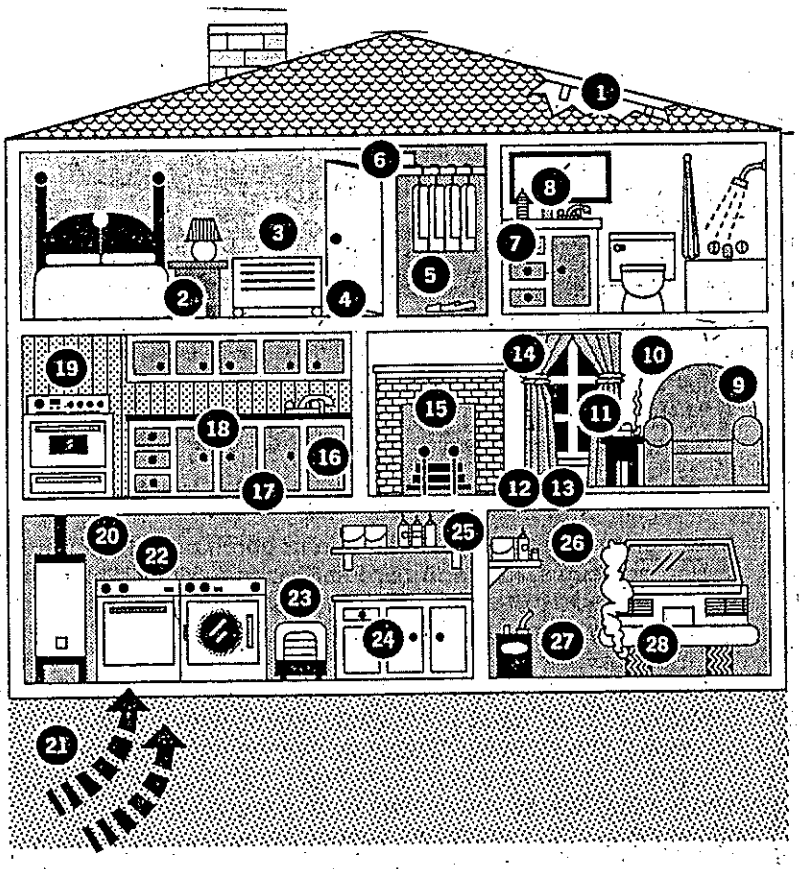
INDOOR AIR POLLUTION

FACT PACK



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Indoor air pollution

Home and Office: Shelter or Threat?

by Rembert Brown

Recent studies by EPA and other federal agencies have uncovered surprising, sometimes disturbing, facts about the size, scope, and sources of indoor air pollution.

Exposure to indoor pollutants takes place in residences, public and private buildings, and vehicles—collectively classified as "indoor environments." The home, workplace, school, automobile—virtually any enclosed structure—contains hundreds of potential sources of air pollutants, both natural and manmade.

Most people today spend about 90 percent of their time in environments of this kind. Such prolonged exposure explains, in part, the high levels of exposure to indoor air pollutants that take place.

Also contributing is the general "tightening" of buildings—residential and other—that has taken place since the 1970s in the national effort to reduce heating and cooling costs. Buildings are much better sealed and insulated than they used to be. During that same energy crunch, heating and air-conditioning engineers cut back on the amount of fresh air per building occupant. These factors have combined to increase personal exposure to indoor air pollutants.

"Sick building syndrome" is the name given the health symptoms caused when occupants of modern energy-efficient buildings have been exposed to indoor air pollutants. These symptoms can mimic those of many diseases, ranging from colds and flu to more serious disorders. Victims have reported headache, eye irritation, sinus problems, runny nose, cough, shortness of breath, and nausea. Complaints have occurred in offices, schools, health-care facilities, and modern buildings of other types. In addition, some well-recognized diseases— "Legionnaire's Disease" among them—can be spread through ventilating systems.

Key Exposure Sources

A number of commonly occurring chemicals and other substances are associated with sick building syndrome and other ailments related to indoor air quality problems. To help bring future research efforts into proper focus, EPA has pinpointed several key categories of pollutants and sources within enclosed environments:

- **Combustion sources.** Gas cooking stoves, woodstoves, kerosene heaters, and other unvented heating and cooking units that employ combustion are major sources of indoor pollutants such as carbon monoxide, nitrogen dioxide, and particulate matter.

  Another major combustion source is environmental tobacco smoke (ETS). This term refers to tobacco smoke released in an indoor environment. It is also sometimes called "passive smoking." Chemicals in environmental tobacco smoke include particulates, benzene, styrene, nicotine, and a number of other substances. ETS is believed to pose a significant risk to health, especially among spouses and children of smokers.

- **Materials and furnishings.** Building materials may be the source of asbestos, formaldehyde, and other volatile organic chemicals (VOCs). In particular, paints and adhesives are major sources of VOCs.

- **Biological contaminants.** Molds, spores, bacteria, and viruses find breeding grounds—and transport mechanisms—in auto and building air conditioners, humidifiers, ventilation systems, and building materials.

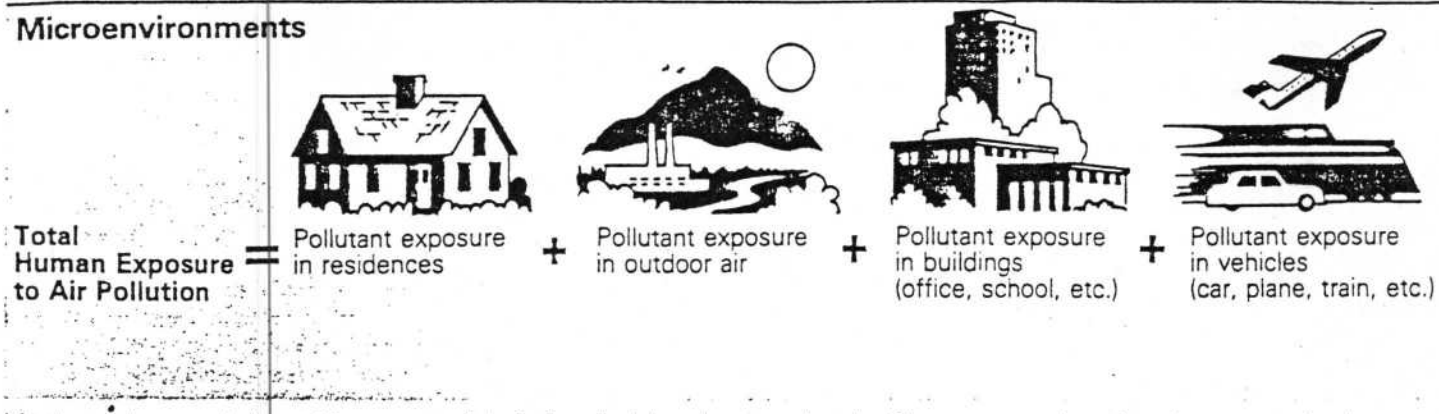
- **Human activities.** The use of many common household products such as pesticides, paints, solvents, cleaning agents, air fresheners, and toilet deodorants may release significant amounts of indoor pollutants. Taking a hot shower can even release low levels of radon and chloroform.

- **Ambient (outdoor) environment.** Several indoor pollutants, among them radon, some termiticides, and combustion products from automobiles, originate outdoors but can collect and concentrate indoors in residences, schools, and other buildings.

Consult the box on "Indoor Air Highlights" for specifics about major indoor air pollutants, their sources and effects, and what steps you can take to deal with them.

How Big a Problem is Indoor Air Pollution?

Since people spend the greater part of their day—and their life—in various indoor environments, it is of compelling importance to seek accurate and early information about the extent to which people are exposed to indoor air pollutants, the health effects which those exposures may cause, and actions people can take to reduce their risk.



Most people spend about 90 percent of their time inside a home, school, office, car, or other closed structure. In these enclosed spaces, they may be exposed to hundreds of natural and man-made pollutants daily.

EPA has conducted a major study which has uncovered some surprising and sometimes disturbing facts about the size, scope, and sources of indoor air pollution. "TEAM," which stands for Total Exposure Assessment Methodology, is an investigation begun by EPA in 1979.

Several thousand randomly selected individuals were screened for age, sex, smoking habits, and occupations until a pool of 600 individuals was located in seven U.S. cities. Individuals selected for the study were then fitted with vest samplers that collected about 20 volatile organic pollutants, including benzene, chloroform, and other solvents, for later analysis in a laboratory.

Participants were asked to answer a questionnaire detailing their activities during the day. They also provided samples of their household water and allowed their breath to be analyzed for a large range of pollutants. In addition, some household backyards were equipped with fixed-site air monitors to compare measurements of personal exposure to those of ambient outdoor air.

Analysis of the exposure data indicated that personal exposure to many chemicals was usually greater, often much greater, than outdoor concentrations of the pollutants. For every one of the dozen or so prevalent chemicals, the mean personal exposures exceeded outdoor concentrations by 200 to 500 percent. This was true even in the two most concentrated chemical manufacturing and petroleum refining areas in the study: Bayonne-Elizabeth, New Jersey, and Los Angeles, California.

Results of the study clearly suggest the major sources of these chemicals are to be found either in the home or in personal activities.

Common activities such as smoking, driving, painting, pumping gas, using air fresheners and moth repellents, visiting a dry cleaner, and even taking hot showers can sometimes dramatically increase one's exposure to these chemicals.

The TEAM study continues, and has been expanded to cover about 40 pollutants, including carbon monoxide, pesticides, and particulates as well as some previously untested volatile organic chemicals. Early findings have been released to the public and Congressional officials.

The variety of chemicals and substances involved, coupled with variations in the levels of individual exposure to them, makes risk assessment a formidable task. Often there is more than one source for a given pollutant, or a variety of different pollutants from different sources can interact in the same indoor environment, with results that are difficult to predict. However, the Agency's Comparative Risk Project has estimated that the risks from indoor air pollution are among the top five environmental problems.

EPA's Indoor Air Program

Steadily accumulating data about the importance of indoor air pollution convinced EPA of the need for an Indoor Air Program. At present, the Agency's program consists of a small, new, and intensely busy group of five people with an annual budget of $200,000.

Part of the Office of Air and Radiation's program development unit, EPA's indoor air group is charged with coordinating EPA's indoor air activities, assisting in setting research priorities, and carrying out the Agency's responsibilities for disseminating information about indoor air quality. They work in conjunction with the Office of Research and Development, which has a staff of 15 and a budget of approximately $3 million devoted to indoor air research.

The goal of EPA's Indoor Air Program is to provide information to homeowners, consumers, state and local governments, architects, building managers, and others so these groups can make informed choices about how they can reduce exposure to indoor air pollution.

Over the next year, in conjunction with organizations in the public and private sector, the program will:

- Develop a booklet for the general public about indoor air quality.
- Develop a technical manual about environmental tobacco smoke.
- Develop a technical manual about diagnosing, mitigating, and preventing building-related illnesses.
- Prepare a directory of state agencies involved in indoor air activities.
- Provide leadership for the Interagency Committee on Indoor Air Quality (CIAQ), the group that coordinates federal indoor air activities.
- Report to Congress by October 1988 about EPA's findings and recommendations concerning indoor air.

The Indoor Air Research Program has among its priorities the following:

- Developing more sophisticated and standardized methods for identifying the causes and remedies for indoor pollution.
- Conducting studies in test chambers and test houses to measure pollution from potential sources and the effectiveness of proposed mitigation techniques.
- Assessing the health effects of exposure to low levels of mixtures of volatile organic compounds and environmental tobacco smoke.

These formidable tasks came to EPA in 1986 as part of that year's Superfund amendments. These responsibilities are largely in addition to other specific indoor air pollution targets, such as radon, asbestos, formaldehyde, and pesticides.

The Agency's recently expressed policy on indoor air pollution calls for EPA to identify significant indoor air problems and, where appropriate, to carry out one or more of the following mitigation actions:

- Issue regulations under existing statutes including the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Safe Drinking Water Act.
- Implement non-regulatory programs such as technical assistance, training, and information dissemination aimed at building the capacity of state and local governments, the private sector, and members of the public to take appropriate actions.
- Refer problems to other federal agencies with relevant authority.
- Request separate indoor air regulatory authority from Congress if appropriate.

Asbestos and radon, two of the most frequently encountered indoor air pollutants with serious health ramifications, are the subject of major programs carried out by other offices at EPA. As a result of special funding from Congress, efforts to reduce exposure levels for both these indoor air contaminants are well advanced.

The future will undoubtedly bring other indoor pollutants into the spotlight as scientific knowledge and public awareness of the various aspects of this multi-faceted problem continue to grow. □

(Brown is a Writer/Editor in the EPA Office of Public Affairs.)

Non-smokers are exposed in some buildings to large quantities of environmental tobacco smoke, known as ETS.

Indoor Air Highlights

There are many different sources of indoor air pollution, and many different ways of dealing with the problems they pose. In general, however, the primary mechanisms for improving indoor air quality entail eliminating, reducing, or sealing sources of pollution.

When a home or other building has a low rate of ventilation to start with, the use of a mechanical heat recovery ventilation system (also called an air-to-air heat exchanger) can be quite effective in reducing the concentration of multiple pollutants without substantially increasing energy costs.

Air cleaners such as high-efficiency particulate filters, negative ion generators, and electrostatic precipitators—used separately or in series—can be effective in reducing particulates. Care should be taken, however, to select air cleaners which will provide adequate air flow and can be easily maintained. Many devices do not do an adequate job of removing particles, and only a few systems have been demonstrated effective against gaseous pollutants.

Environmental Tobacco Smoke

Sources: Cigarettes, cigars, pipes.

Effects: Numerous—because of the wide variety of harmful chemicals in the smoke—including eye, throat, and lung irritation; increased long-term risks of lung cancer, emphysema, and cardiovascular disease by "passive smokers."

Steps You Can Take: Quit/prohibit smoking or limit indoor smoking to one area that is directly vented to the outdoors.

Indoor Air—How Clean Is It?

Contaminants in Homes and Offices Pose a Serious, Growing Health Threat

By Larry B. Stammer
Special to The Washington Post

Ever since Congress authorized the Clean Air Act in 1970, the nation has marshaled its political, economic and technological forces to rid the skies of health-threatening air pollution.

Billions of dollars have been spent to control emissions from motor vehicles, factories, refineries and power plants. Still stricter standards are planned.

Yet a growing body of scientific evidence suggests that indoor contaminants may pose the most pervasive air pollution threat of all. Concentrations of some toxic, cancer-causing and mutagenic pollutants found indoors are up to 100 times greater indoors than they are outdoors. They far exceed limits placed on the same pollutants in outdoor air by the federal Clean Air Act.

From tobacco smoke and radioactive radon gas to molds, fungi, combustion products and everyday household products such as air fresheners and pesticides, humans are being exposed in their homes, offices and vehicles to thousands of chemical and biological agents.

Couple these concentrations with the fact that most people spend 80 percent to 90 percent of their time in increasingly tight, energy-efficient buildings, and indoor pollution becomes especially worrisome.

