Healthy Air, Healthy Homes

Formaldehyde and Indoor Air Quality

Formaldehyde is the most prevalent indoor pollutant. Fortunately, there are a number of ways both building professionals and homeowners can reduce levels of this harmful substance and improve overall indoor air quality.

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Does Indoor Air Quality Matter? Good indoor air quality, or IAQ, is a hot topic these days. Whether you're a building professional or a homeowner, you're likely becoming educated on the topic and are interested in implementing strategies to improve IAQ in homes.

THERE IS OVERWHELMING EVIDENCE to suggest that IAQ is a top concern for homebuyers. A study by BCC Research found that the IAQ market in 2013 was $7.7 billion and is expected to grow to $11.4 billion by 2019. A report published by UL Environment found that 83 percent of respondents polled had recently purchased green products; 42 percent listed IAQ as a primary concern.

But how much does good IAQ matter?

We spend 90 percent of our time indoors. According to the EPA, levels of indoor air pollutants are two to five times higher than outdoor levels. In fact, studies show that poor indoor air quality is responsible for 14 times as many deaths as outside air pollution.

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. These include children, the elderly and the chronically ill; those suffering from respiratory or cardiovascular disease are especially vulnerable. In addition, one in five adults has an allergy to indoor air particles and one in seven children has asthma.

Fortunately, there are many simple ways to improve IAQ, both during construction and once the home is occupied. Some of these strategies specifically target formaldehyde, one of the most prevalent toxic indoor air pollutants found in homes today.

Formaldehyde and Indoor Air Quality

What is formaldehyde?

FORMALDEHYDE IS AN ALDEHYDE, one in a large class of substances called volatile organic compounds, or VOCs. A colorless, strong-smelling gas at room temperature, formaldehyde is produced through natural processes in the upper atmosphere; it is also released through combustion, including wildfires. It is even produced in small amounts by plants and animals, including humans.

Formaldehyde is also an important industrial chemical and is used in many products and processes; in addition, it is the precursor for many other compounds. One of its largest uses is in the manufacture of wood resins and adhesives for pressed wood products such as plywood and particleboard.

Though formaldehyde is naturally present in small amounts in both indoor and outdoor air, combustion and industrial activities can release large amounts of formaldehyde, resulting in higher than normal concentrations locally. Formaldehyde is also released directly through materials in a process called out-gassing or off-gassing. If there is no way for

formaldehyde molecules to escape, concentrations in indoor air can far exceed levels in the outside atmosphere.

Formaldehyde does not accumulate in the environment, as sunlight and bacteria can break it down within a few hours. Human bodies metabolize formaldehyde quickly, so it does not build up in tissues. But formaldehyde is still quite toxic to humans.

Formaldehyde exposure is linked to a range of health issues. Short-term exposure can cause itchy and watery eyes, runny nose, burning sensations in the eyes, nose,

and throat, and headaches. High-level exposure can affect memory and learning, aggravate insomnia, and cause irritability. Some studies have revealed a link between formaldehyde and childhood asthma. It is a recognized carcinogen, increasing the risk of myeloid leukemia and nose and throat cancers, and it can provoke allergic reactions, including skin lesions and dermatitis in the face. Sensitivity varies among individuals, but in general, children are more vulnerable than adults.

How Formaldehyde Enters the Home

BUILDING MATERIALS CAN introduce formaldehyde into the home during construction, whether it's a new home or remodel of an existing one. Common building materials and products that contain formaldehyde include pressed board products such as plywood, particleboard, and MDF; pre-finished flooring; and paints and finishes. It is worth noting that, as of October 2015, U.S. fiberglass insulation manufacturers have phased out formaldehyde in their lightweight residential products.

Formaldehyde can also enter the home once it is occupied, through both activities of the occupants and new products brought into the home. Combustion, whether from cigarettes, wood-burning stoves or gas ranges, is one of the primary sources of the chemical. A surprising number of common household items also contain formaldehyde. These range from cleaning products and pesticides to cosmetics and hair care products to paints, varnishes, and adhesives. New furniture and some wrinkle-free fabrics also contain the chemical; in addition, carpeting can trap formaldehyde from other sources and re-release it. The use of computers, printers and copiers releases ozone, which can react with other VOCs to form formaldehyde.

Building a Healthy Home from the Ground Up

THE FIRST STEP TO ENSURING a healthy home is to make sure building materials and products aren't contributing harmful substances to the air. The most common sources of formaldehyde and other VOCs are pressed-wood products, flooring, paints and stains, finishes, caulks, and adhesives. Fortunately, it's getting easier to specify no-VOC paints and other low-emitting products and materials. Here are some guidelines:

- Choose pressed-wood products, including particleboard, MDF, and hardwood plywood, that are labeled in compliance with the American National Standards Institute (ANSI) or California Air Resources Board Airborne Toxic Control Measure (CARB ATCM) criteria.

