



# CLEANING TO REDUCE INDOOR AIR CONTAMINATION

Surprisingly, indoor air is usually more contaminated than outdoor air. Contaminants are in the form of gases and fine particles.

Household cleaning is generally ineffective in removing gaseous pollutants, but it can affect the concentration of particles in the air. Fine particles (particulates) include dust and smoke that enter a dwelling from outside, as well as particles that are generated inside.

Often indoor air is more polluted because most particulates are generated within the living space. Internal sources of particulate contamination are smoke and grease aerosol (airborne particles) from cooking and using self-cleaning ovens; mold and fungal growth from moisture and high humidity; allergens produced by pets, insects, and dust mites; toxic lead dust from peeling lead-based paint; and airborne dust from vacuuming and duct cleaning.

Some particulates enter the house in another form and become airborne. The dirt brought in from outside on shoes or pets is deposited on the floor, where it is ground into small particles as it is walked on.

The smallest particles are suspended in the air, while the larger ones settle back on the floor, only to be reground again. The outside dirt can be a carrier of pesticides, pollen, fungi, bacteria, animal feces and insect parts.

Airborne particles can cause breathing problems and allergies in sensitive individuals and severe health problems for persons with asthma. Controlling the concentration of particulates can help relieve symptoms and prevent disease.

This publication identifies sources of particulate air pollution and means of reducing airborne particles in homes by using effective cleaning methods and other control strategies. Cigarette smoke and pollen are not covered, because household cleaning may not affect their concentrations.

## Cooking

**Sources of contamination.** Cooking generates heat, humidity and three types of aerosols: solid smoke particles, grease vapor that condenses into semiliquid

particles as it cools, and grease spatter particles from uncovered frying. The self-cleaning oven produces aerosol during the cleaning cycle, and significant amounts pass through the oven's smoke eliminator into the air. A poorly designed system can increase the haze level in a 12- by 14-foot kitchen by 700 percent.

**Solutions.** An exhaust fan can divert moisture and some fraction of these particles before they become part of the room air.

For a given air flow, a vented range hood is more effective in exhausting moisture and particulates than a ceiling or wall fan because the hood is closer to the generation source. The disadvantage of a recirculating hood is that it must clean the air it captures before returning it to the room.

The most effective hood has an intake configuration that matches the range top, has the highest air flow consistent with a tolerable noise, and is set as close to the range top as permitted by the mechanics of cooking (stirring, viewing food, etc.). Any hood used with a gas range should not generate air currents that will distort the shape of the flame from each burner.

A recirculating hood can be used if a vented hood is not possible, but it must have a series of effective filters—(1) a washable, aluminum-mesh filter to remove grease spatter particles; (2) a pleated, glass-fiber filter to remove smoke; and (3) an activated carbon filter to capture odor.

The self-cleaning mode of the oven should never be operated without the exhaust fan on. This is especially true for the initial break-in cycle. Use of an exhaust hood or an effective filtering system in a recirculating hood reduces cooking contaminants in the house, reducing the need to clean.

## Mold and Mildew

**Sources of contamination.** Mold and mildew in the home generate spores that become airborne. Some spores settle on other surfaces to generate new mold colonies, while others remain suspended for long periods of time and can be inhaled. Sensitive individuals exhibit allergic reactions.

Moisture or a high humidity level is required for mold growth. There are many common places where

molds grow. These include:

- Walls, floors, carpeting and on stored materials in damp basements and crawl spaces.
- Bathrooms without exhaust fans.
- Laundry areas where dryers are not vented outside or clothes are hung to dry.
- Homes with new construction materials.
- Homes where there have been spills, leaks or other water damage.
- Homes where a humidifier or an unvented combustion heater is used.

**Solutions.** Reducing humidity levels in the home is essential. Shut off or adjust the humidifier if the relative humidity level is more than 50 percent or if condensation forms on windows.

Use exhaust fans vented to the outside when taking baths or showers and when cooking. Vent clothes dryers to the outside. Do not use unvented kerosene or gas heaters. Repair all plumbing leaks.

Do not store natural materials containing high levels of moisture, such as firewood, inside the house. Reduce humidity with a dehumidifier, air conditioner or furnace. Increase the air flow to problem areas. Use a vapor barrier to reduce the outside moisture that enters a crawl space.

Keep surfaces clean and dry to remove existing mold colonies and to prevent mold colonies from starting. Hard surfaces that have mold growing on them should be cleaned, disinfected and dried.