How worrisome remains an open question. Aside from the severe effects of indoor pollutants like asbestos, lead and carbon monoxide, little is known about the health threat posed by other common pollutants.

Still, scientists say that it is reasonable to conclude that as exposures increase indoors, so do the risks. In fact, in a report to Congress last year, the Environmental Protection Agency noted: "Sufficient evidence exists to conclude that indoor air pollution represents a major portion of the public's exposure to air pollution and may pose serious acute and chronic health risks."

According to estimates by some individual researchers, indoor pollution could rank among the top 10 causes of death in the United States.

Scientists for years have appealed to the EPA for greater attention to indoor pollution issues. During the Reagan administration, EPA requests for research funds were repeatedly reduced, and the Bush administration has allowed only modest increases.

While the EPA staff has estimated that $20 million a year would be needed for indoor air pollution research, the Bush administration this year is spending only $2.68 million.

Still, even with limited funds, the EPA is calling for studies to pin down the health effects of indoor pollution. It also is seeking ways to reduce indoor contaminants as well as a joint effort by government and industry to develop a voluntary program to upgrade building ventilation standards as well as building design, and improved operation and maintenance of heating, air conditioning and ventilation systems.

In a report made public in December, the EPA compared risks of 20 different environmental problems. Radon, indoor air pollution and pesticide residues on foods pose the greatest health risk but received the least amount of federal spending, the report said. Toxic dumps and leaking underground gasoline storage tanks pose far less risk but receive the most money and attention from the EPA, the study said.

"We concentrate on the big visible sources, chemical plants and oil refineries and outdoor air, but the true exposures are the little things under your nose," said Lance Wallace, an EPA scientist who has pioneered studies aimed at determining the "total exposure" to pollutants from all sources, both outdoors and indoors.

The EPA has estimated that indoor pollution may cost "tens of billions" of dollars annually when medical spending and lost productivity are added up. The Consumer Federation of America has placed the costs as high as $100 billion a year.

A bewildering array of organic compounds from household products form the catalog of indoor pollution threats:

- Asbestos, found in cement and insulation, can lead to lung cancer or asbestosis, a chronic lung ailment. Numerous asbestos abatement programs are underway in schools and public buildings. Last July, the EPA banned most remaining uses of asbestos.
- Lead, which retards intellectual and emotional development in children, can be found in older plumbing and in household dust as old paint deteriorates or is chipped away during remodeling.
- Radon, a radioactive gas, invades homes through cracks in the foundation and is the nation's second-leading cause of lung cancer. It may be present at levels the EPA considers unsafe in as many as 12 million U.S. homes.
- Formaldehyde, a probable human cancer-causing agent, wafts from foam insulation, plywood and particle board.
- Benzene, a known human carcinogen, is emitted by synthetic fibers, plastics and some cleaning solutions. It is also present in gasoline fumes and cigarette smoke.
- Nitrogen dioxide, carbon monoxide and fine particulates that can cause respiratory illnesses spew from kerosene heaters and unvented or poorly maintained gas appliances.
- Chemicals that are known animal carcinogens or toxics are often found at very low levels in air fresheners, shoe polish, paints, printed materials, household cleaners, solvents, moth balls and dry-cleaned clothes.
- An estimated 84 percent of U.S. households use home pesticides, many of which have never been tested to determine their health effects.

The World Health Organization has estimated that as many as 30 percent of new and remodeled buildings may be plagued by indoor air quality problems—an estimate borne out by widespread reports of "sick building" illnesses, including workers at the EPA's own headquarters in Washington.

EPA researchers theorize that, based on available data, indoor pollution, including secondhand tobacco smoke, may account for as many as 11,400 deaths yearly. Radon exposures may result in 3,000 to 20,000 additional deaths.

It wasn't until 1985 that the magnitude of the indoor pollution threat became readily apparent. A five-year EPA study surveyed 600 individuals in six cities to find out what their exposure was to 20 different chemicals, some of which have been linked to cancer and birth defects.

Researchers were startled by the findings. It did not matter whether the study participants lived next to an oil refinery or in a pristine rural setting. Indoor concentrations of the 20 chemical compounds studied were almost always higher, often by 10 times or more, than they were outdoors. Peak concentrations in some homes were 200 to 500 times higher than outdoors.

Blood samples and breath tests revealed that participants from rural areas were burdened with as much chemical contaminants in their systems as urban dwellers—a fact that researchers said could only point to indoor sources of pollution common in every household.

Wallace said that 37 participants in the air pollution exposure studies who filled their own gasoline tanks at self-service pumps had twice as much benzene in their breath two to five hours after filling up the gas tank as 300 other participants who did not fill their own tanks. But, Wallace added that "the most important exposure to benzene is cigarettes."

Benzene levels in homes with smokers were 30 percent to 50 percent higher than in nonsmoking households. Smokers and those around them are exposed to an estimated 4,600 chemical constituents in cigarette smoke, a number of them cancer-causing. Various studies have estimated that environmental tobacco smoke may ac-

count for upwards of 5,000 deaths a year among nonsmokers.

Indeed, EPA scientist James L. Repace has said that the risks of indoor air pollution from tobacco smoke to nonsmokers are almost twice as great as from radon gas, and more than a hundred times as great as the total death rate from all cancer-causing hazardous outdoor air pollutants regulated by the EPA under the Clean Air Act.

Each year, there are 200,000 emergency room admissions for allergies; one third of them are believed to be caused by microbiological contaminants found indoors, according to Harriet Burge, the director of the University of Michigan's allergy research laboratories at Ann Arbor.

Biological contaminants can thrive in building ventilation systems that are poorly maintained or designed. They also can proliferate in hot water systems if water is not kept at temperatures of at least 113 Fahrenheit.

Formaldehyde, which is widely used in building materials and furnishings, can cause eye, nose and throat irritation, coughing, skin rashes, headaches, dizziness, nausea, vomiting and nosebleeds. It also causes nasal cancer in rats and is thus a suspected human carcinogen.

Generally, the newer the building material or furnishings, the higher the formaldehyde gas emissions. High temperatures and humidity can compound the problem.

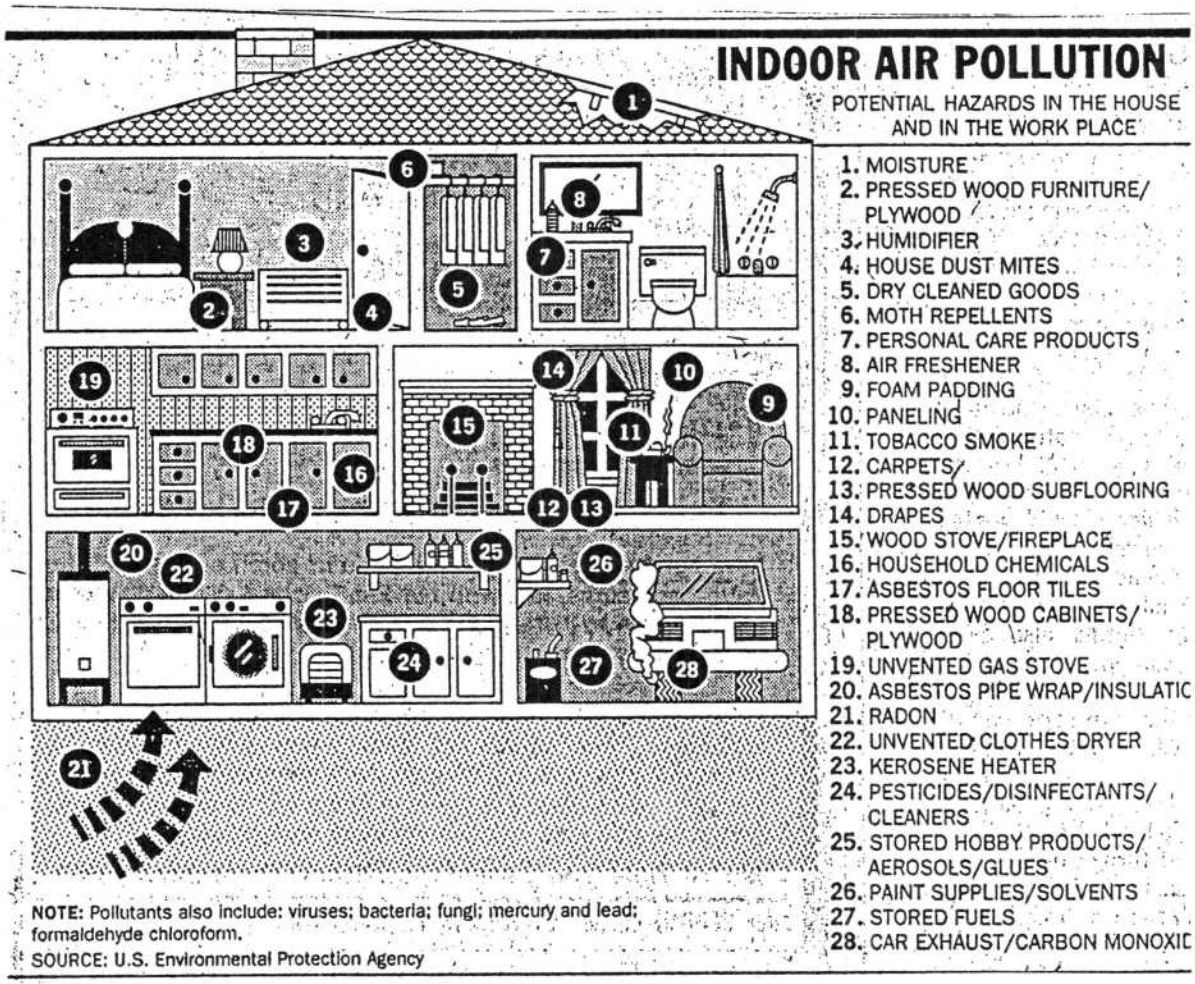
Reducing or eliminating exposure to indoor contaminants is often fairly straightforward. It could involve changes in behavior as obvious as stopping smoking (or only smoking outdoors) or making certain that ventilation systems are properly maintained and operated.

Ordinary house plants can help, a study by the National Aeronautics and Space administration found. The study said that philodendrons, spider plants and the golden pothos were most effective at absorbing formaldehyde, while flowers like the gerbera daisy and chrysanthemums reduced levels of benzene. Bamboo palm, English ivy, peace lily, mother-in-law's tongue and Chinese evergreen also proved to be effective air purifiers, the study said.

Consumers can substitute safer products for those that give off toxic chemicals, and carefully follow directions on the use and storage of pesticides, paints and solvents.

"In a large number of cases we see it's going to be pretty much up to individuals to make their own choices as to what steps they should or shouldn't take to reduce their exposure to indoor air pollution," said Robert Axelrad, director of the EPA's indoor air division.

"These kinds of health risks have been there all along. We just haven't realized it," said John Holmes, chief of the California Air Resource Board's research division. "But slowly we're getting the results from what is a gigantic experiment. As it becomes clear what the risks are, at least on a selective basis, society will move to reduce or severely limit those risks." ■



Pesticides (products that kill household pests). *Remedy:* Use nonchemical methods of pest control where possible. Follow manufacturer's directions. Mix or dilute outdoors. Open windows when using indoors. Take plants or pets outside when applying pesticides. Do not store pesticides inside home. Clean shoes and hands to avoid tracking pesticides indoors. Call EPA at 1–800–858–PEST for more information. *See* P

Stored Fuels (e.g. gasoline, kerosene). *Remedy:* Buy limited quantities. Use well-sealed containers. Do not store inside home. *See* O

BASEMENT OR GROUND FLOOR

Asbestos Pipe Wrap & Furnace Insulation. *Remedy: See All Rooms: Floor Tiles Containing Asbestos. See* A

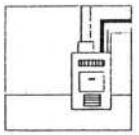
Dehumidifier. *Remedy:* Empty and clean water tray often. *See* B

Ground Moisture. *Remedy:* Clean and disinfect basement floor drain regularly. Keep basement dry and free of moisture and mildew. *See* B

Radon. *Remedy:* Test your home for radon—do it yourself kits are easy and inexpensive. Fix your home if your radon level is 4 picocuries per liter (pCi/L) or higher. For more information, contact your state radon office or call 1–800–SOS–RADON. *See* R

Stored Hobby Products (e.g. paint, glue, epoxy). *Remedy:* Follow manufacturer's directions. Use outdoors, if possible. Indoors, open window or use exhaust fan. Reseal containers well. Clean brushes and other materials outside. *See* O

Unvented Clothes Dryer. *Remedy:* Vent to outdoors. *See* B; CB, if gas-fired dryer.



HEATING & COOLING SYSTEMS

Air Conditioner. *Remedy:* Empty and clean water tray often. Follow all service and maintenance procedures, including changing filter. *See* B

Furnace. *Remedy:* Have your heating system inspected and serviced every year. Repair fuel or gas leaks promptly. Follow service and maintenance guidance, including changing filter. *See* CO CB

Fireplace. *Remedy:* Open flue when fireplace is in use. Have flue and chimney inspected annually for blocks, leaks, or other damage. *See* CO CB

Gas Space Heater. *Remedy:* In room where heater is located: open a door to the rest of the house; turn on exhaust fan; and open a window slightly. *See* CO CB

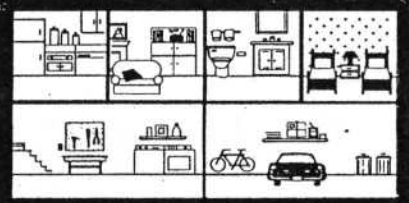
Kerosene Heater. *Remedy:* Vent to outside. Only use fuel recommended by manufacturer. Refill outside. If using unvented, open a door to the rest of the house and open a window slightly. *See* CO CB

Woodstove. *Remedy:* Vent to outside. Choose a properly sized woodstove that is certified to meet EPA emission standards. Make certain all woodstove doors fit tightly. Use aged or cured (dried) wood only; never use pressure-treated wood. Follow manufacturer's directions. *See* CO CB

For more information on reducing indoor air problems in the home, contact: Indoor Air Quality Information Clearinghouse at **1–800–438–4318**. Ask for a free copy of *The Inside Story: A Guide to Indoor Air Quality.* Operators are also able to answer questions and supply more information about specific indoor pollutants found in your home.

Funding for this document was provided through a cooperative agreement with the U.S. Environmental Protection Agency.

How Healthy Is The Air In Your Home?



A Room–by–Room Checklist for Your Home's Indoor Air

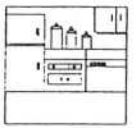
CONSUMER FEDERATION OF AMERICA

To live more safely and stay healthy, we often take simple steps to protect ourselves and our families. Smoke detectors alert us about the potential for fire. Parents childproof their homes to protect their inquisitive toddlers. Yet, few of us recognize that the air we breathe inside our homes can make us feel tired or dizzy, make our eyes itch or our throats feel scratchy, bring on an asthma attack, spread an infectious disease, or even, over a long period of time, contribute to our risk of cancer.