- Consider using "manufactured-home" pressed-wood products, which are made with composites meeting Ultra Low Emission Formaldehyde (ULEF) or No Added Formaldehyde (NAF) requirements.
- Take advantage of third-party certification programs such as GREENGUARD® and FloorScore® to help vet other products. Rewarding manufacturers that participate in such programs will also create a positive feedback loop, potentially encouraging other manufacturers to participate in them, as well.

Ensuring adequate ventilation in your projects is another important part of the IAQ equation, especially as building envelopes become "tighter" and more energy efficient. Continuously replacing indoor air with fresh air will prevent the build-up of formaldehyde and other harmful substances, and will control moisture, as well. Moisture promotes mold and mildew growth, which can aggravate allergies and asthma and compromise the durability of your building. Adequate air cycling can be achieved through natural ventilation—the strategic opening of windows—or through the use of mechanical whole-house and/or spot ventilation fans. ASHRAE 62.1 and 62.2 are the recognized standards for ventilation system design and acceptable IAQ in the U.S.; CSA F326 is the Canadian standard. These standards define the minimum requirements for mechanical and natural ventilation systems and the building envelope intended to provide acceptable indoor air quality in low-rise residential buildings. Make sure to educate the homeowner and occupants on effective use of fans and other devices.

Homeowners are also looking for more active

Seven Tips for Building and Remodeling Projects

1. Build in "swing" seasons (fall and spring)
2. Use CARB-compliant building materials
3. Use insulation that doesn't contain UF foam
4. Specify no-VOC paints and finishes
5. Let materials off-gas before installation, especially engineered wood and laminate flooring products
6. Seal surfaces of formaldehyde-emitting products that are not already laminated or coated
7. Use products that actively remove formaldehyde from the air, such as AirRenew® drywall

The AirRenew® family of drywall products from CertainTeed contributes to indoor air quality by capturing formaldehyde molecules from the air.

solutions to achieve the best IAQ. Air filtering and cleaning systems are becoming popular, although it's important to understand that some of these systems are better at controlling particulate matter, while others target gaseous molecules. The effectiveness of these products depends on two factors: the efficiency with which the device collects pollutants from indoor air; and how much air is drawn through the device, usually expressed in cubic feet per minute. These systems also require regular maintenance. Filters need to be replaced regularly, as they become less effective as they become clogged with materials. Clogged filters can also strain system motors, making them less efficient.

Finally, there are also products that improve IAQ without complex installation or additional energy use. For example, the AirRenew® family of drywall products from CertainTeed actively works to absorb and remove formaldehyde from indoor air. This way, even the walls and ceilings can play an important role in keeping interior air safe and clean.

Five Innovative Strategies for Healthier Homes

Most pros understand the basics of good IAQ: use low-emitting materials and ensure adequate ventilation. Here are some lesser-known but effective strategies that will improve the overall health of your projects.

1. Sleep-friendly lighting: Natural light is critical to health and well-being. New LED lighting technology can complement natural daylighting to promote health. LED bulbs with adjustable color temperature are designed to stimulate the human body's natural circadian rhythms and improve sleep patterns. In the morning, the lamps emit a more concentrated blue-white hue to boost the natural waking cycle, while in the evening the lamps produce an amber hue, mimicking candlelight or fire.

2. Naturally antimicrobial materials: Kitchens can promote the growth of dangerous bacteria and microbes. Rather than inundating their homes with chemical cleaning products, some homebuyers are instead choosing antimicrobial surfaces such as quartz and copper, both of which combine an appealing aesthetic with a natural defense against bacterial growth. Copper is the first solid metal to gain EPA public health registration and is being used to create antimicrobial sinks, faucets, hardware and switch plate covers.

3. Under-mounted sinks: Under-mounting helps minimize the potential for microbe growth by eliminating the bacteria-trapping lip between the edge of a standard drop-in sink and the counter surface. Although this is not a new innovation, it is becoming more popular as awareness of the impact of such choices on health and wellness grows.

4. Allergen-reducing flooring: Carpets can harbor dust, mites, and other allergens. Increasingly, homeowners are choosing hardwood flooring over wall-to-wall carpeting in the main living areas of new homes. Hard surface floorings free of formaldehyde and other known respiratory irritants are becoming the standard.

5. Formaldehyde-absorbing drywall: The AirRenew® family of drywall products from CertainTeed uses an innovative technology to remove formaldehyde from the air and convert it to a harmless inert compound contained safely within the board. It installs like standard drywall and will continue to work within the home to reduce formaldehyde exposure and improve overall IAQ for up to 75 years.