One of the most effective, least expensive disinfectants is chlorine bleach (sodium hypochlorite). Products with an EPA registration number are reliable disinfectants and have instructions for disinfecting.

Appliances that collect or distribute water need to be cleaned and disinfected regularly to prevent mold growth. These include dehumidifiers, humidifiers, air conditioners and refrigerator drip pans.

## Vacuum Cleaning

**Sources of contamination.** Dirt in a carpet or on a hard-surfaced floor is clusters of very fine particles. Cleaning the floor with a broom or vacuum disturbs the dirt particles and causes the smallest ones to become airborne.

In perfectly still air, particles smaller than 20 microns (about one-half the diameter of the finest human hair) stay suspended in the air.

Vacuum cleaning turns floor dirt into an air pollutant two ways.

1. *If the air from the vacuum discharges down, it*

disturbs settled dirt particles and causes them to become airborne. When the cleaner discharges down over a dirty carpet, research shows a 98-percent increase in household airborne dust concentration in the following two-hour period.

2. *The bag in the vacuum cleaner is not a perfect filter.* A 100-percent efficient filter would have such high resistance to air flow that the vacuum cleaner would not work.

The vacuum's filter bag holds the larger particles and allows the smaller ones to pass into the room air. Using a vacuum cleaner that discharges upward can result in a 35-percent increase in airborne dust. As a result, the floor is cleaner, but the air is dirtier.

**Solutions.** Wet-cleaning hard-surfaced flooring is less likely to cause particles to become airborne than in vacuuming or sweeping. However, good cleaning technique can help reduce the amount of fine particles discharged from the vacuum cleaner.

Begin at an edge of the carpet (in a doorway) with the wand of a canister vacuum. Always work toward uncleaned carpet with the canister behind on cleaned carpet. An upright cleaner or horizontally-discharging canister cleaner does not disturb settled dirt particles in the air discharge.

Some vacuum cleaners are designed with blowers which handle high-efficiency (HEPA) filters. The filters capture at least 99.97 percent of the smallest particles in the discharge air. Because these vacuums are expensive, they may be justified only if someone in the household has severe dust allergies.

Less-expensive alternatives are the special replacement bags now available, which claim to improve the collection efficiency of older vacuum cleaners. Keep in mind, however, that improved filtration efficiency comes at the expense of air flow, and good vacuum cleaning requires both vacuum and air flow.

A central vacuum system with motor, suction blower, and filter bag installed in the basement or garage may solve several problems of portable cleaners. There is no air discharge into a home's living space; the vacuum discharge air and small particles are exhausted to the outside. Being isolated from the living area, the motor and blower noise is less evident in the room being vacuumed.

## Dust Mites and Animal Dander

**Sources of contamination.** Dust mites are microscopic animals that use dead human skin cells as a food source. Various allergens are produced by dust mite feces and body parts. They cause sensitive individuals to experience sneezing; nasal obstruction and discharge;

redness, watering and itching of the eyes; wheezing and difficulty in breathing; and skin rash and itching.

For dust mites to reach concentrations high enough to cause problems, certain environmental conditions must exist: a food source of skin cells, relative humidity greater than 45 percent and a uniform temperature of 65 to 80 degrees Fahrenheit.

Highest concentrations of the mites are found in carpets, fabric-covered partitions or walls, and bedding and mattresses. Persons experiencing chronic symptoms should be tested by an allergist.

Pet dander is another allergen. Some individuals can experience allergic symptoms when the dander becomes airborne. Others are sensitive to the saliva of pets.

**Solutions.** If a household member is allergic to animal dander, the solution that offers the most relief is to remove the animal from the house. Vacuuming furnishings captures some dander but it does not offer much relief.

Several measures are effective in reducing the concentration of dust mites, as well as reducing allergic symptoms in individuals sensitive to dust mites.

- Vacuum-cleaning intensively and regularly (once a week) floors, carpets, fabric covered furniture, mattresses and bed frames. Use a cleaner with a high-efficiency filter, if possible. This is no guarantee of success, because mites and feces are very difficult to pull from carpet.
- Lowering the relative humidity of the room air to below 45 percent and the temperature to below 68 degrees. The humidity should be reduced even more if the temperature is increased.
- Ventilating with outside air if the infiltration rates (air leakage) naturally are low.
- Using fitted sheets or allergen-tight covers over mattresses.
- Replacing feather and down pillows with those that have synthetic fillings.
- Steam cleaning the carpet and fabric-covered furniture.
- Removing fabric furnishings, such as replacing the carpet with hard-surface flooring.
- Washing bedding in hot water (130 degrees or hotter).