You may be surprised to learn that the air inside your home may be more seriously polluted than the outdoor air, even if you live in a large industrial city. This, coupled with the fact that you spend a large amount of time inside your home, makes indoor air quality a health concern. Some people, such as the young, the elderly, and the chronically ill, are even more seriously affected. Fortunately, there are simple steps you can take to reduce your exposure to indoor pollutants.

How To Use This Checklist

Use the following room-by-room guide to check for indoor pollutants. In each room, we have listed different household products, the indoor air problems associated with them, and remedies intended to help decrease your family's exposure to indoor pollutants. A summary of adverse health effects or symptoms associated with different pollutants is also included. This information is not intended to replace the services, advice, or consultation of a physician.



KITCHEN

Household Cleaners. *Remedy:* Open window. Use according to manufacturer's directions. *See* O

Moisture from Cooking & Dishwasher Use. *Remedy:* Install and use exhaust fan. *See* B

Pressed-Wood Cabinets. *Remedy: See Living Room: Paneling, Pressed-Wood, Cabinetry. See* [F]

Unvented Gas Stove & Range. *Remedy:* Keep burners properly adjusted (blue flame tip, not yellow). Install and use exhaust fan. Never use a gas stove to heat your home. *See* [CO] [CB]

BATHROOM

Air Freshener. *Remedy:* Open window or use exhaust fan instead. If using air fresheners, follow directions. *See* [O]

Moisture, Mold & Mildew. *Remedy:* Install and use exhaust fan. Fix plumbing leaks promptly. *See* [B]

Personal Care Products (e.g. hair spray, nail polish). *Remedy:* Open window or use exhaust fan. Follow directions for use. *See* [O]

BEDROOM

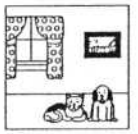
Dry Cleaned Goods. *Remedy:* Do not accept dry cleaned goods with chemical odor until they have been properly dried. Try a different dry cleaner. *See* [O]

Humidifier. *Remedy:* Clean according to manufacturer's directions. Refill with clean water daily. *See* [B]

Moth Repellents (with paradichlorobenzene). *Remedy:* Avoid breathing vapors. Place moth repellents in trunks or other containers and store separately (attic, storage closet), away from living areas. *See* [P]

LIVING ROOM

Paneling, Pressed-Wood Furniture & Cabinetry. *Remedy:* When purchasing new paneling, pressed-wood furniture or cabinetry, ask about formaldehyde content and release. Some types of pressed-wood products, such as those with phenol resin, emit less formaldehyde. Also, pressed-wood products coated with polyurethane or laminates may reduce formaldehyde emissions. After installation, open windows. Maintain moderate temperature and humidity. *See* [F]



ALL ROOMS

Animals (dander; hair, feather, or skin). *Remedy:* Clean house regularly. *See* [B]

Carpets. *Remedy:* Clean and dry or remove water-damaged carpets promptly. If installing new carpet, ask your retailer to air out the carpet before installation. Ask for low-emitting adhesives, if adhesives are needed. Leave the premises during and after installation. Open doors and windows; use window fans or room air conditioners. Vacuum regularly. *See* [B] resulting from water damage; [O] from new carpet.

Draperies. *Remedy:* New draperies may be treated with a formaldehyde-based finish and may emit formaldehyde for a short time. Open doors and windows. Maintain moderate temperature and humidity. *See* [F]

Health Effects of Common Indoor Pollutants

[A] **ASBESTOS:** No immediate symptoms, but long term risk of chest and abdominal cancers and lung diseases. Smokers are at higher risk of developing asbestos-induced lung cancer.

[B] **BIOLOGICALS:** Includes allergens (mold, mildew, pollen) and infectious disease agents (viruses, bacteria). Eye, nose, and throat irritation; shortness of breath; dizziness; drowsiness; fever; digestive problems; asthma; humidifier fever (a respiratory illness); influenza and other infectious diseases.

[CO] **CARBON MONOXIDE:** At low concentrations, fatigue in healthy people and chest pain in people with heart disease. At higher concentrations, impaired vision and coordination; headaches; dizziness; confusion; nausea; flu-like symptoms that clear up after leaving home; and death. Hundreds of people die each year in their homes from CO poisonings.

[CB] **COMBUSTION BYPRODUCTS:** Eye, nose, and throat irritation. Nitrogen dioxide may cause decreased lung function and increased respiratory infections in young children. Respirable particles may cause respiratory infections, bronchitis, and lung cancer (*See Environmental Tobacco Smoke*).

[E] **ENVIRONMENTAL TOBACCO SMOKE:** Eye, nose, and throat irritation; headaches; lung cancer; may contribute to heart disease. Specifically for children, increased risk of lower respiratory tract infections (bronchitis, pneumonia) and ear infections; increased severity and frequency of asthma episodes; decreased lung function.

[F] **FORMALDEHYDE:** A widely used chemical in household products. Eye, nose, and throat irritation; wheezing and coughing; fatigue; skin rash; severe allergic reactions. May cause cancer. May also cause other effects listed under *Organic Gases*.

[L] **LEAD:** Lead affects practically all systems within the body. Lower levels of lead can adversely affect the central nervous system, kidney, and blood cells and can impair mental and physical development. Lead at high levels can cause convulsions, coma, and even death.

[O] **ORGANIC GASES:** Gases released from chemicals used in household products. Eye, nose, and throat irritation; headaches; loss of coordination; nausea; damage to liver, kidney, and central nervous system. Some organic chemicals may cause cancer in humans.

[P] **PESTICIDES:** Eye, nose, and throat irritation; damage to central nervous system and kidney; increased risk of cancer.

[R] **RADON:** An invisible, radioactive gas. It is the second leading cause of lung cancer. No immediate symptoms. Smokers are at higher risk.

Environmental Tobacco Smoke (from cigarette, pipe, and cigar smoking). *Remedy:* Do not smoke in your home or permit others to do so (especially near children). If smoking cannot be avoided, open windows or use exhaust fans. *See* [E] [CO] [CB]

Floor Tiles Containing Asbestos. *Remedy:* Periodically inspect for damage or deterioration. Do not cut, rip, sand, or remove any asbestos-containing materials. If you plan to make changes that might disturb the asbestos, or if materials are more than slightly damaged, repair or removal by a professional i needed. Call EPA at 202–554–1404 for more information. *See* [A]

House Dust Mites. *Remedy:* Clean house and vacuum regularly. Wash bedding in hot water. *See* [B]

Lead-Based Paint (if manufactured before 1978). *Remedy:* Leave lead-based paint undisturbed if it is in good condition. Do not sand, burn off, or remove lead paint yourself; to remove, hire a person with special training for correcting lead paint problems. For more information call 1–800–LEAD–FYI. *See* [L]

Moisture. *Remedy:* Use exhaust fans. Use dehumidifier if necessary (*See Basement: Dehumidifier*). *See* [B]

GARAGE

Car Exhaust. *Remedy:* Do not idle car in garage. To keep exhaus out of house, use weather stripping on door from garage to house. *See* [CO] [CB]

Paint Supplies. *Remedy:* Open windows when usin Follow manufacturer's directions. Buy limited quant ties. If products contain methylene chloride (e.g. paint strippers), use outdoors. Reseal containers well. Clean brushes and other materials outside. *See* [O]

Growing Concern Over Indoor Air Pollution

By Wiley Buck

Americans are spending more and more time indoors, up to 90 percent according to the Consumer Federation of America. VCRs, CDs, and other amenities are making life inside homes and offices more and more comfortable.

But more comfortable doesn't necessarily mean safer. In fact, several studies have shown it's quite the opposite—indoor air is hazardous. The EPA's 1987 landmark Total Exposure Assessment Methodology study concluded that to a large degree an individual's exposure to indoor air toxins overshadows exposure to toxins outside the home. Levels of toxins in the indoor air can be 10 to 100 times as high as the National Ambient Air Quality Standards (NAAQS), developed under the Clean Air Act.

The NAAQS levels, currently used for outdoor air quality control only, are most often based on a risk of 1 in 100,000 of contracting a fatal disorder from the air pollutant. Pollutants inside, then, can pose a fatal risk up to 1 in 1,000. And this estimate is conservative, since the NAAQS do not yet recognize the synergistic dangers of simultaneous exposure to many pollutants.

What the indoor pollutant levels are doing to the other 999 folks who survive is not encouraging either. Several barometers indicate that the effects are quite deleterious. Environmental Illness (EI) sufferers, a growing segment of the population, have lost virtually all resistance to the onslaught of pollutants most people encounter everyday. "Indoor air pollution is our biggest problem," says Lynn Lawson, Public Relations Director of the Human Ecology Action League, a support group for EI victims. Up to 15 percent of the American citizenry suffer from some chemical sensitivities, according to one estimate. In addition, the "Sick Building Syndrome"—when a new office building causes people to become ill—strikes the majority of the occupants to some degree.

The total cost of indoor air pollution? David Mudarri of the US EPA Office of Air and Radiation estimates tens of billions of dollars in lost worker productivity alone.

Indoor air pollutants are only one indoor toxin. Water also brings in a variety of pollutants, some which are the result of the distribution and storage of the water within the building. And dust from lead paint, itself a dangerous and very common pollutant, is known for its tenacity to stick to whatever surface it comes in contact with, constituting an indoor "land" pollution problem.

Air Toxins

Air toxins come in three basic forms: chemical, radioactive, and biological. Levels are determined by three factors: 1) source strength and entry efficacy; 2) reactivity once indoors; and 3) exhaust or dissipation rate.

Source strength is usually the dominant factor and, accordingly, source reduction and entry prevention are usually the most effective means of getting rid of an indoor pollutant. Increasing the dissipation rate will help alleviate the Indoor Air Quality (IAQ) problem, but will not typically solve it.

Uncontrolled ventilation—leaky windows, doors, and walls—is ineffective because the ventilation rate does not correspond with emission rates and occupancy rates. Hence, there is not a strong correlation between indoor pollutant levels and the energy efficiency of a building. Properly designed and controlled ventilation—mechanical, and to a lesser degree, natural—is effective, but it limits energy conservation.

In a typical office or home, sources of toxic indoor air can include building materials, building systems, durable goods, household products, voluntary activities, human respiration, and outdoor sources. The majority of the sources are brought in voluntarily, like a herd of toxic Trojan horses.

Given the countless possible contaminants, it is tough to choose which are the worst in an overall sense. Some of the most dangerous toxins at the highest levels are found in isolated cases. Other toxins, described below, are more ubiquitous while still hazardous.

Formaldehyde

Revelations about urea-formaldehyde foam insulation (UFFI) splashed the dangers of formaldehyde into the mass media and the public's eye. When the foam was banned, the collective consciousness of the dangers of formaldehyde died with it. But formaldehyde remains one of the most common and deleterious indoor pollutants.

Formaldehyde is used in a variety of household products. As glue resin in the form of urea-formaldehyde or phenol-formaldehyde, it gives many construction materials their integrity. Fiberboard, particleboard, plywood, chipboard, paneling, and carpeting are some of the many carriers and emitters of formaldehyde. Acid catalyzed wood finishes found on cabinets also contain formaldehyde.

Formaldehyde outgasses from the glue into its so-called "free" form. The rate of outgassing is dependent upon age of material, humidity, and temperature. With each 10 degree rise in temperature, formaldehyde doubles its

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ite of emission. Airborne formaldeyde forms caustic formic acid when it omes in contact with water. This hemical reaction takes place in the oist linings of the respiratory tract. n cases of extreme exposure, it is susected of causing nasal cancer. In nilder cases, the symptoms include eadache, runny nose, sinus congesion, sore throat, and most indicaively, unusual fatigue—all flu-like ymptoms.

Symptoms increase exponentially vith the concentration of formaldeyde in the air. For most people, symptoms occur around 0.1 parts per million.

Dr. Thad Godish, director of the Indoor Air Quality Research Laboratory at Ball State University, reported that in homes with formaldehyde resin board as subflooring he has found airborne formaldehyde levels of 0.1 to 0.3 ppm, and 0.07 to 0.15 ppm in homes with UFFI. In mobile homes, he has measured airborne formaldehyde levels between 0.2 and 0.6 ppm. The "base rate" of emissions for an older home with conventional furnishings, he finds, is between 0.04 and 0.07 ppm.

Bioaerosols and Humidity

Every home has a community of living organisms with which we usually live comfortably. However, given certain temperature and moisture conditions, these bacteria, viruses, fungi, and mites can thrive to bothersome levels. By some accounts, this is the most ubiquitous of all indoor air quality problems.

Most bothersome are the fungi known as riboflavins and actinomycedes. These fungi have toxins in their cell walls, which they release as a defense mechanism. Fungi often attach themselves to toxic substrate such as a painted wall, and proceed to defecate toxic compounds from their system into the air. Dust mites, invisible to the naked eye, shed skin and produce feces to which 20 percent of us are allergic.

Anywhere that the humidity and temperature sources are supportive, they will thrive. Under refrigerators, in air filters and ducts, in humidifiers and de-humidifiers, in bathrooms and on window sills, the conditions are often ideal and bioaerosols thrive.

General room conditions are oftentimes hospitable as well. Any relative humidity level outside of the 40 to 60 percent range will promote growth of one or more organisms. The higher the relative humidity, the more likely that problems will develop.

Lower humidity levels tend to encourage allergic rhinitis and sinusitis in people as well. Measured levels of relative humidity can vary across the board, and without some sort of control, will generally be outside of this range.

Combustion Products

The use of gas appliances, vented and unvented, increases the amount of combustion products in the air. With a properly vented gas appliance, the levels attained do not appear to be deleterious. With unvented appliances, however, dangerous levels of combustion products can gather in a closed space.

Most sources of indoor air pollution are substances brought in voluntarily, like a herd of toxic Trojan horses.

At the flame temperature of natural gas—approximately 1,200 degrees celsius—atmospheric diatomic oxygen and nitrogen are broken down into their elemental states. The sulfur compounds known as mercaptans—added to the gas to give it its characteristic odor—also break apart at these temperatures, releasing their sulfur molecules. An array of chemical reactions then occur, with the end products being sulfuric oxides, nitrous oxides, carbon oxides, and water. These end products cover the spectrum of toxicity, from lethal to harmless.

The worst case is the formation of carbon monoxide, CO. Carbon monoxide is formed in appreciable quantities only when there is a lack of oxygen for the combustion process. Inhaled, carbon monoxide effectively restricts the transfer of oxygen from the blood to the cells. Elevated carbon monoxide blood levels bring about dizziness, headaches, nausea, and fatigue—again, flu symptoms often hiding the true cause of illness. Higher levels bring about unconciousness and even death.

Recirculated combustion air is one common cause for elevated levels of carbon monoxide. Combustion air is recirculated when there is no venting system, or when there is a breakdown in the the venting system. One recent study, cited in the *Chicago Tribune*, found that "three to five percent of patients coming to the emergency room of the University of Illinois Hospital in the winter of 1985-86 with . . . flulike symptoms were suffering from carbon monoxide (CO) poisoning," according to Dr. Paul S. Heckerling.

Carbon monoxide poisoned patients shared two common characteristics: They had been heating their living quarters with their stoves; and others in their homes fell ill. Faulty venting systems cause up to 300 deaths a year.

