

The air within homes can be more polluted than the outdoor air. Although we spend most of our time indoors, the focus tends to be on outdoor air quality. Design that is sensitive to air quality issues can have a major impact on our health and wellbeing.



A healthy interior

**Exposure** to indoor pollutants can pose a significant health risk. It has been linked to a range of health problems. Unhealthy indoor air can cause problems such as headache, fatigue, coughing, sneezing, dizziness, and eye, nose, throat and skin irritation.

**Some health effects** from indoor air pollutants may be experienced soon after exposure. Others may not be felt until many years later.

**CSIRO estimates that occupants of new homes may be exposed to many times the maximum allowable limits of some indoor air pollutants.**

**Exposure** to these levels can continue for many weeks after occupying a new home.

**Contributors to indoor air pollution include:**

- > The use of synthetic building materials, finishes and furnishings which release or outgas pollutants.
- > The use of personal care products, pesticides, and household cleaners.
- > Biological sources such as insects, pests, moulds and other fungi.

**The majority** of chemicals in common use in our indoor environments have not been thoroughly tested. Little is known about their effects on the human nervous systems.

**Even less is known** about the cumulative and interactive effects of chemical exposure. While pollutant levels from individual sources may not pose a significant health risk by themselves, most homes have multiple sources of indoor air pollution which may interact.

## FACTORS TO CONSIDER

**There are four factors to consider** when addressing the health effects of materials. They are:

- > **Emissions.**
- > **Toxicity.**
- > **Quantity.**
- > **Proximity.**

Usually more than one factor will play a part so they cannot be considered separately.

## EMISSIONS

**Some materials** will emit more contaminants than others. Emissions are generally highest when materials are new, and in conditions of high humidity and temperature.

**The relative importance** of any single source depends on how much pollutant it emits and how hazardous those emissions are. These factors can be affected by the age of the source and how well it has been maintained.

**Some sources**, such as building materials and furnishings, release pollutants more or less continuously, although the quantity decreases over time. Without exception, all domesticated animals are allergenic. Other sources will only pollute while they are in use. These include common household chemicals such as cleaning products and pest sprays, as well as smoking, stoves, and some room heaters.

**Cooking** activities are also associated with increased pollutant emissions (particularly fried foods) regardless of stove type.

**High pollutant** concentrations can remain in the air for long periods after some of these activities and can settle on exposed surfaces to be re-emitted over time.

## TOXICITY

**Toxicity** describes the potential harm a compound can inflict. Toxic effects can be acute and immediate or chronic over a long term. Pollutants such as lead or asbestos manifest their effects over long term exposure. Airborne pollutants show their effects over short term exposure.

## QUANTITY

**The materials** used in floors, ceilings and walls are present in greater amounts than others. Low emissions from large quantities of materials can result in high total amounts of chemicals in the air.

## PROXIMITY

**Materials** found inside the home are more likely to affect people than materials found outside. However people who are very chemically sensitive may also be affected by outside materials.

## SIMPLE STEPS TO BETTER AIR QUALITY

Building designers can improve the quality of indoor air by adopting four basic ideas:

- > **Eliminate.**
- > **Ventilate.**
- > **Separate.**
- > **Absorb.**



*Non-toxic construction and finishes*

### ELIMINATE

Identify the causes of indoor air problems and wherever possible eliminate the source through better product selection and better design. Some problem materials/sources to avoid include:

**Volatile organic compounds (VOCs)**, which are a range of chemical substances that become air borne, or volatile, at room temperature. They are given off by most paints, paint strippers, wood preservatives, aerosol sprays, glues, cleansers and disinfectants, moth repellents, air fresheners, stored fuels and automotive products, hobby supplies, and dry-cleaned clothing. Indoor air VOC concentrations can be highly variable.

**Formaldehyde**, a common VOC, is released from some manufactured wood products such as plywood, wall paneling, particleboard, fibreboard and furniture made with these products. Formaldehyde is also released from combustion sources, tobacco smoke, treated textiles, and some glues.

**Respirable particles** from fireplaces, wood stoves, kerosene heaters, tobacco smoke and other combustion sources.

**Carbon monoxide and nitrogen dioxide** from unflued kerosene and gas space heaters, leaking chimneys and boilers, gas water heaters, wood stoves, fireplaces, gas stoves, automobile exhaust from attached garages, and tobacco smoke.