Formaldehyde-Scavenging Drywall for Improved Indoor Air Quality

How AirRenew® Works

IN ADDITION TO ALL of the well-known strategies that building professionals have to ensure good indoor air quality, a new tool works to remove formaldehyde from inside air even after you've left the jobsite. Developed by CertainTeed, formaldehyde-scavenging drywall captures formaldehyde molecules circulating within rooms and converts them to inert compounds.

AirRenew® drywall continues to work after breathable paints, primers, texture, and wallpaper have been applied. CertainTeed claims that AirRenew® will effectively remove formaldehyde from indoor air for up to 75 years. The product looks and installs like normal drywall.

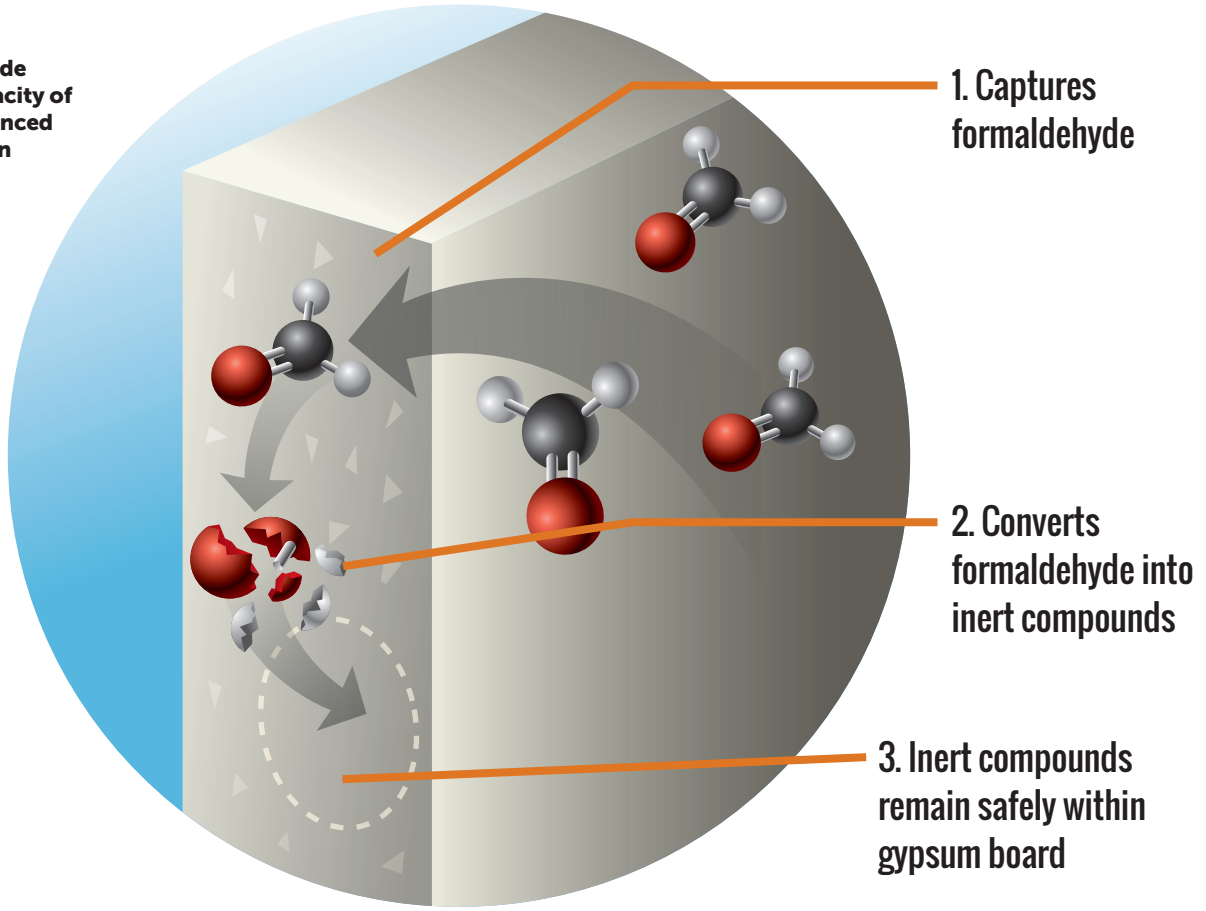
AirRenew® Essential comes with formaldehyde-scavenging technology, while AirRenew® with M2Tech® provides an additional zone of protection against mold and moisture. It is enclosed in 100 percent recycled mold- and moisture-resistant paper and achieves the best possible scores for mold resistance: 10 and 0 for mold per ASTM D3273 and ASTM G21, respectively.

The entire AirRenew® family of drywall products has earned GREENGUARD® Gold Certification and has been validated by UL Environment.