The second most harmful combustion product is the formation of nitrous oxide (NO2). NO2 reacts with water to form a strong acid, which can permanently damage lungs, cause headaches, and upper respiratory infections. Levels of NO2 can exceed the EPA's National Ambient Air Quality Standards in homes with unvented appliances.

Other sources of dangerous levels of combustion products include unvented kerosene heaters, wood stoves, and combustion engines.

Cigarette Smoke

A combustion product by definition, secondhand cigarette smoke contains a myriad of over 4,700 compounds, both gases and particles, many of them toxic. Sidestream smoke has even higher concentrations of some toxic and carcinogenic substances than the smoke inhaled by the smoker. However, sidestream smoke is usually diluted as it circulates.

The Surgeon General of the United States reports that there is very solid evidence that nonsmokers suffer lung disease from secondhand cigarette smoke. The symptoms and diseases parallel those caused by smoking. Cigarette smoke also acts as a vehicle for other toxins to enter the lungs.

Asbestos

Asbestos is a mineral known for its fibrous nature. Most of the asbestos in the US originated in Canada. The fibers are so small that once inhaled, the respiratory system has great difficulty in expelling them. Asbestos causes scarring of the lung tissue, asbestosis, mesothelioma, and cancer of the digestive tract. You can expect to find asbestos on old boilers, heat pipes, and

shingles. At one time it was widely used as a sound absorbing material in tiles and "popcorn" ceilings.

It is suspected that fiberglass dust may pose the same risks as asbestos does, but the consensus is not strong.

Radon

Radon gas is found in varying levels everywhere in the United States. Radon is a natural decay element of uranium found in soil, and it is its decay elements that are dangerous. Inhaled into the lungs, radon decay products are themselves likely to decay and emit harmful radiation into the lung tissue. The immediate effect includes irritation of the lung, but the real danger lies in its cancer causing effect. Radon is believed to cause between 2,000 and 30,000 cancer deaths every year, according to the EPA, which puts it second only to cigarette smoking.

Most (85-90 percent) of the radon that enters a home comes directly from the soil. It is in the basement that radon finds most of its entry routes—cracks, drains, and piping all offer access routes. Some of this radon is brought up to higher floors by dissipation and via the chimney effect of a building, which essentially draws the basement air up. Radon concentrations, however, fall precipitously the higher it is measured in a building, posing little or no threat above the third floor.

Summary

The problems with indoor air quality have prompted little constructive response from the government agencies we might expect to be involved. The US EPA has interpreted the NAAQS levels as applying to outdoor air only, leaving a glaring lack of standards for indoor air. The Occupational Safety and Health Administration issues standards for the workplace—the only indoor air quality standards currently in place—but typically does not enforce them in offices.

Radon is the one exception to EPA's lack of standards for indoor air quality. EPA has a "guideline" of four picocuries per liter of air. Lifetime exposure to this level represents, according to EPA's estimates, a one to five percent chance of contracting lung cancer. This compares to NAAQS' acceptable risk of 0.001 percent, which means that EPA is willing to accept a risk 1,000 to 5,000 times greater than NAAQS. This can only lead one to ask if residential standards for other pollutants developed by the EPA would also allow this level of risk.

Bill Silver, an official in the Service Employees International Union Local 925, doesn't necessarily see the EPA's lack of commitment as the foremost barrier to improving IAQ in office spaces. The problem is, instead, the mindset of office workers.

"It's not common for people to associate poor indoor air quality with their health problems, and that's the greatest barrier," Silvers says, to obtaining improved IAQ. "The building owners which are addressing IAQ are pretty much the exception" he continues, even though "the solution tends to be quite simple."

It was only with the passage of the 1986 Superfund amendments that EPA was mandated to begin research and information dissemination regarding IAQ, but their current budget is spent mostly on radon. "Only five percent of my job description deals with IAQ" says Mardi Klevs, the only person working on non-radon IAQ at US EPA six state Region 5 headquarters in Chicago. This may change, as well as the lack of standards. A bill to expand EPA's funding for IAQ work from $3.6 million to $48 million has been introduced to Congress, but was opposed by the Reagan administration.

California, Canada, and many European countries, meanwhile, have developed standards which address indoor air quality from this vantage point.

What To Do

There is an awakening market for both home testing and alternative products. Some guidelines to follow for homeowner testing include:

Radon The two basic choices for a simple home or office test is an activated charcoal canister or an alpha-track detector. Alpha-track detectors take 30-90 day samples, while charcoal canisters take three to seven day readings. Although the EPA recommends taking a screening measurement with a charcoal canister, it is more accurate to take a longer reading with an alpha-track detector, unless very high levels are suspected (in which case you might not want to wait 30-90 days for the reading). Both types cost about $25 including analysis, and are available in hardware and home supply stores, though the alpha-track detectors are not as readily available.

Formaldehyde Again, given the fluctuations in formaldehyde emission rates, the longer the reading the more representative it will be. There are several manufacturers of "badge" detectors or eight-hour samplers, but the longer monitors are more difficult to find. One manufacturer is Air Quality Research International in Berkeley, California. Their seven-day monitor costs about $50 including analysis.

Combustion Products Carbon monoxide badges and alarms and nitrous oxide monitors that give quick results (CO) and sample measurements are available. Prices range from $10 to $100.

Bioaerosols One of the most difficult to identify, bioaerosols are best controlled by controlling humidity levels, and inspecting and cleaning areas that are potential growth media. Inexpensive hygrometers are available at hardware stores, and general humidity levels can be brought into the preferred range with the use of humidifiers and dehumidifiers, which must be cleaned regularly since they themselves are growth media.

Material Safety Data Sheets Request an MSDS from the manufacturer of any product you plan to purchase and bring indoors. An MSDS will report on some of the dangerous chemicals in the product, excluding those found in small quantities.

FOR MORE INFO

Housing Resource Center, 1820 W. 48th St., Cleveland, OH 44102, (216) 281-4663. HRC hosts the annual Bluperint for a Healthy House conference, and prints an index of testing and mitigation products.

Thad Godish, Ph.D., director, Indoor Air Quality Research Laboratory, Ball State University, Muncie, IN 47304, (317) 285-5782. Concentrates on formaldehyde. Mardi Klevs, US EPA, Region V, Office of Air and Radiation, 230 S. Dearborn, 5AR-26, Chicago, IL 60604, (312) 886-6054. David Mudarri, US EPA Headquarters, Office of Air and Radiation, 401 M Street SW, Washington, DC 20460, (202) 382-7753.

Consumer Federation of America, 1424 16th Ave. NW, Suite 604, Washington, DC 20036, (202) 387-6121. *Non-Toxic and Natural: How to Avoid Dangerous Everyday Products and Buy or Make Safe Ones*, Debra Lynn Dadd, J.P. Tarcher, Inc. Los Angeles. Distributed by St. Martin's Press, New York. 1984. A thorough user-friendly reference guide. *Healthful Houses: How to Design and Build Your Own*, Clint Good and Debra Lynn Dadd, Guaranty Press, Bethesda MD. 1988. Another user-friendly reference guide with a better concentration on building products and systems. Lynn Lawson, public relations director, Human Ecology Action League, P.O. Box 66637, Chicago, IL 60666, (312) 665-6575.

indoor air

A Sickness in the Air

WASHINGTON, D.C.

"I am a barometer of the things to come," says Stella Lansing. She calls herself a canary, a modern-day version of the bird that coal miners used to carry into the mines. If the bird died, the miners knew methane was in the air and it was time for them to get out.

Like canaries, Lansing is supersensitive to certain substances. But for her, it was formaldehyde from a new carpet, not methane, that sent her respiratory and neurological systems into a panic in the spring of 1986. And it happened not in a coal mine but while she was at her desk at the U.S. Department of Labor.

That reaction changed her life. Once an avid outdoorswoman, she now spends most of her time near special filters to help her breathe. Seven drugs keep her body functioning. "I have aged considerably in the last three years," says Lansing, a vocational-rehabilitation specialist. "I tried to reintegrate into the Department of Labor, but it became very apparent that I was permanently sensitized."

Bobbie Lively-Diebolt was a senior staff member at the U.S. Environmental Protection Agency. In January 1988, when a new carpet was installed at EPA, she had a severe reaction. "I got to work at 7 A.M., my voice started cracking by 7:15," she says. "By 7:20 I was in bad shape. I completely lost my voice, I had problems breathing, everything was in slow motion." She has not been able to return to her office.

"Before all this happened I was extremely healthy," she says. She jogged twenty miles a week and did aerobic weight-lifting on alternate days. Today, says Lively-Diebolt, "I go very few places. I'm very restricted. I always travel with a respirator in my purse."

Doctors say Lansing and Lively-Diebolt are suffering from an indoor-air-related illness, a condition created largely by sick-building syndrome, which affects buildings constructed during the energy-conscious 1970s.

Designed to seal out harsh climates, such structures also seal out fresh air. And they seal in a growing number of toxic substances in today's office environment—from typewriter correction fluid and photocopier toners to new office furniture and carpet adhesives. Poorly organized office space and inadequately maintained ventilation systems typically exacerbate the problem.

In what they hope are precedent-setting cases, Lansing and Lively-Diebolt were able to get some of their medical bills covered under workers' compensation. Still, coverage doesn't include the $700 worth of air-filter equipment Lively-Diebolt had to put in her home or the $10,000 furnace she plans to install. Nor has it put her career back on track.

"They considered me damaged goods—unable to do the job," she says as she enters her second year on extended leave without pay. She says her boss has yet to fulfill an agreement to find her a job she can do from home.

While sick-building syndrome is believed to affect as many as 30 per cent of buildings nationwide, many Federal workers maintain they are at particular risk. A survey conducted for the American Federation of Government Employees earlier this year found that more than three-fourths of the respondents—1,829 union and nonunion employees at twenty-seven Federal agencies in the Washington area—believe the air quality where they work is a problem, and nearly two-thirds agreed that their agencies are not doing enough to provide clean air.

The underlying problem, says David Schlein, national vice president of the American Federation of Government Employees, is that no laws exist to require employers to monitor air quality, and, simply put, the employer—the Federal Government—prefers to cut costs at the expense of worker safety.

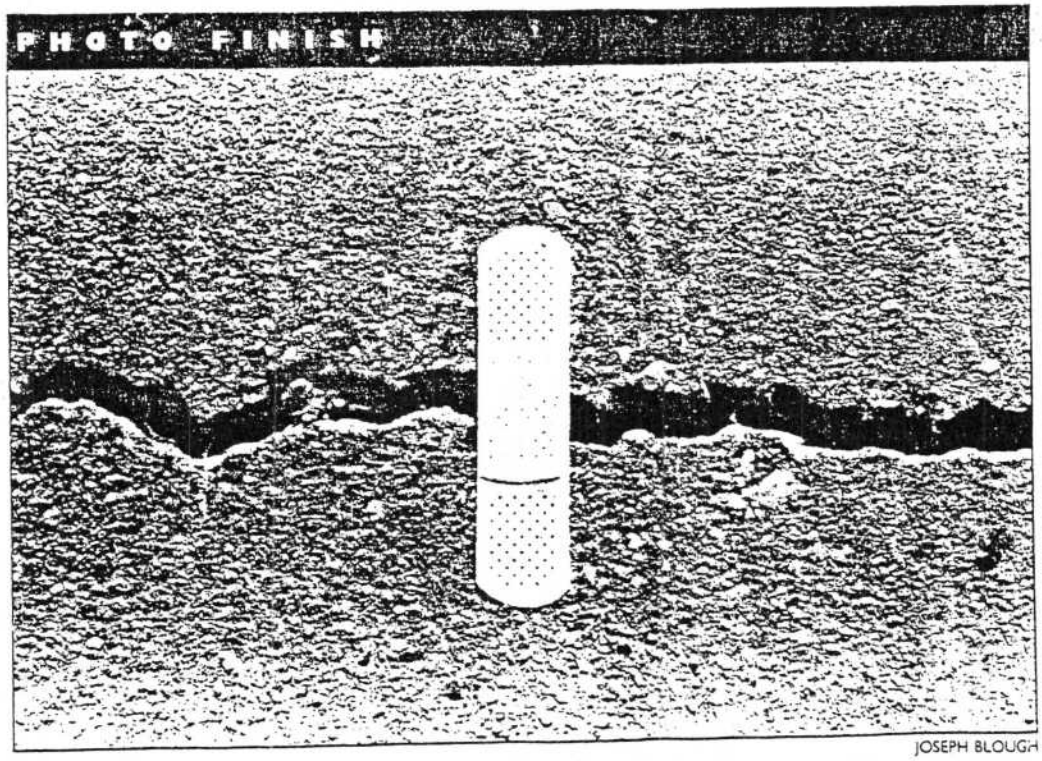
This summer, Schlein asked Congress to consider legislation that would require all employers, not just the Federal Government, to monitor indoor air pollution.

"I have come to know firsthand the devastation that occurs in the lives of the victims," he told members of a House subcommittee while Lansing, Lively-Diebolt, and others sat nearby, their respirators at the ready. "Some dedicated public servants have seen their careers and their health ruined by indoor-air-related illness."

—MARY BETH S. MARKLEIN

(Mary Beth S. Marklein is a free-lance journalist in Washington, D.C.)

PHOTO FINISH



JOSEPH BLOUGH

Quake

NOTE: Tobacco smoke also contains volatile organic compounds (including benzene and formaldehyde); combustion gases; and particulates. For details about these indoor air pollutants, see below.

Combustion Sources

Pollutants/Sources: Carbon monoxide, nitrogen dioxide, and particulates from gas stoves, kerosene heaters, woodstoves, malfunctioning furnaces, car exhausts (via building ventilation systems, loading docks, and garages adjoining residences and offices).

Effects: Carbon monoxide: Headache, dizziness, nausea, and death at very high concentration. Nitrogen dioxide: Throat, lung, and eye irritation. Particulates: Eye, nose, and throat irritation, bronchitis, emphysema, lung cancer, heart disease.

Steps You Can Take: Install an exhaust fan vented to the outdoors above your gas range. Increase ventilation to the local area where woodstoves and kerosene heaters are used. Follow manufacturers' directions and use proper fuel in space heaters.

Materials and Furnishings

Sources: Asbestos in insulation, ceiling surfaces, etc.; formaldehyde in plywood and particleboard (also present in tobacco smoke); other volatile organic compounds in a wide range of building materials including caulking and adhesives.

Effects: Asbestos: Lung, chest, and abdominal cancer, plus scarring of the lungs. Formaldehyde: Breathing difficulty, eye and skin irritation, nausea, dizziness. Volatile organic compounds: Breathing difficulty, eye and skin irritation, nausea, dizziness, increased risk of serious lung disease.

Steps You Can Take: Asbestos: Call EPA's TSCA (Toxic Substances Control Act) hotline at 1-202-554-1404. You'll be sent a free packet including an asbestos fact sheet, a booklet, and report offering "Guidance for Controlling Asbestos-Containing Materials in Buildings." It is important to remember a few basic principles: Do not remove or disturb asbestos-containing material that is in good condition. When such materials are frayed or in poor condition, call in a professionally trained contractor to handle the problem. *Formaldehyde:* Purchase materials labelled "low-emitting formaldehyde." Coat pressed-wood surfaces to reduce emission of formaldehyde. Follow manufacturers' directions and ventilate before and after use of materials containing volatile organic compounds.