**Pesticides, insecticides and termiticides** used indoors. Also, products used on lawns and gardens that drift or are tracked inside the house.

**Biological pollutants** including bacteria, moulds, mildew, viruses, animal dander, house dust mites and cockroach

faeces, and pollen. Biological pollutants can form part of household "dust" and be respirable.

**Xylene and Toluene** solvents in paints, glues and carpets as well as polyurethane.

**Vinyl chloride monomer styrene** in vinyl floor coverings, blinds, textiles, synthetic rubber underlay, two part fillers and paints.

**Isocyanates** in polyurethanes, glues and fillers.

**Glycol Ether** and derivatives used as solvents in water based paints, varnishes and glues.

**Epoxy resins** used in tile, wood and metal glues, cement and surface binder.

**‘Natural’ materials are generally preferable to synthetic. However some natural materials can have significant environmental and health impacts.**

**Cotton growing** requires large amounts of pesticides unless grown organically and wools are often treated with chemicals to prevent moth attack. Some people are highly allergic to wool.

**Many timbers** are also treated with chemicals against biological attack and to increase durability. Choose untreated products wherever possible, and never burn treated wood.

**Where possible** use sustainably grown solid wood or plywood. If manufactured wood products such as MDF or particleboard are used, cover all surfaces and edges with laminates or seal them with low emitting paint or varnish to reduce emissions of formaldehyde. Look for those made with phenol formaldehyde rather than urea formaldehyde as they are less harmful.

However not all traditional materials are safe. Old paint contains high levels of lead and creosote wood preservative is highly toxic. An increasing range of safer products is becoming available, but beware of ‘green’ claims and always read the list of ingredients.

### How to eliminate pollutants

**When building or renovating** ask your architect or builder to help achieve good IAQ. Purchase building materials that have low emissions and ensure provision for adequate ventilation both during construction and after occupancy. Select materials which have been pre-dried, are quick drying, use water as the solvent or are classed as zero or low VOC. Ask to see the products material safety data sheet.

**Many ‘traditional’ materials** such as limewash for walls, beeswax polish and linseed oil for wood finishing, vinegar and lemon juice for cleaning, and herbs for pest control have no or very low levels of toxicity.

**Always check** before disturbing existing materials and take the necessary precautions if harmful substances are found. Removal is not necessarily the best option. Seek expert advice.

## Renovation can release toxic substances, such as lead from old paint or asbestos, into the air.

**Choose products** with low pollutant emissions. There are products with very low or no solvent and harmful particle emissions. These include:

- > **Termite barriers** made from granite or stainless steel instead of chemical barriers.
- > **Hard finished flooring** such as ceramic tiles.
- > **Timber** finished with plant based hard oils or waxes instead of polyurethane finishes.
- > **Linoleum or cork** glued with natural rubber latex.
- > **Rugs** on hard floor surfaces which can be more easily cleaned than carpet.
- > **Sisal, coir or jute** flooring materials instead of carpets.
- > **Plant or mineral** based paints instead of petrochemical paints and varnishes. There are low VOC conventional water-based paints available - and these are generally preferable to oil based finishes.
- > **Jute or recycled textile** underlay instead of synthetic carpet underlay.

### Carpet and air quality

**A variety of symptoms** are associated with new carpet, particularly synthetic and synthetic/wool blends. Even 'pure' wool carpet is usually treated with a range of chemicals to repel insects and stains.

When installing new carpet:

**Try** to find a low emission product.

**Ask** the supplier to unroll and air out the carpet in a well-ventilated area before installation.

**Opt** for mechanical fixing. If adhesives are needed ask for low-emitting water based adhesives to be used.

**Leave** the premises during and immediately after carpet installation.

**Open** doors and windows. Increasing the amount of fresh air in the home will reduce exposure to most chemicals released from carpet.

Carpet can also be a breeding ground for dust mites. If you install carpet, choose one with a low pile and have it cleaned regularly.

A number of alternatives to carpet are available which have low emissions, such as linoleum, coir or seagrass matting, cork and hard floor finishes such as timber, ceramic tile or concrete - but be aware of the finishes used to treat such surfaces.

## Carpets can be difficult to keep clean. They may act as reservoirs for dirt and pollutants.

If you have carpets, use a ducted vacuum so that dust is removed from the house or a vacuum with a high quality filter - and maintain it properly.