## Lead Dust

**Sources of contamination.** Paint used on both interior and exterior walls of homes before 1978 contained lead compounds. Dried paint solids can

contain up to 40 percent lead. Paint solids end up on the floor from peeling, chipping, oxidation or abrasion when doors and windows are opened and closed.

Young children risk lead poisoning. When they play on the floor where lead dust is present, they put dust-contaminated hands and toys in their mouths.

Another source of lead is soil that has been permanently contaminated. The lead comes from the exhaust fumes of vehicles that use leaded gasoline or exterior lead-based paint. Children are at risk when they play on contaminated soil and from contaminated soil tracked into the house.

**Solutions.** Vacuum cleaning floors and carpets to remove lead particles is ineffective. It can actually increase the amount of lead dust in the air.

Intensive vacuuming with a central vacuum system or a high-efficiency filter will gradually reduce the lead concentration in the carpet. However, many repetitions are needed to reduce the concentration.

Two-stage steam cleaning—using special detergents and combining vacuum cleaning with shampooing—also is not very effective. A large proportion of lead remains in the carpet. In severe cases, the only solution is to remove and dispose of the carpet.

Repeatedly wet cleaning hard-surface floors and other hard surfaces, such as window sills, is an effective method of removing lead dust. Removing shoes before entering the house or using shoe-cleaning pads at entrances can sharply reduce lead concentrations from contaminated soil.

## Air Ducts

**Sources of contamination.** Air ducts can be a source of dirt, dust or biological contaminants and create an indoor air problem, but this is rare. Duct cleaning may release contaminants into the home and become the source of a problem.

Air distribution ducts in a new home collect construction dust (sawdust, sheetrock dust) during and after installation. With the initial flow of air, construction dust is blown into the rooms through the air supply ducts, and dust in the return air ducts is caught in the furnace filters.

After a few days or weeks, only a thin coating of dust remains on the duct surfaces because the dust is caught in the filters. Filters must be inspected regularly and cleaned or replaced, according to the manufacturers' directions, at least twice a year. As a filter loads with dust and lint, it actually becomes more efficient, but it must be cleaned or replaced because the air flow is gradually reduced.

Several factors can cause dust to cling to duct surfaces. Oily or greasy aerosol produced by cooking and

other household activities can attach to the ducts as it passes through. The moisture from bathing or showering, cooking, or improperly vented dryers also acts as an adhesive on duct walls.

When winter humidity levels are low, air passing over a sheet metal air duct creates a static-electric charge on the metal surface. The static charge attracts fine particles and the oil or moisture coating holds them.

Exhaust vents in the bathroom, from the clothes dryer and from the kitchen range hood expel lint, grease and water vapor. If the home does not have efficient venting, return ducts in the furnace become dust-laden.

Air duct cleaning disturbs the thin dust coating on the inside of the ducts. When the fan is running, the unstable dust can be blown into the house.

**Solutions.** Duct cleaning is not considered a routine procedure for maintaining a heating and cooling system. Duct cleaning or replacement is justified when there is water damage that causes mold to grow in the ductwork; debris blocks the air flow; dust is seen coming from supply registers; or offensive odors are coming from the ducts. Surface stains near the supply registers, especially from cigarette smoke, are normal and do not justify commercial duct cleaning.

Duct cleaning professionals employ one or more of these methods: contaminant removal (brushing or vibration plus vacuum cleaning); encapsulation (spraying a sealer into the duct); disinfection (using a fungicide to inhibit the growth of mold); and duct replacement.

Before contracting to have ducts cleaned, consumers should require a thorough explanation of the procedures that will be used.

## Summary

The control strategies discussed here include exhausting particulates, lowering humidity and cleaning particulates from surfaces to prevent them from becoming airborne. Residential air cleaners and filtration systems may be considered for removing airborne particles.

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The following publications are useful in making a decision:

- *Residential Air-cleaning Devices*. EPA publication number 400/1-90/002.
- *Residential Air Cleaners*. EPA Indoor Facts No. 7, February 1990.
- *Fine Particle Pollution*. North Central Regional Publication 393, October 1991.

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