Biological Contaminants

Sources: Air conditioning systems, humidifiers, cooling towers, household pets.

Effects: Pneumonia-like respiratory infections, allergic reactions.

Steps You Can Take: To avoid harboring and distributing biological microorganisms, clean air-conditioning systems and empty humidifier water trays frequently. Keep surfaces clean and dusted.

Human Activities

Sources: Hazardous substances in pesticides, paints, solvents, cleaning agents, polishes, air fresheners, toilet deodorants, copying machines, hot water, textiles, the dry-cleaning process.

Effects: Breathing difficulty, eye and skin irritation, nausea, dizziness, increased risk of serious lung disease.

Steps You Can Take: In the home, use integrated pest management techniques instead of chemical pesticides. Use consumer products according to the manufacturers' directions and ventilate during and after use. Remove unused spray cans, paints, etc. Store remaining cans in garage or room vented to outside. Use a fan vented to the outdoors when you take showers to reduce exposure to organics released from hot water.

Ambient (Outdoor) Environment

Sources: Contaminants such as radon and termiticides that originate outdoors in the soil but collect, penetrate cracks in structures, and concentrate indoors.

Effects: Increased risk of cancer.

Steps You Can Take: Have your home inspected and modified, if necessary, by a qualified contractor. *Radon:* Test your home for radon. EPA conducts a Radon Measurement Proficiency Program. This voluntary program allows laboratories and businesses engaged in radon detection to demonstrate their capabilities. The names of firms participating in this program can be obtained from your state radiation program or from your EPA regional office. *Termiticides:* Testing for pesticides is expensive and is recommended only if you suspect that high levels may be present. To locate a commercial laboratory qualified to test your indoor air for traces of termiticides, call the National Pesticide Telecommunications Network (NPTN) at 1-800-858-7378. You may also want to contact EPA's Public Information Center for additional information about radon and termiticides: 1-202-475-7751.

Radon tops list of indoor pollutants

If you're more than a bit uptight about dangerous indoor air pollution, you should be. After all, some of that stuff can kill you.

At the same time, however, you stand a good chance of driving yourself crazy if you try to make sure you are completely protected from all of the various pollutants that can be trapped inside your house.

Unfortunately, that seems to be exactly what's happening to potential home buyers, reports Kenneth T. Austin, chairman of HouseMaster of America, a large home inspection service headquartered in Bound Brook, N.J.

At the other extreme, HouseMaster, which operates in 110 cities in 31 states, also has found that sellers are almost totally insensitive to the problem.

"There's a real dichotomy out there," says Austin. "Buyers are very concerned, almost to the point of paranoia, but the apathy on the part of sellers is just as incredible. They're like smokers who don't want to hear about the risks they are taking."

Actually, the correct approach to indoor pollution rests somewhere between those two extremes. Here, as Austin sees it, is the proper order for your concern, starting with the pollutants that you should be most worried about:

■ Radon — Because of its insidious nature and its proven harmful effects, this colorless, odorless, radioactive carcinogen should be everyone's priority.

Radon, which comes from the natural breakdown of uranium in the soil, has always been there. It's just that outside in the open air it is diluted to the point of being harmless.

But the gas can seep into houses. And once trapped inside, it can accumulate to dangerous levels. In fact, scientists now estimate that it is a leading cause of lung cancer, second only to cigarette smoking.

Home inspection services don't normally test for radon, but most will perform the service at an extra charge. Or you can do it yourself.

A short-term test kit, which runs $15 or so, will allow you to find out quickly if there might be a problem. If it shows questionable results, a longer test of several months duration is in order.

■ Asbestos — Most often associated with commercial buildings, asbestos is a durable, fibrous, noncombustible material that also can be found in houses, especially older ones. And like radon, it is highly carcinogenic.

While products containing asbestos are rarely used in new construction, it has been found in many roofing, flooring and insulating products as well as spackling compounds that were installed before 1972, when asbestos was banned.

Inspection services don't go out of their way to find the material.

If the house has a hot water or steam heating system, look for pipe, furnace and duct insulation that is torn or crumbling. It can release invisible particles which, if inhaled, will remain in your lungs permanently.

It takes a laboratory test to determine if a product contains asbestos. And if asbestos is found, its removal is a task for a trained contractor, not a do-it-yourselfer.

■ Formaldehyde — The use of urea formaldehyde foam, a major source of pollution, is practically nil now. But it was once an important insulating material, especially in mobile and manufactured homes. Formaldehyde also can be found in plywood, particle or fiber board, wall paneling, floors, shelves, cabinets and even furniture.

The gas that is emitted from this material has been linked to nasal cancer in laboratory rats, but it is more likely to affect humans with respiratory problems or allergies. The gas decreases over time, and houses more than a year old pose little threat.

Again, inspectors won't go out of their way to look for formaldehyde, especially because it is so prevalent. But don't let that stop you from at least checking for foam-type insulation.

Look for an opening in an inside wall on the exterior of the house — remove a wall plate and look behind or around the junction box, or take off the panel that covers the main water valve — and search for hardened foam.

Since not all foam is urea formaldehyde, you'll have to cut out a section and have it analyzed.

To test for the gas from other sources, you can hire a contractor or buy a do-it-yourself test kit. But you might not want to bother unless you or a member of your family already suffers from bronchial problems.

■ Water pollutants — The Environmental Protection Agency sets limits on 30 possible water pollutants, but lead is the one nearly everyone is worried about. Also, some byproducts of the chlorine used to disinfect water are known carcinogens.

If the house has a well, by all means, says Austin, have the water tested for both potability and purity.

But if the place is on a municipal system, you probably needn't worry. Most tap water is relatively safe, and plumbers no longer use lead solder to bind pipes together.

■ Combustion gases — Any appliance that burns fuel will give off byproducts of combustion, which can be lethal but more often just cause dizziness and headaches.

Most private home inspectors will be on the lookout for problems.

Frequent causes of combustion contaminants are defective central heating systems in which the exhaust is not vented properly, or cracked furnace heat exchangers.

If the house has a wood stove or a kerosene heater, make sure they, too, are vented. And stop smoking. Cigarettes are a major source of nitrogen oxide and carbon monoxide — and formaldehyde, too.

■ Allergens — Although the microbes and fungi that make one of every six people itch and sneeze often find their way inside, the allergens in most houses are man-made, or at least man-caused.

A common allergen is that created by the stagnant air and water in improperly maintained humidifiers, dehumidifiers, air conditioners and air-cleaning filters.

Other forms of allergens come from storing — and even using — common household cleaners, pesticides, solvents, paints and other chemical products. Dust, too, is a major source of allergic reaction, as are mold and mildew.

■ Chlordane — This carcinogenic chemical was used widely in killing termites before it was banned last year. And it is a perfect example of just how far the pollution scare has gone.

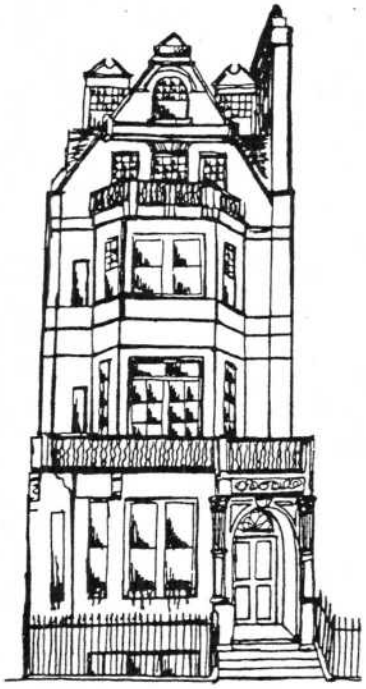
Chlordane, says Austin, is dangerous only when applied improperly, so it should be at the bottom of the pollutant list. "You could almost build an argument for not even mentioning it," he says. "The incident rate is very low compared to the other pollutants."

FOOTNOTE: If you want to check a house for pollution before you buy it, add a contingency clause to your offer that allows you enough time. Otherwise you could lose out to someone who's not as careful.

Also, make sure your contract spells out exactly what will happen if a problem is discovered. Will the seller pay to have it corrected? Or will the he or she give you something off the agreed-upon price to have the work done after

New CPSC Study Report

Indoor air worse than outdoor



Older homes have safer air, materials

Formaldehyde levels in new homes are about the same as in homes insulated with urea formaldehyde foam (UFFI). That bad news surfaced in an Oak Ridge (Tenn.) National Laboratory study that found levels of volatile chemicals in the air in 40 homes – ranging from new to more than 40 years old – were about 10 times those of outdoor levels. And researchers found about 150 different chemicals indoors – compared to 10 or less outdoors – during the nine-month, three-season study that was conducted for the U.S. Consumer Product Safety Commission.

Kailish C. Gupta, project officer for the study, noted in a status report released March 16 that "little attention ...has been paid to the quality of indoor air and especially of residential air."

"Concern about the quality of indoor air derives from the finding that levels of several pollutants (e.g. nitrogen dioxide, carbon dioxide, formaldehyde and other organics) have been generally higher indoors than outdoors, and in many instances exceeded the recommended outdoor exposure standards," Gupta said. "This concern is heightened by the fact that Americans, on the average, spend 65 per cent of their time in their residences and certain subpopulations such as infants, the elderly, and the ill, who are likely to be more susceptible to the effects of pollutants, spend an even greater percentage of their time indoors.

"It has been estimated by the National Academy of Sciences that indoor air pollution may contribute $15 to $100 billion to the national health care costs. The decline in the quality of indoor air has recently become of greater concern because of the recent trend to conserve energy by tightening homes which has resulted in reduced air exchange. Based on these preliminary observations it becomes apparent that there is a need to determine what pollutants we are exposed to in our homes and what hazards they may pose."

Gupta pointed out that little research had been conducted on indoor pollution and more data was needed on such pollutants as "formaldehyde and other volatile inorganics and organics found in the home due to the use of a large number of consumer and structural products such as aerosols, plastics, cleaners, polishes, paints and varnishes. stoves, heaters, furnishings, urea formaldehyde foam insulation (UFFI) and pressed wood products."

Under-five-year-old homes show twice the formaldehyde levels of older homes.

Formaldehyde measures evaluated

Formaldehyde was the focus for much of the project because one of the purposes of the research was to evaluate two formaldehyde measuring devices. Measurements showed summer formaldehyde concentrations in homes of up to five years old were about twice those in homes five to 15 years old and more than three times as high as in homes more than 14 years old.

There was little seasonal variation in older homes, but spring and summer formaldehyde levels in new homes were about twice those in the fall. This indicated heat and humidity play major roles in formaldehyde emissions. Data also indicated formaldehyde concentrations in UFFI homes increased as outdoor temperature increased, hitting a peak level in late afternoon or evening before declining. But levels in homes without major sources of formaldehyde appeared to decrease during the day as occupant activity increased. Such observations tend to make single measurements of formaldehyde meaningless.

The study also measured the effect of increasing air exchange rates by turning on the central fan, or opening a window. Such increases in air exchange did reduce concentrations, but not in proportion to the increased rate.

Gupta speculated that this might be due to increases in emission rates caused by decreases in "background formaldehyde levels."

In addition to the ongoing formaldehyde measurements, the 40 homes also were monitored once during spring and summer and again in the winter to determine levels of volatile organic chemicals. The 24-hour samples turned up from 20 to more than 150 "volatile organics" which included benzene, toluene, naphthalene and others capable of causing everything from leukemia to depression of the central nervous system.

Gupta said sampling procedures were not capable of quantifying "highly volatile organics" which "may actually be of greater toxicological concern than the less volatile."

"These include halogenated hydrocarbons such as methylene chloride as well as lower molecular weight aldehydes and monomers that may be released from plastics and resins," Gupta said.

But experiments to determine a practical way to deal with highly volatile organic chemicals were conducted. One experimental method pointed to a car in an attached garage as a major source of the dangerous chemicals.

Because three out of four of the homes had electric heat, there were few particulates measured. But Gupta said winter data were being analyzed. Since nearly every home had a wood burning fireplace or stove, winter results could be significant.

TVA country

Nearly all of the homes had central air-conditioning. Turning on the heating, ventilation and air conditioning system (HVAC) nearly doubled the number of air exchanges per hour.

"The major contribution to the air exchange rate by the HVAC system is to decrease the concentrations of most pollutants in the home during use," Gupta said "The effects of meteorological conditions on the air exchange rate of the houses require further analysis."

Attached garages, standard in new homes, contribute to indoor pollution

Because the study was conducted in TVA country, natural gas – considered by many clinical ecologists as the number one source of many patient problems – was not much of a factor. Only two homes had gas ranges, for example. But most of the homes had attached garages which, according to the preliminary study, probably means you're better off getting wet than driving your car into your house.

The study, which marks the first time that a government agency looked seriously into indoor air pollution in homes, continues. More reports are due this year, targeting "specific pollutants and/or specific sources of these pollutants for detailed evaluation and health hazard evaluations."

HAZARDOUS WASTE NEWS #43

From RACHEL: Weekly news and resources for citizens fighting toxics -- September 21, 1987

INDOOR AIR IS MORE CONTAMINATED THAN OUTDOOR AIR; HOMES AT RISK

Why is it important to reduce the use of hazardous materials (as distinct from reducing hazardous wastes)? Here's one compelling reason: Indoor air pollution is a greater source of exposure to hazardous chemicals than is outdoor exposure, even if you live near major "point sources" of pollution, according to a careful study by the federal Environmental Protection Agency (EPA).

From 1979 to 1985, EPA researchers studied the outdoor air, the indoor air, and chemicals carried on the breath of 355 individuals living in the [heavily industrialized] Jersey City-Bayonne part of New Jersey, in [not so industrialized] Greensboro, North Carolina, and in [not industrialized] Devils Lake, North Dakota.

The EPA looked for 20 chemicals in all these locations and they found 11 of them at all locations. This is known as the TEAM [Total Exposure Assessment Method] Study and it was carefully done; about 5000 samples were taken in all, 1500 of them taken to provide quality control checks on the data.

Participants in the study wore a small, battery-operated pump pinned to a vest; the pump drew in air close to the subject's face, providing a good measure of the quality of the air a person was breathing. At night the pump was placed on the bedside table (providing a measure of indoor air). Other pumps were placed in peoples' back yards or side yards, providing measures of outdoor air. At the end of each day, each person's breath was sampled. Thus the study provided data on (a) personal air; (b) indoor air; (c) outdoor air; and (d) breath.

In New Jersey, 11 hazardous chemicals could be measured consistently in breath and air samples. The chemicals are 1,1,1-trichloroethane, p-xylene, ethylbenzene, tetrachloroethylene, o-xylene, p-dichlorobenzene, chloroform, trichloroethylene, and carbon tetrachloride. Averages (medians) for personal air exceeded outdoor averages for every chemical in every season, usually by a factor of 2 to 5. This means that, in a typical day at work and at home (combined), people breathed in 2 to 5 times as much hazardous chemical as they would have if they had sat in their back yards for 24 hours. This was true even if the people lived within a mile of a source of industrial air pollution.

