



Take a

Understanding Indoor Air Quality and Toxicity

By JAN D. STENSLAND, MS, ASID, LEED

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and play in what the
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"chemical soup."

The U.S. Environmental Protection Agency (EPA) ranks indoor environmental pollution as one of the top five environmental risks to public health. Several federal reports corroborate this ranking. We breathe 2,000 to 3,000 gallons of air per day, and indoor air can be 10 to 50 times more polluted than outdoor air (EPA, 1998). In order to affect indoor air quality and toxicity, designers and their clients need to understand the physiological impact of materials and byproducts found inside buildings. These are topics that have a profound effect on our health, safety and well being, but are rarely addressed in design schools.

Three main factors contribute to the challenges we currently face concerning poor indoor air quality.

- First, building materials used prior to World War II were predominantly made from natural materials. We now live, work and play in what the EPA has called a "chemical soup." More than 60,000 chemicals are now in use, the individual effects of even 10 percent of which are not well understood, and the combination of which may never be known.
- Second, today we build much tighter buildings than were built prior to 1945. Combine tighter buildings with more chemicals and other contaminants inside and out, and the result is an increase in the amount of toxins found indoors.
- Third, these more modern, tighter buildings have less outside air infiltration than their predecessors to help dilute the contaminants. (EPA, July 1991)

An Invisible Threat

By addressing the issues around volatile organic compounds (VOCs), interior designers can make some of the most significant improvements in indoor air quality for their clients. "A typical homeowner's exposure to just six of the most common VOCs could result in as many as 5,000 additional cancer cases a year—a level of risk that...places VOCs [third after] cigarette smoking and radon as indoor air hazards" (Wallace, 1986). "...Indoor air pollution consistently causes greater health risks than hazardous waste sites..." (EPA, 1989).

Exposure to VOCs is widespread. They exist as vapor at normal room temperatures, are potent narcotics and depress the nervous system. Many of these substances react with sunlight and nitrogen

Breath

to form ground-level ozone that damages the lungs, decreases lung function and sensitizes lungs to other irritants. Exposure to VOCs can produce symptoms such as headache, irritability, difficulty concentrating and fine-motor deficits (Hodgson, 1988). The most commonly found VOCs include toluene, benzene (a known carcinogen), naphthalene, chlorinated solvents, polycyclic aromatic hydrocarbons and aldehydes such as formaldehyde, many of which are used in the manufacture of plastics, nylon, paints, paint thinners and solvents. By addressing the issues around VOCs, interior designers can make some of the most significant improvements in indoor air quality for their clients.

Other Factors Designers Need to Consider

Health risks associated with contaminants are related to the dose, the environment and the occupant. The off-gassing of VOCs from paint occurs at higher levels of concentration when the paint has just been applied. If the paint contains formaldehyde, occupants with asthma or other chronic lung ailments could be adversely affected for longer periods of time, particularly because formaldehyde continues to off-gas after the paint has dried.

Temperature, humidity, light and noise levels, pressure differences and the presence of other contaminants can combine to have direct and indirect effects on occupants exposed to toxins (EPA, 1991). Genetic variability, gender, personal habits such as smoking, age and health status can also make a difference whether or not, or even how much, someone is adversely affected by a substance. And naturally, those who are immunosuppressed or who have chronic respiratory or cardiovascular disease are much more vulnerable to the adverse effects of toxins. (EPA, 1991)

Just for Example

Formaldehyde is one of the most common VOCs and is ranked as one of the top 10 percent most hazardous compounds to ecosystems and to human health. At low levels, formaldehyde is an irritant and sensitizer, causing tingling in the nose, a dry throat and sore throat. At higher levels, it causes airway irritation and pulmonary effects such as coughing, chest tightness and wheezing. Prolonged exposure can cause nosebleeds, cognitive dysfunction, nausea and dizziness. Formaldehyde can also cause irritation and dermatitis when exposed to the skin and is a known human carcinogen. (Scorecard.org)

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Elements of Sustainably Built Environments

By KIRSTEN CHILDS, ASID

A sustainable approach to the built environment creates buildings that

- are healthier for people and enhance productivity.
- can be built at market rate and cost much less to operate.
- use less fossil fuel and conserve energy, saving operational costs and requiring less maintenance.
- generate less global pollution—CO, CO₂, NO_x, SO_x—components of global warming and acid rain.
- are designed to use less potable water, a critical strategy since only 0.013 percent of the world's water is drinkable.
- are resource-efficient and designed to manage waste at the highest productive level.



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If a designer specifies a variety of materials that contain formaldehyde and each meet a certain off-gassing limit, the combined total can actually be a much higher level of exposure.

Formaldehyde is widely used as a solvent in glues and binders, and in fabric treatments such as permanent press clothing, soil and wrinkle-free fabric finishes. It is used in numerous flooring materials such as rugs, vinyl flooring, carpet backings and adhesive binders, as well as vinyl wall covering, plastics, fire retardants, cardboard, paper, shampoos and disinfectants. The highest levels of formaldehyde off-gassing emanates from cabinets, particleboard and wood composites. It is also found in insulation and is especially prevalent in gloss-type paints.

Alternatives to Using Formaldehyde

Source	Alternatives
Cabinets	Replace particleboard or interior grade plywood with a wheatboard substrate.
Fabrics	Specify finish-free fabrics and fire-resistant fabrics such as wool.
Flooring Materials	Specify materials that pass the CA 1350 emissions test. (Go to www.chps.net/manual/index.htm#specs and click on 01350.)
Furniture	Specify furniture without particleboard or plywood substrate. Otherwise, seal all surfaces.
Insulation	Specify formaldehyde-free insulation, blown-in cellulose or recycled cotton batting insulation.
MDF (Medium Density Fiberboard)	Specify formaldehyde-free MDF.
Paints, especially gloss types	Specify no-VOC, no formaldehyde lines.
Sealants and preservatives	Specify no-VOC, no formaldehyde lines.

Simple things designers can do to improve the indoor air quality (IAQ) of a space:

- Design for the most vulnerable population. It's more inclusive and better for everyone's health.
- Design with the least amount of toxins possible to meet the design intent.
- Learn more about what's in materials. Ask manufacturers to provide answers to the questionnaire on the [Healthy Building.net](http://HealthyBuilding.net) Web site.
- Avoid products that are related to or cause poor IAQ.
- Specify or purchase products that are environmentally responsible. Insist that manufacturers make healthier products!

Understanding Risk

A standard industry risk assessment is based on determining how much of a hazardous activity or material is safe, acceptable or insignificantly harmful, and assumes that exposure will take place. "Alternatives assessment" (O'Brien, 2000), another way to think about toxic exposure and associated risks, reviews the issue of risk with as wide a perspective as possible, including the possibility of *not* doing an activity or using a compound. This method addresses any possible long-term ramifications of the action or compound. The alternatives assessment embraces the precautionary principle, to quote Benjamin Franklin, "An ounce of prevention is worth a pound of cure."

Eliminating a toxin is the easiest way to ensure a healthy environment, but that isn't always possible for a variety of reasons. Problem materials can also be isolated, encapsulated and sealed. Air cleaning and filtration can help remove the strongest out-gassing immediately after the materials are installed and added outdoor ventilation is always beneficial. ○

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