### Pest control

Use non-aerosol products when possible. Try traps or herbs to control pests. If chemical controls are needed use low toxic types such as pyrethrum based products. Low toxicity biologically based pest and termite control chemicals are available.

### Storage

Keep gas releasing products such as solvents, paints and glues in sealed containers or cupboards, preferably outdoors, and use them outdoors whenever possible. Dispose of them correctly.

### VENTILATE

If too little fresh air enters a home, pollutants can accumulate to levels that can pose health and comfort problems.



Where homes are on a main road or in an industrial area where there is lots of dust it is best to install an air filter. In particularly cold or hot climates ensure systems have an energy recovery facility. Air filters may also be necessary for people with high chemical sensitivity.

**Indicators** of poor ventilation can include condensation on windows or walls, smelly or stuffy air, and areas where books, shoes, or other items become mouldy.

## Adequate ventilation is necessary when using unflued gas stoves or heaters.

**Buy only** 'low-NOx' heaters and avoid using them in confined spaces for prolonged periods. Heaters should be properly maintained.

**Follow** the correct installation and maintenance procedures for chimneys and flues to prevent combustion gases and particles entering the room.

**Control dampness** to minimise the growth of mould and fungi. House dust mites, the source of one of the most powerful biological allergens, thrive in damp, warm environments.

**Ventilation** can conflict with energy efficiency principles so the design should enable occupants to open and close the building as necessary and to facilitate good cross ventilation when desired. Talk to a designer about how to strike a balance between the need to introduce fresh air into your home while maintaining comfortable temperatures.

**Energy efficiency** measures will also help reduce mould growth - insulated walls and double glazed windows are warmer, so they are less likely to experience condensation and mould growth.

**Remember, try not to ventilate excessively in hot or cold weather or you will be wasting precious energy.**

**In cooler climates** consider using air preheated by the sun for ventilation, or flush the house at the warmest time of the day. In hot climates flush the house with cooler night time air.

### SEPARATE

**Separate** problem materials from occupants by using air barriers or sealers such as coatings. Laminates can be used to seal composite wood products. There is a range of low or no emission paints and varnishes on the market.

If you find asbestos or old lead paint which cannot be removed, seal it with paint

**Choose a garage** that stands separate to your home, or ensure that any internal door to the garage is well sealed. Think about having an air lock.

**Use doormats** to keep dust from shoes outside.

**Keep compost heaps** and bins away from the house as they can be a source of fungal spores. Maintain your compost correctly.

**Make sure** the flue outlets of gas, water heaters and room heaters are kept away from open windows.

### ABSORB

**Research** at the University of Technology, Sydney has shown that commonly used indoor plants remove VOCs from indoor air, and this increases with prolonged exposure.

**Healthy** and well maintained plants are essential for best performance and will not contribute to pollution. Use a mix of aesthetically pleasing indoor plants and use as many as possible commensurate with good design.

However, if you need to treat your plants for pests, make sure you do it outside.

**Indoor plants can confidently be used to improve the quality of the indoor environment, as well as for their beauty.**

#### FURTHER KEY REFERENCES

Environment Australia 2000 *State of Knowledge Report: Air toxics and indoor air quality* [www.environment.gov.au/epg/airtoxics/](http://www.environment.gov.au/epg/airtoxics/)

Department of Health and Aged Care *Healthy Homes – a guide to indoor air quality in the home for buyers, builders and renovators* (Forthcoming)

US Environment Protection Authority (1995) *The Inside Story: A Guide to Indoor Air Quality* [www.epa.gov/iaq](http://www.epa.gov/iaq)

Rogers, P *Safer Pest Control for Homes and Gardens* Choice Books

Pollak, J.K. (1993) *The toxicity of chemical mixtures: an introduction to recent developments in toxicology*, Centre for Human Aspects of Science & Technology and the Public Interest Advocacy Centre, Sydney

Edwards, Brian 1998, *Green Buildings* Pay E & FN Spon UK, NY.

Immig, J.; Rish, S.; Brown, S.K.; 1997, *Indoor Air Quality Guidelines for Sydney Olympic Facilities*, CSIRO BCE Technical Report TR97/3

Wood R.A. Orwell, R.L., Tarran, J. and Burchett, M.D. (2001) *Pot-plants really do clean indoor air*. NIAA 2001, The Nursery Papers, Issue 2001/2.