In NJ, the night-time readings (indoor air) exceeded outdoor air concentrations in 28 out of 30 cases.

In North Carolina and North Dakota the results are even stronger (because in NC and ND the outdoor air is cleaner): in 17 out of 18 cases, personal air exceeded the levels found in outdoor air, usually by a factor of 5 to 10.

The chemicals on peoples' breath were closely correlated with their activities of the previous 12 hours. People had chloroform (a carcinogen) on their breath if they were exposed to chlorinated water (through drinking, showering, bathing, washing clothes and dishes).

Other factors causing increased exposure to chemicals:

Occupation: Employment in plastics, wood processing, service stations/garages, painting, textiles, metals, scientific laborat

WELCOME TO NEW READERS

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ories, dye plants and even hospitals were associated with significantly increased exposure to 9 of the 11 chemicals.

Home characteristics: living with a smoker or a chemical plant worker increased the exposure of everyone in the home.

Common daily activities: pumping gasoline (filling one's gas tank) or visiting a service station; visiting a dry cleaner; keeping moth crystals or room deodorizers in the home; furniture refinishing; painting; scale model building; using pesticides; smoking; traveling in a car--were all associated with increased exposures to one or more of the 11 chemicals.

Specific exposures are as follows: smokers (and those living with smokers) have elevated levels of benzene, styrene, ethylbenzene and p-xylene on their breath. The sidestream of a cigarette provides much more benzene than does the smoke inhaled by the smoker (240 micrograms per cigarette in the sidestream vs. 35 micrograms in the mainstream). About 60% of U.S. children live in homes with smokers and are thus exposed to benzene, a cause of leukemia. Children with one parent smoking have a doubled risk of leukemia; with both parents smoking the risk of leukemia is increased five-fold (compared to children of non-smoking parents).

Chlorinated water causes indoor air in New Jersey to have four times as much chloroform as outdoor air.

A person visiting a dry cleaner for five minutes has twice as much tetrachloroethylene (PCE) on his or her breath, compared to a person avoiding such a visit. PCE levels in dry cleaning shops are very high.

Moth crystals and room deodorizers are intended to maintain high levels of p-dichlorobenzene in homes, so no one should be surprised that they succeed. Recently p-dichlorobenzene was determined to be a carcinogen. In homes using moth crystals or air deodorizers, p-dichlorobenzene levels are 25 times higher than in outside air (in NJ).

What can be done to reduce exposures to chemicals in the home and at work? Consumers can purchase less of the offending products (moth balls, for example); citizen pressure can force manufacturers to reduce their use of hazardous chemicals; citizen pressure can force government agencies to adopt standards for building materials (for example, particle board is today loaded with formaldehyde, a carcinogen); and ventilate the place better. Programs to force waste reduction will help little, if at all.

The TEAM study results appeared in the scientific journal Environmental Research, Vol. 43 (1987), pgs. 290-307.

GAO FINDS FEDERAL AGENCIES SLOW TO PLAN CLEANUP OF THEIR TOXIC DUMPS

The federal General Accounting Office (GAO) has issued a 36 page report, Superfund: Civilian Federal Agencies Slow to Clean Up Hazardous Wastes [GAO/RCED-87-153], which says federal agencies have so far found 1,882 hazardous waste sites on their property but have evaluated only half of them. Most agencies are still looking.

The report is available free from GAO, DHISF, P.O. Box 6015, Gaithersburg, MD 20877; phone (202) 275-6241.

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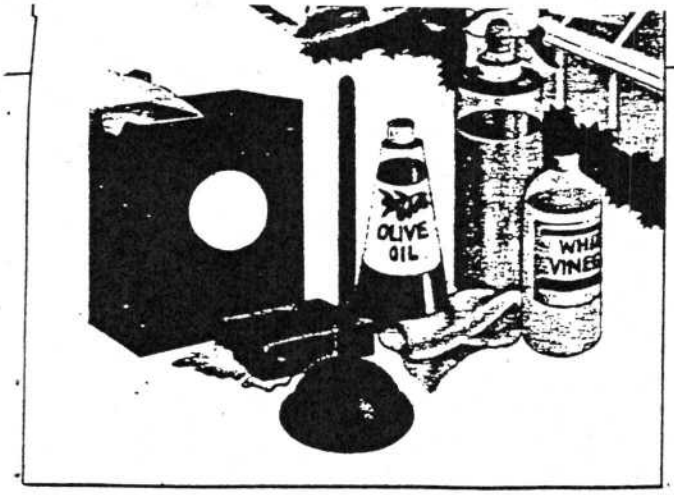


FIGHTING HOMEMADE POLLUTION

INDOOR

Your guide to nontoxic home maintenance—Sharon Faelten

Sharon Faelten's most recent book is The Allergy Self-Help Book. *(Emmaus, PA: Rodale Press, 1983).*

When it comes to taking care of our homes, sometimes we are our own worst enemies. With the best of intentions, we clean our ovens, wax our floors, refinish our furniture, cook our dinners, fire up our woodstoves, switch on our air conditioners, vacuum our rugs, and struggle to keep our lawns and gardens weed-free.

Unfortunately, all of these efforts and many others contribute to an invisible, often odorless mist of pollution trapped inside our squeaky-clean castles.

The resulting effect on health is hard to measure precisely, but researchers are convinced that indoor air pollution is responsible for a variety of ills, from persistent sniffles, headaches, dizziness, diarrhea, rashes, and abdominal and chest pains to outright poisoning and lung cancer.

Consider the specific effects of two common gaseous pollutants: carbon monoxide and nitrogen dioxide (their primary sources indoors are gas stoves, heaters, and clothes dryers). Carbon monoxide (CO), a colorless, odorless gas, combines with hemoglobin in the blood to form carboxyhemoglobin (COHb), which interferes with oxygen absorption. Inhaled in large quantities, CO is fatal. But the gas is harmful even at the lowest levels. Some people with the heart condition angina pectoris suffer discomfort when blood levels of COHb are as low as 1 percent.

Nitrogen dioxide (NO_2) is associated with pulmonary edema, bronchoconstriction (a respiratory problem), and increased chances for infections of all types. Yet air-quality research teams have routinely measured NO_2 levels as high as 700 micrograms per cubic meter in kitchens with unvented gas stoves and in other areas with unvented kerosene or gas heaters—compared with outdoor levels of only 15 micrograms per cubic meter.

Poor ventilation—especially in closed-up, winter environments—can also lead to health problems. It fosters the growth and reproduction of bacteria and other microorganisms, particularly in wet areas such as bathrooms or basements; as a result, your chances of catching the flu or other upper-respiratory illnesses increase.

But indoor air pollution is by no means confined to the cold-weather heating season. In fact, pollutants of all types accumulate most heavily in the "shoulder seasons"—spring and fall—when the air is humid, and the furnace doesn't kick on for as long or as often as it does in the dead of winter, when it serves to dry out and circulate air. (Formaldehyde and other pollutants cling to moisture like iron clings to a magnet.)

Right outside our homes there are more problems. Chemical weed killers and pesticides, spread on the lawn and garden to wipe out unwanted plants and insects, kill because they're strong poisons. These potent compounds can leach into well water or, if sprayed on trees, enter your house through open windows. Pesticides and herbicides are usually stored indoors, adding to the stockpile of pollution sources.

Fortunately, there are numerous simple, practical steps you can take to reduce this sinister cloud of homemade air pollution, as the accompanying chart shows.

First of all, take stock of unnecessary sources of pollution in your home. In one experiment, 13 noxious chemicals were detected in a room after a single product—scented oven cleaner—was used. Add in the number of other high-tech cleaning aids stashed in the broom closet, and you get an idea of the magnitude of the problem. But when you read our chart, you'll start to see how many of these polluters you can easily do without.

Tossing out many of those exotic cleaners will save you money, too. Often, a few simple products such as soap, vinegar, baking soda, ammonia, washing soda (sodium carbonate), and borax can do the job of a closetful of more complicated formulas.

The workshop, too, can be a miniature chemical warehouse. Don't hoard half-empty cans of volatile paints, solvents, and cleaners. When you finish a job, clean the area immediately—and throw out what you don't expect to use in the near future. And always ventilate well, with a fan, when you use hobby products.

It's also a good idea to air out the entire house regularly, winter *and* summer. If you can't bear to let heat paid for with expensive petrodollars drift away into the stratosphere, your next best bet is to install an air-to-air heat exchanger.

Your house can be "home, sweet home" again if you know what you're up against and how to fight back. ■

In the push to make our homes airtight fortresses against the weather, we are locked in a dangerous new enemy: indoor pollution.

It has many sources: building materials, insulation, carpeting, furniture, unvented gas appliances. We make matters worse by setting loose all kinds of pollutants in and around our homes - toxic cleaning products, paint strippers, pesticides, herbicides and more, and by most reports, the quality of the water that flows through our taps is also declining.

CLEAN is starting a series of articles which were contained in NEW SHELTER magazine special report, November, 1984. These articles address the sources of indoor pollution you might not be aware of. Even more important, it presents solution to the problem. "Fighting Homemade Pollution" arms you with detailed information about the safest ways to keep your home clean, bug-free and healthy. In "Cleaning the Air", we show you how to find - and fix- your home's air polluting troubl spots. For those of you who will be buil ing new homes, "A Clean Start" gives step by-step instructions for creating a nontoxic home from the ground up - for littl more than the cost of a conventional home In "Pure Solutions" you will learn how to evaluate and improve your drinking water with minimal fuss and expense. Finally, the lists of resources and further reading provided with these articles will help you along the road to a healthier and happier home.

NONTOXIC HOME MAINTENANCE GUIDE

	Pollutants that may be emitted	Precautions, solutions, or alternatives	Comments
Cleaning Products and Activities			
Aerosols (*see also* air fresheners and deodorizers, disinfectants and germicides, oven cleaners, and pest and weed control)	hydrocarbons (petroleum distillates), including butane, isobutane, propane, and possibly methylene chloride; nitrous oxide	Use pump-spray or other nonaerosol versions of cleaning and grooming products. For example, use cream, stick, or roll-on deodorants; use liquid, paste, or powder oven cleaners.	Ingredients in aerosol products are not always disclosed on the label. The small size of aerosol-propelled particles makes it possible for them to be inhaled deeply into the lungs and quickly absorbed into the blood. Aerosol mists act like magnets for radon-decay products, carrying any radon in the air with them into the lungs. The problem is exacerbated when aerosols are used in closed spaces, such as bathrooms and workshops.
Air fresheners and deodorizers	formaldehyde	Open a window, or use an exhaust fan—or do both. Sprinkle baking soda in odor-producing areas. Place an open box of baking soda in the refrigerator to absorb food odors.	Air-freshener products don't really "freshen" the air; they deaden our sense of smell or counteract one odor with another.
Carpet deodorizers	formaldehyde	Sprinkle baking soda over the entire carpet. Use approximately 1 cup per medium-sized room. After 30 minutes, vacuum.	Baking soda will absorb smoking, cooking, and pet odors that settle into the carpet. (Do not put baking soda on a damp carpet.)
Carpet and rug shampoos	naphthalene, sodium lauryl sulfate, turpentine, 1, 1, 1-trichloroethane, and petroleum distillates	Make your own carpet shampoo: Mix ½ cup mild liquid dishwashing detergent with 1 pint boiling water; let cool. Whip the paste into a stiff foam using an electric mixer. Apply it to the carpet with a damp sponge. Rub gently. Work in 4 × 4-foot sections. Wipe off the suds with a clean cloth. To rinse, add 1 cup of white vinegar to 1 gallon of lukewarm water. Rinse each section and wipe the carpet dry as you go. Change the rinse solution frequently.	Clean the carpet on a dry, sunny day with the windows open to speed drying. Don't soak the carpet—it may mildew. Test any shampoo first on an inconspicuous area, to prevent discoloration.

continuec

	Pollutants that may be emitted	Precautions, solutions, or alternatives	Comments
Disinfectants and germicides	cresol, phenol, and related chemicals	Wash items with soap and water, or with borax or sodium carbonate (washing soda) in water.	Chemically sensitive people often react to phenols and other chemicals in disinfectants.
Drain cleaners	hydrochloric acid, potassium hydroxide (lye), sodium hydroxide (caustic soda)	Prevent clogging by covering drains with a screen to keep out grease, food scraps, hair. To loosen blockage, use a rubber plunger or plumber's "snake" (or both). Follow up by pouring 1 cup of salt, 1 cup baking soda, and 1 cup vinegar down the drain. Flush with 2 quarts boiling water.	If you use a commercial chemical drain opener that fails to work, you'll be left with a drain clogged with a highly caustic compound.
Floor wax and wax strippers	turpentine and other fumes	To polish linoleum and vinyl floors without commercial wax: Mix 1 part thick boiled starch with 1 part soap suds. Rub the mixture on the floor, and polish dry with a clean, soft cloth. To remove old wax: Pour a small amount of club soda on a section of floor. Scrub in well; let soak for a few minutes, then wipe clean.	People who are sensitive to fumes and odors have been known to suffer headaches or other discomfort after exposure to fresh floor wax.
Furniture polish (solvent type)	petroleum distillates	Use olive oil, 100 percent lemon oil, beeswax, or beeswax and olive oil.	
Oven cleaners	potassium hydroxide (lye), sodium hydroxide (caustic soda), perfumes	Wipe away grease and spills after preparing each meal. Wipe away charred spills with a nonmetallic bristle brush. To remove baked-on grease and spills, sprinkle with dry baking soda; scrub with a damp cloth after 5 minutes. (Don't let baking soda touch wires or heating elements.) Scour racks and burner inserts with steel wool.	Aerosol oven cleaners are among the worst contributors to indoor air pollution. People with asthma, chronic bronchitis, and other respiratory problems are particularly susceptible to fumes of strong oven cleaners. No matter how thoroughly you try to rinse these cleaners, a residue remains that begins to emit additional fumes the minute you heat the oven again.
Spot removers	ammonium hydroxide; amyl, butyl, and ethyl acetate; benzene; naphtha; sodium silicofluoride; 1, 1, 1-trichloroethane	For butter, coffee, gravy, or chocolate stains: Sponge up or scrape off as much as possible, immediately. Dab with a cloth dampened with a solution of 1 teaspoon white vinegar and 1 quart cold water. For stains that have set, try a dab of full-strength white vinegar. Or put paper towels underneath to blot, and apply a solution of equal parts ammonia and water. (If an ammonia stain remains, blot it with a solution of table salt in water.)	Taking care of spots immediately, with nontoxic compounds, avoids a trip to the dry cleaners. Commercial dry-cleaning agents such as perchloroethylene and tetrachloroethylene may cause lightheadedness, dizziness, and other central-nervous-system symptoms.
Home Workshop and Hobby Products			
Paint, oil-based	various solvents and hardening agents	Use water-based paint whenever possible. Seal all paint cans with a tight-fitting lid.	Ingredients in oil-based paint may cause flulike symptoms when inhaled
spray	methyl chloride, toluene, xylene	Use nonaerosol paints.	(See comments under aerosols)
Paint strippers, glues and adhesives, turpentine, varnish, lacquers, auto-body-repair compounds	volatile fumes from various solvents; toxic chemicals, such as methylene chloride (Paint strippers made before 1978 may contain benzene, which probably causes cancer.)	Use outdoors or in a very large room with a steady current of dry (not humid) air. Ventilate well: Open all windows and the door, *and* use a large exhaust fan to blow fumes out. Wear a paper filter dust mask when grinding or sanding. Use a dust attachment on power tools. Clean up dust and filings with a vacuum cleaner, not a broom. Don't soak brushes in solvents. Clean them immediately, and soak them in plain water or soap and water. Always wear protective goggles, gloves, and a work apron. Separate the work area apart from the living space as much as possible. Never pour leftover solvents down the drain, flush them down a toilet, or dump them into a storm sewer. They will leach into the drinking-water supply. Call your public-health or sanitation department to find out if there's a local disposal program.	Solvents used in furniture refinishing can cause headaches, drowsiness, blurred vision, impaired motor response, and chemical intoxication. Paint solvents are of particular concern to people with heart conditions and those who wear contact lenses because methanol and certain other solvent compounds can stress the heart, and contact lenses absorb strong vapors and hold them against the eye, causing irritation or eye damage.

