdoor periods. The forced air heating/cooling system can also pull in humid outdoor air due to leaky supply or return ducts that are in the walls, attics or crawl spaces. This is common as ducts leak on average 30% of their capacity, a problem remedied by professional leak testing and repair or replacement of the duct system.



To monitor moisture in your home, purchase one or more inexpensive humidistats and use it to help operate your home at a relative humidity of between 40-55%. A dehumidifier can help somewhat in areas such as basements, although the cause of the moisture should be addressed. Air conditioning systems also work as a dehumidifier, but must run 10 minutes before pulling any moisture from the air.

Building Materials and Furnishings

One of the major contributors to poor indoor air quality are building materials, including wood products, paints, adhesives, etc., used during construction or renovation. Choose products carefully to minimize the introduction of pollutants including (but not limited to) volatile organic compounds (VOCs), 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 Paint fact sheet). Offgassing of formaldehyde, found in the binder of many wood products, can be minimized by using materials with formaldehyde-free binders or sealing all six sides of the materials with a low-permeance sealer or paint (see Cabinets fact sheet).

Select products that do not require offgassing adhesives, such as tack strips for carpet, nailing for hardwood floors, and mortar for tile. Using the raw floor as the finish surface in another option, as with stained concrete floors (see Flooring fact sheet). Also ensure that absorptive materials such as carpet or furniture fabrics are not installed prior to the installation of a product that is likely to offgas pollutants. Such fabrics emit their own VOCs as well, so select materials that offgas less.

Pests

An integrated pest management (IPM) plan will help to ensure quick identification of pest problems and that the least toxic method of treatment is used to address them. Preventative measures include pest-resistant building materials and physical pest controls such as termite barriers and properly sealed

penetrations. Components of an effective IPM plan are identification, monitoring, action decisions, treatment, prevention, and controls.

Carbon Monoxide

Carbon monoxide is created by fuel combustion 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 or preventing its escape. Monitor carbon monoxide with a detector similar as one would for smoke. Make sure to vent your gas stove directly to the outside. Install fireplaces, water heaters, and furnaces that are sealed 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. Install ducts in non-conditioned space and test them for leakage. Leaking ducts can create negative indoor pressure, a state that could reverse the flow of the vents on combustion appliances and pull exhaust into your home.

Air Ventilation and Filtration

Tighter building systems have also brought many homes to the point of requiring additional mechanical ventilation to both flush pollutants outside and introduce fresh air. As exhaust fans discharge air, the home is depressurized and replacement air is drawn from the outdoors. Such air typically comes in through holes in the home such as cracks/leaks in the walls, floors, ceilings, windows, and doors, a process which results in introducing unconditioned, unfiltered, uncontrolled and possibly humid 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.

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. They also help keep the blower and heating/cooling coils clean so they can operate efficiently and not wear out prematurely.



Choose a filter that has a MERV rating (Minimum Efficiency Reporting Value) of 8-12 and replace them as often as is necessary (see Air Filters fact sheet). Incorporate a mechanical ventilation system that allows occupant control of both exhausting indoor air as well as the return rate and filtration of outdoor replacement air.

Pollution Prevention

Leave the outside outside. Occupants track many pollutants and contaminants, such as dust, road grime, pesticides, and fertilizers, into homes on the bottom of shoes, depositing them on floors and carpets. In addition to their adverse effect on IAQ, direct physical exposure to such substances is a potential hazard for occupants, especially small children who typically have significant contact with the floor. Minimize the impacts of tracked in pollution 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. As mentioned earlier, seal or separate the garage/home connection. Consider outside pollutants such as high traffic roadways, neighbors, trash bins, and car exhaust when locating fresh air intakes and operable windows.

“Cleaning” products can pose a major threat to good indoor air quality because they contain numerous chemicals that offgas and can be inhaled by occupants. To reduce this danger, install materials and furnishings in your home that can be cleaned and maintained using the least toxic methods. Choose cleaning chemicals that minimize their impact on indoor air quality, the environment, and occupant health. Reduce 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 garage closet or other structure that is ventilated to the outside.

For More Information

- **Energy Star** is an EPA/DOE program that provides good information on ducts, air

infiltration, and ventilation:

www.energystar.gov

- The **EPA Indoor Air Quality Program** has good information on all types of indoor air quality issues including mold, asthma, and radon: www.epa.gov/iaq
- **Canada Mortgage and Housing Corporation** has excellent resources on all aspects of home ownership such as indoor air quality, healthy building materials, moisture, radon, carbon monoxide, etc: www.cmhc-schl.gc.ca/en/co/maho
- **Energy and Environmental Building Association (EEBA) Builder’s Guides** (for various climates) are easy to use books for construction professionals that show exact details of window, door, and siding flashing installation (authors Joe Lstiburek and Betsy Pettit): www.eeba.org
- The **Building Science Corporation** website is the absolute best and most up to date source of information on moisture control, flashing, filtration, ductwork, and ventilation. It also showcases many other construction details that will reduce problems with home water leaks and moisture problems: www.buildingscience.com
- **The Healthy House Institute** provides information and tools to improve and protect indoor air quality: www.hhinst.com
- **Building Green** is an independent company that publishes *Environmental Building News* and is committed to providing accurate, unbiased information designed to improve the environmental performance of buildings: www.buildinggreen.com
- **Southface Energy Institute** has a number of useful fact sheets, technical bulletins, and information on insulation, air sealing, combustion appliances, and testing: www.southface.org
- **University of California Statewide Integrated Pest Management Program** provides good information on integrated,



ecologically sound pest management practices: www.ipm.ucdavis.edu

- **National Pesticide Information Network** provides good consumer information on pesticides: npic.orst.edu

- **American Lung Association**, Health House website provides homeowners and builders information on how to build a healthy home: www.healthhouse.org
- For more information about Build It Green, visit our web site at www.BuildItGreen.org or call us at 510-845-047

Disclaimer

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