"These types of products are great additions to any builder's toolbox, and are very appealing to homebuyers looking to provide a clean, healthy living space for their families. With the AirRenew® drywall line by CertainTeed, you can offer an effective, non-mechanical solution to help deliver optimum IAQ and contribute to a healthy indoor living space, in an increasingly health-conscious market."

–Tom Prokop, Innovation and Product Manager, CertainTeed Gypsum

The formaldehyde absorption capacity of AirRenew® advanced drywall has been validated by UL Environment.



Maintaining Healthy Indoor Air Quality

Breathe Deep: Tips for Improving Indoor Air Quality

WHILE BUILDING PROFESSIONALS have a responsibility to ensure the best IAQ possible in all of their projects, homeowners and occupants have a big role to play, as well. You can impact IAQ both by the way you manage your home and by the products and materials you bring into it.

1. Ventilate—naturally. One of the easiest ways to improve indoor air quality is to open a window or two and let fresh air inside. Using natural ventilation—i.e., open windows—rather than a heater or air conditioner can also lower your energy bills. For best results, create cross-ventilation by opening windows on opposite sides of the room. Consider "night flushing" your home by opening windows at night, when temperatures cool off.

2. Ventilate—mechanically. Your home likely already includes one or more fans that replace the stale air inside your home with fresh air from outside. These fans might provide "spot ventilation" in specific rooms, such as bathrooms, or they might be whole-house fans. Sometimes these are integrated into your heating and cooling system.

If you do have fans that require manual operation, such as a bath fan or range hood, use them every time you take a shower and every time you cook. Leave them on for five to ten minutes afterward, to make sure all contaminants and moisture have been removed. Consider upgrading to a model that includes an occupancy or moisture sensor; such fans automatically kick on and turn off. In addition, maintain vents and filters.

3. Keep it cool. VOCs evaporate more readily when temperature and humidity are higher, so keep indoor

temperatures and humidity levels as low as possible while maintaining comfort.

4. Check fabrics. The U.S. doesn't regulate formaldehyde in clothing, and the chemical is frequently used in "wrinkle-free" or "wrinkle-resistant" garments. Some people who are especially sensitive to formaldehyde develop rashes on contact. Avoid permanent press fabrics or wash before wearing. Note that furniture upholstery may also contain formaldehyde.

5. Look for the label. Unfortunately, formaldehyde is ubiquitous. It is found in many household cleaners, pesticides, paints and varnishes, and even in cosmetics and medications. Reading labels can help you avoid formaldehyde, but you must be aware that the chemical is often not listed outright, but in other substances such as quaternium-15, diazolidinyl urea, and imidazolidinyl urea.

Third-party certifications are making it easier to source non-toxic alternatives to many common household products. Though some manufacturers provide their own labels, third-party certifications provide a standardized way to compare products. Some of these programs include GREENGUARD®, Declare®, and FloorScore®. Low-emitting wood products will be labeled ULEF (ultra-low emitting formaldehyde), NAF (no added formaldehyde), and CARB (California Air Resources Board) Phase 1 or 2.

6. Store separately. As with all hazardous chemicals, if you must have products that may emit formaldehyde, store them in an unattached garage or separate building, and make sure to dispose of them properly.

7. Control smoking and combustion. Combustion fumes are one of the primary sources of formaldehyde in homes. Cigarette smoke contains over 4,000 chemicals, many of them toxic, which is a good reason to adopt a strict "No smoking" policy indoors.

Wood stoves produce a complex mixture of gases and fine particulates, including formaldehyde and several other toxic air pollutants. Replace older stoves with newer, EPA-certified models, which have strict standards for particulate matter produced and burn much cleaner. These certified stoves should also cut your wood consumption by about one third. Using high-quality, well-seasoned wood will ensure the fuel burns cleanly, and maintaining your stove by having it swept at least once a year not only ensures better combustion, it reduces the risk of chimney fires.

Finally, if you have a gas or propane cooking appliance, be sure to ventilate while using them. Hopefully, you have a range hood or other kitchen fan; if you don't, opening a nearby window is better than nothing.

8. Neutralize formaldehyde with plants. One simple strategy for neutralizing formaldehyde and other VOCs is to keep indoor plants. Of course, plants absorb CO_2, but they absorb other compounds, too. Research conducted by NASA shows that flowering chrysanthemums ("mums") are especially effective at removing pollutants, including ammonia, benzene and formaldehyde, from the air. According to the study, golden pothos ivy, spider plants and philodendron are the most effective in removing formaldehyde.

Healthy Home and IAQ Resources

To learn more about how solutions from CertainTeed can contribute to creating healthy homes, visit **CertainTeed.com/CleanTheAir**