continued

	Pollutants that may be emitted	Precautions, solutions, or alternatives	Comments
Pest and weed control	aldrin, arsenic trioxide, carbon disulfide, chlordane, cryolite, dimethyl dichlorovinyl phosphate (DDVP; a nerve poison used in flea collars and "pest strips"), dieldrin, heptachlor, hydrocyanic acid gas, lead arsenate, methoxychlor, methyl bromide, nitrosamines, paradichlorobenzene, parathion, sodium arsenate, strychnine	Spray plants with nonchemical compounds. Examples: Spray with a soap-and-water solution (3 tablespoons of soap per gallon of water) for aphids, mealybugs, mites, and whiteflies. Spray with pyrethrum, a product of a type of chrysanthemum, to control caterpillars, beetles, aphids, mites, leafhoppers, thrips, moths, and dozens of other fruit and vegetable pests. Introduce other predatory bugs, such as soldier bugs, ladybugs, damsel bugs, pirate bugs, spiders, lacewings, and gall midges to control unwanted pests. Use bacterial pesticides, such as *Bacillus popilliae* for Japanese beetles and *B. thuringiensis* for many types of insect larvae. Interplant with pest-repellent plants: marigolds, coriander, thyme, yarrow, rue, and tansy. Indoors, dispose of garbage to avoid attracting ants. Use flypaper and flyswatters. Discourage roaches with a mixture of 2 tablespoons flour, 1 teaspoon cocoa, and 4 teaspoons borax. Place on small sheets of paper in corners, nesting places, and near moldings. To control fleas on dogs and cats: Bathe animals every 2 to 4 weeks with pet shampoos containing insect-repellent herbs such as rosemary, rue, eucalyptus, and citronella. For termites, ask exterminator to use organophosphates, such as chlorpyrifos (Dursban T.C., by Dow).	All chemical sprays and even many of the organically approved botanical sprays are toxic to people. Some chemical sprays cause cancer. If you decide to use chemical pest- and weed-control products anyway, dispose of leftovers properly to lessen the impact on the air and water supply. Store *all* insecticides and herbicides under lock and key, to prevent accidental poisoning in children.
Heating and cooling systems			
Air conditioning (poorly maintained)	molds, dust, and disease-causing microorganisms; refrigerant gases (mainly fluorocarbons)	Clean reservoirs regularly with detergent or a hydrogen peroxide solution. Central unit: Clean or replace filters (usually located in furnace) before cooling season and periodically thereafter. Have the ductwork vacuumed regularly. Room unit: Clean the filter (located behind the air-intake grille on the front) once a month during periods of heavy use. Vacuum dust and lint from the condenser and evaporator yearly. Have the system checked for leaks periodically.	Air conditioners recirculate indoor air, thereby lowering the rate of indoor–outdoor air exchange. Legionnaire's disease (*Legionella pneumophila*) is a well-known example of air-conditioning-related bacterial illness.
Coal-burning stove or furnace	benzo [a] pyrene and polycyclic organic compounds (POMs), polycyclic aromatic hydrocarbons (PAHs)	Install air-filtration equipment. Burn hard, not soft, coal.	Because benzo [a] pyrene and POMs cause cancer at high levels of exposure, scientists are concerned that those pollutants may pose a risk at low levels, too. Hard coal burns "cleaner" than soft coal.
Forced-hot-air heating system	dust, nitrogen dioxide (in gas furnace systems)	For dust: Check the air filter. If it's metal, remove and hose it off or scrub it once a month. If disposable, replace it every two months during the heating season. Place all-metal or cloth filters over duct openings to rooms. Have furnace and ductwork vacuumed by a professional furnace-cleaning company once a year, just before heating season. Check for leaks, a cracked heat exchanger, or a blocked flue.	Performing routine maintenance on furnaces and heating systems helps to cut down on air contamination, no matter what type of fuel the system uses.

continued

	Pollutants that may be emitted	Precautions, solutions, or alternatives	Comments
Woodstove	nitrogen dioxide, benzo [a] pyrene	Burn hot fires (300° to 400° F). Adding firebrick and having a draft opening to the back center of the stove can help to raise stove temperature without increasing the amount of wood burned and therefore the amount of pollution produced. Burn raw, untreated wood only, not scraps of creosoted or treated lumber. If the stove has a blower, vacuum and clean it, or replace the filters before the first fire of the season (or 3 days after the last fire).	*In general*, hotter fires produce less pollution. However, this tendency varies from stove to stove. Stoves with low cross-draft baffles seem to produce far less pollution than stoves without baffles or with inclined or horizontal baffles, according to one study. Woodstoves need a good supply of combustion air for safe and efficient operation in superinsulated homes.
Appliances			
Clothes dryer (gas)	carbon monoxide (CO), nitrous oxide (NO), nitrogen dioxide (NO_2), hydrocarbons (including benzene and acetylene)	Vent outside, or replace with an electric dryer.	*See* stove (gas), below, for comments on health effects of unvented gas appliances.
Stove (gas)	carbon monoxide (CO), nitrous oxide (NO), nitrogen dioxide (NO_2), sulfates, hydrogen cyanide, aldehydes	Vent exhaust outside. (A recirculating range hood isn't adequate.) Ask the gas utility company to extinguish the pilot light; light the stove with a match or flint striker instead.	Pollution from an unvented gas appliance can cause respiratory distress and aggravate angina pectoris in people with heart disease. It is also responsible for a variety of allergic complaints, from fatigue, irritability, and headaches to asthma, nausea, and joint pains.
Vacuum cleaner (dust-bag-equipped)	dust (including highly allergenic animal dander and insect particles)	Replace with a water-trap vacuum cleaner, or install a central vacuum-cleaning system, and vent the exhaust away from living quarters.	Water-trap vacuum cleaners collect dust in water instead of an airbag. They do not vent dust back into the room via the exhaust hatch and are, therefore, cleaner to use. Water-trap vacuum cleaners are also more powerful, picking up more dust to begin with. They are highly recommended by allergists for people with asthma and other allergies..
Water softener	lead, cadmium (leached from pipes), sodium	Hook the softener up to the hot-water supply only, and use the cold-water tap for drinking and cooking. Use only if the water is very hard (20 grains per gallon or higher).	Soft water leaches heavy metals out of pipes because it's more acidic. Lead disrupts normal production of hemoglobin in blood. Low levels can lower one's ability to fight off infection. Heavy exposure leads to nerve disorders. Cadmium buildup can lead to high blood pressure, kidney disease, and iron-deficiency anemia. Overconsumption of sodium often leads to high blood pressure in susceptible people.
Cigarette Smoking			
Tobacco smoke	over 1500 chemicals, including acrolein, aldehydes, aluminum, benzo [a] pyrene, carbon monoxide, formaldehyde, hydrocarbons, hydrogen cyanide, nitrites, phenols, pyridines, and sulfur	Install air-filtration equipment. Ventilate the house as much as possible. If you smoke, think about quitting. If visitors to your home ask if they can smoke, don't be afraid to say no.	If no one in your house smokes, you are automatically avoiding one of the biggest contributors to indoor pollution and one of the biggest known threats to health and life. Cigarettes are responsible for more cases of lung cancer than all other sources of pollution combined. Cigarette smoke also contributes to heart disease, emphysema, and bronchitis and triggers severe reactions in asthmatics and other people with respiratory allergies. In some ways, this is the easiest source of pollution to eradicate; in other ways, it's the hardest.

FOR FURTHER READING

The Household Pollutants Guide by the Center for Science in the Public Interest. Garden City, NY: Anchor Books, 1978

Clean Your House and Everything in It by Eugenia Chapman and Jill C. Major. New York: Grosset and Dunlap, 1982

The Encyclopedia of Natural Insect and Disease Control, Roger Yepsen, Jr., ed. Emmaus, PA: Rodale Press, Inc., 1983

The Household Environment and Chronic Illness by Guy O. Pfeiffer. Springfield, IL: Charles C Thomas, 1980

"Indoor Air Pollution: A Public Health Perspective," *Science*, July 1983

"The In's and Out's of Air Pollution," *Technology Review*, August/September 1982

"A Test of Small Air Cleaners," NEW SHELTER, July/August 1982

"Clean Water at Your Tap," NEW SHELTER, October 1983

Science for Measuring Indoor Pollutants Advances

Improved Instrument Can Measure Smaller Degrees of Exposure to Organic Substances

The technology of measuring indoor air pollution has leaped ahead in the past decade, growing along with scientific interest in the subject, according to Environmental Protection Agency officials, private consultants and published research papers.

The basic instrument to measure concentrations of volatile organic compounds—emitted from solvents, cleaning fluids or dry-cleaned clothing, among other things—is a chromatograph, a device that uses a neutral gas to push the compound through a looped tube that is coated with a material called adsorbent that attracts it.

The rate at which the compound moves through the tube—translated by a detector into a standard peak-and-valley chart—tells the researcher how much is there and confirms what substance it is. The most sensitive can detect quantities down to the picogram, essentially one part of material per billion parts of air.

The chromatograph has been around since the 1950s, but it has been used for indoor air pollution only in the past decade, with the development of synthetic adsorbents suited to organic compounds.

Improvements in the chromatograph's analysis capabilities have made possible the development of portable monitors, which collect cruder data than bulkier fixed machines but come closer to duplicating real-life conditions.

In 1984, the engineering lab at the EPA's Research Triangle, N.C., office developed a prototype portable monitor the size of a silver dollar to record personal exposure to organic substances.

This year, EPA will publish results of a study in which Baltimore housewives wore newly developed portable monitors to measure their exposure to nitrogen oxide while cooking with gas stoves.

Another portable tool is a total organic analyzer that gives a rough reading of the overall amount of chemicals in a room. Made possible by the development of microcircuitry for the space program, it works by breaking up organic substances into electrically charged ions and measuring the energy that breakup causes the substances to give off.

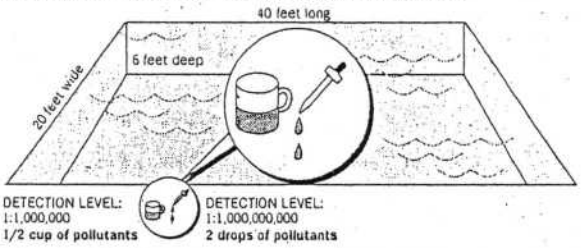
Some new devices have only limited use. When EPA scientists wanted to measure the amount of chloroform released when people took hot showers, they devised a gadget that could take 12 rapid sequential air samples without clogging up because of high humidity.

The chromatograph is useful when scientists have a rough idea of what they are looking for, but an even more sophisticated analysis tool is the mass spectrometer, which is better known for its use in drug testing. An invention of the 1970s, it breaks materials into atomic fragments that can be matched, like fingerprints, to the compounds in them. In an EPA study of 10 public buildings released last year, the mass spectrometer found that a typical air sample contained 100 to 200 chemical compounds.

— D'Vera Cohn

INCREASING DETECTION LEVELS

In a swimming pool measuring 40 feet long by 20 feet wide by six feet deep, at a detection level of one part per million (1:1,000,000), 1/2 cup of pollutants could be detected. At one part per billion (1:1,000,000,000), 2 drops of pollutants could be detected.



YEAR	DEGREE TO WHICH POLLUTANTS CAN BE DETECTED
1950	ONE PART PER MILLION (1:1,000,000)
1960	ONE-HALF PART PER MILLION (0.5:1,000,000)
1965	ONE PART PER BILLION (1:1,000,000,000)
1975	ONE PART PER TRILLION (1:1,000,000,000,000)
1983	ONE PART PER QUADRILLION (1:1,000,000,000,000,000)

BY TOBEY—THE WASHINGTON POST

Indoor Air

In Fight Against Pollution, The Frontier Moves Indoors

Dry Cleaning, Copiers May Pose Hazards

By D'Vera Cohn
Washington Post Staff Writer

Workers at the Library of Congress' Madison annex have been complaining of headaches, sinus problems and skin rashes ever since the white marble structure that is Washington's second largest office building opened in 1981.

This month, three federal agencies are embarking on a half-million-dollar detective project to find out whether and, if so, how the building is making the employees sick.

The enterprise will employ questionnaires, use sophisticated measurement methods that in some cases did not exist a decade ago, and try new techniques that could add to the recent and sometimes uncertain science of assessing indoor air pollution. Results may not be known for a year.

The study "will be an example for other agencies and private industry all over the country," said Nancy Bush, a library spokeswoman.

It is a unique venture, but so is much of the work being done on indoor air quality. The topic is so new that there is a lot of information on the prevalence of many pollutants, but no agreement on what levels are safe.

In addition, the private consulting industry, which is largely unregulated, is growing so quickly that some express concern about shoddy work.

"We're just surveying the issue right now," said Michael Berry, manager of the Environmental Protection Agency's indoor air research program in Research Triangle, N.C. Assembling a solid base of information, he said, will require "lots of dollars and about half a decade."

A few indoor pollutants, such as asbestos and tobacco smoke, have been amply studied, and there is scientific consensus on their dangers. However, little is known about the bacteria that grow inside heating and cooling systems, or of the effects of low levels of so-called volatile organic compounds emitted from typewriter correction fluid, cleaning materials, carpet adhesives, moth cakes and other such products. In the middle are substances that are known to be toxic in large doses—ozone for example—but whose lesser-level indoor effects are uncatalogued.

One reason the science is so new is that the issue of indoor air quality was not recognized until the energy crisis of the 1970s prompted construction of airtight buildings that trap pollutants and encourage cost-conscious building managers to turn down ventilation. In other cases, the problem stems from products such as photocopying machines and portable humidifiers not widely used until recently.

Much of the technology underlying the science is of recent vintage. It was not until 1981 that federal researchers, using newly developed monitors small enough for people to wear, could prove that some people are exposed to higher levels of pollutants indoors than outdoors. It was only in the 1970s that synthetic materials were developed making it easier to test for chemicals where only one molecule is present in every billion molecules of air—an important advancement because indoor chemicals often are present only at such low levels.

One frontier of indoor pollution research is going on behind the doors of a ranch house a few miles from Berry's office. The garage and house are filled with devices to measure the products of everyday life.

Federal scientists are using the unoccupied house rented by EPA to test the real-life dispersion of substances such as nitrogen dioxide and carbon monoxide, given off by kerosene heaters; perchloroethylene, a chemical that is emitted in low levels by dry-cleaned clothing and causes cancer in animals; and organic compounds released by hair spray and other personal care aerosol products.

They also are using it to design a computer program to map the flow of air and pollutants to predict the path a substance will take through a home without running a cumbersome experiment.

And it is cumbersome. To study the "perc" in dry-cleaned clothing, researchers hung a man's two-piece wool-blend suit, a woman's wool skirt and two polyester blouses—jokingly called an "EPA standard load"—in a closet, then sampled the fumes the clothes gave off over three weeks depending on whether the plastic wrapping was on or off, or the clothing had been aired out for a few hours. It took 12 weeks to run four scenarios.

The tests found no significant difference in chemical emissions under different conditions. "What we found was it doesn't matter much what the homeowner does once it gets home," said Merrill Jackson, who oversees research at the EPA house.

Ken Giles of the Consumer Product Safety Commission, which ordered the research, said the agency is encouraging cleaners to improve their processing to remove more of the distinct-smelling chemical.

The safety commission also is negotiating with kerosene heater manufacturers for a voluntary standard on nitrogen dioxide emissions. In keeping with a Reagan administration philosophy, the agency will promulgate mandatory standards only when voluntary ones fail.

Other federal agencies have mandated asbestos standards, and there are recommended government

standards for radon, as well as private industry guidelines for adequate ventilation, temperature and humidity in buildings. A few products, such as paint strippers, carry federally mandated warning labels.

There are occupational standards for some chemicals, but they are designed to protect factory workers. Many researchers and consumer groups think they are inadequate for the more sustained but lower level exposure of less brawny office employees to a mixture of compounds.

To answer the question of what happens when people are exposed to low levels of a lot of substances, an EPA lab in Chapel Hill, N.C., is testing the impact of 22 commonly used chemicals on the memory and breathing passages. Students will sit in a room-sized steel chamber infused with the witches' brew for several hours, after which they will be given memory tests and have nasal passage cell samples taken.

None of the chemicals is known to cause human cancer, and all will be present in one-tenth the amount that industrial standards allow.

Most EPA officials believe the government is not likely to set recommended ceilings on exposure to any one chemical, though some believe there might be guidelines for overall chemical exposure.

Some experts, concluding that stale air is the biggest culprit, say that cleaning the ventilation system and turning up the air flow will take care of most problems. But some environmental activists are pressing for more.

Earon Davis, an environmental health consultant who publishes a newsletter on indoor pollution, said he believes there should be standards for individual products, standards for overall chemical exposure and special efforts to protect a growing minority of workers who are particularly chemically sensitive.

"There is some baseline level we can set that will protect the majority of people," he said. "But there also has to be a second system to deal with those with unusual sensitivities," a group he estimates equals up to 15 percent of the work force.

Not only is there an absence of national standards for many pollutants, but there also is little government accreditation of laboratories doing the work, aside from some regulation of asbestos removal companies and EPA-sponsored training of radon detection firms. The best advice, experts say, is to look for firms that have good references and a long track record.

Even that may not be enough. When Public Citizen, a group founded by Ralph Nader, conducted an accuracy test of radon testing firms, three out of seven of the nation's largest home detection companies failed—meaning they were off by more than 25 percent in detecting the amount of radon in an exposed canister.

The firms all had passed a similar EPA screening, but the Public Citizen canisters were sent anonymously, whereas the laboratories knew which testing devices were from EPA so they could be especially careful in analyzing them, Public Citizen said.

"People go into the stores and see EPA-approved on the label and . . . people do put their faith in that," said Amy Schirmer of Buyers Up, the Public Citizen division that conducted the tests. "That's all right if we trust the EPA test, but we don't."

Partly in response to the Buyers Up study, which was released last month, EPA announced Friday that it will begin so-called blind testing for some of the new applicants for the EPA proficiency rating, though not for firms that already won a proficiency rating.

The indoor testing industry is growing so quickly that it is easy for standards to slip, said Christopher Dyson, the Buyers Up laboratory director. Small companies often do not have a quality assurance officer to make sure proper procedures are followed, he said, and there is so much turnover that at some labs he dealt with two or three people in charge during the year that the radon project took to complete.

"Everyone wants to get into it because supposedly you can make a lot of money," Dyson said.

John McCarthy, president of Environmental Health and Engineering of Newton, Mass., said his firm has been called in to double-check the work of other consultants, and "we find that many times their methods are not state-of-the-art or their interpretations do not follow the most current scientific findings."

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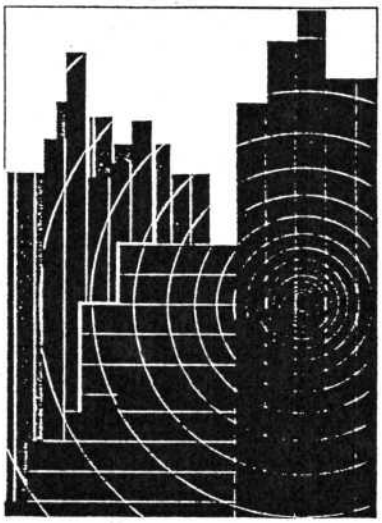
Indoor Air Pollution in the Office



Are you working in a sick building?

When you're at work, do you get headaches? Do you have difficulty breathing? Are you groggy or nauseated? Do your eyes burn? Do you find yourself sneezing or coughing? And do you feel better when you leave the office? If so, there's a possibility that you are working in a SICK BUILDING.

The "sick building syndrome" is a recently recognized phenomenon, and, unfortunately, an increasingly common one. When a significant number of building occupants experience symptoms that do not fit the pattern of any particular illness and are difficult to trace to any specific source, the problem may be "sick building syndrome".

Sick building problems may arise because of improperly designed or maintained heating, ventilating and air conditioning (HVAC) systems; office equipment, furniture and supplies; and operations in the building.

To save rising energy costs, new buildings are tightly sealed and modern ventilation systems recycle a large portion of inside air. Often, fresh air may not reach the worker. For example, use of flexible office partitions in large open spaces can interfere with the air distribution as it was originally designed. Energy costs in older buildings are reduced by adding insulation, caulking, and weather-stripping. Windows are made air-tight, and outside air dampers are closed. Whether a building is old or new, the same recirculated air is breathed again and again by the people working in these buildings.

The problem is made worse by increasing numbers and varieties of pollutants from furnishings; air conditioning, heating and ventilating systems; modern office equipment and supplies; humidifiers and dehumidifiers; and secondhand tobacco smoke.

The result? **Air pollution levels can be far greater indoors than outdoors.**

How big a problem is office air pollution?

A World Health Organization report suggests that as many as 30 percent of new and remodeled buildings worldwide may generate excessive complaints related to indoor air quality. In a nationwide random sampling of office workers, 24 percent perceived air quality problems in their work environments, and 20 percent believed that their work performance was hampered accordingly.

What Are The Symptoms Of Working In A Sick Building?

The effects of office air pollution usually show up first as one or a combination of the following symptoms: stuffy nose, sneezing, dry cough, tightness of the chest, or sore throat. Other symptoms may also appear, including fatigue, headache, nausea, skin irritation, and burning, itching eyes. However, these symptoms may be a result of a variety of causes. Frequently, it is difficult to firmly establish the relationship between the symptoms and the work environment.

This is not the whole story. Germ-caused illnesses — such as Legionnaire's Disease, which can lead to serious infection or even death — are often the result of indoor air pollution.

This brochure suggests some solutions to office air quality problems. Call your local Lung Association for more information.

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What Causes Office Air Pollution Problems?

The major reasons for poor indoor air quality in office buildings are the presence of indoor air pollution sources; poorly designed, maintained or operated ventilation systems; and uses of the building that were unanticipated or poorly planned for when the building was designed or renovated.

Frequently, no single pollutant is present in unhealthy amounts, yet because there are so many pollutants present, the total effect may be unhealthy. **Pollutants most likely to cause problems in the office are:**

Biological Agents

Biological agents are present in the air almost everywhere, and are a common factor in office air pollution. They include bacteria, viruses, fungi, pollen, dust mites and other insects, animal dander (tiny scales from hair, feathers, or skin) and molds. They can travel through the air and are often invisible. They are usually inhaled, either alone or by attaching themselves to particles of dust and then entering the respiratory system.

Major Sources Offices can be especially vulnerable to microorganisms, because fungi and bacteria find nourishment in inadequately maintained air-circulation systems and in dirty washrooms.

Health Effects When biological agents are allowed to flourish in poorly maintained ventilation systems, severe health problems can result that can be experienced throughout an entire building.

Infectious and noninfectious diseases can be caused by various biological agents. They can make you sneeze, trigger allergic reactions, cause rashes, watery eyes, hoarseness, coughing, dizziness, lethargy, breathing problems, and digestive problems.

People with asthma are especially susceptible to allergic problems caused by biological agents. Their very sensitive airways can react to various allergens and irritants, making breathing difficult.

Carbon Monoxide

This odorless gas is a regulated outdoor air pollutant. It can be an even greater hazard indoors. In some office buildings, afternoon levels of carbon monoxide can be 10 to 20 times greater than EPA's daily standard for outdoor air quality.

Major Sources Garages and loading docks in buildings are a major source of carbon monoxide. If improperly vented, or if there is a leak in the duct work, the gas can seep into a building's offices in unhealthy amounts.

Health Effects Carbon Monoxide can produce fatigue, confusion, headache, dizziness, and nausea. It can impede coordination and worsen heart problems. Very high exposures can cause death.

Formaldehyde

Formaldehyde is a commonly used chemical compound found in as many as 3,000 different building products.

Major Sources In office buildings, the major sources of formaldehyde are likely to be particleboard, fiberboard, and plywood in furniture and panelling; glues; and upholstery and drapery fabrics.

Health Effects Exposure to formaldehyde can cause headaches, sore throats, and fatigue. Other health effects can include rashes, nausea, dizziness, and eye and respiratory tract irritation. Furthermore, formaldehyde has been found to cause cancer in animal research and industrial workers.

Secondhand Tobacco Smoke

Secondhand smoke—the smoke from someone else's cigarette, cigar or pipe—contains more than 4,000 chemicals, including nicotine, formaldehyde, carbon monoxide, and other known cancer-causing agents. While smokers themselves face serious health risks from tobacco, it is now clear that even people who don't smoke may be threatened. Exposure to secondhand smoke, also called environmental tobacco smoke, may have certain harmful—possibly even fatal—health effects such as lung cancer and heart disease.

Health Effects Tobacco smoke can irritate eyes, nose and throat and can cause headaches and nausea. The Surgeon General of the United States has concluded that secondhand smoke is definitely dangerous to human health. Involuntary smoking has now been established as a cause of lung cancer in healthy nonsmokers.

More than half of all U.S. employers have instituted restrictions on smoking in their facilities. A 1989 survey of Fortune 50 companies reported that at least 10% have smoke-free policies and almost 42% permit smoking only in limited, designated smoking areas.

Volatile Organic Compounds

Volatile organic compounds (VOCs) are released from certain solids or liquids as gases at room temperature. They include a variety of chemicals (benzene, carbon tetrachloride, styrene) which may have both short-term and long-term health effects.

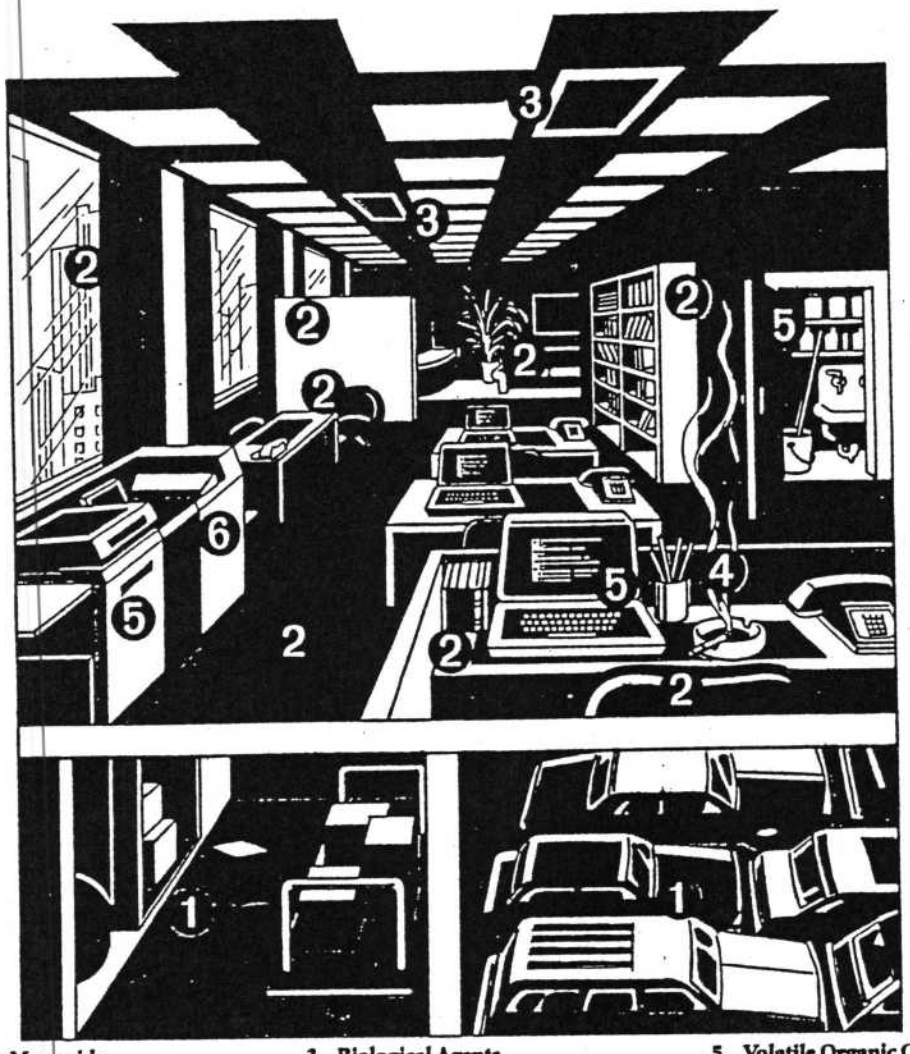
Major Sources Volatile organic compounds can be found in some furniture, paint, adhesives, solvents, upholstery, draperies, carpet, spray cans, clothing, construction materials, cleaning compounds, deodorizers, copy machine toners, felt-tip markers and pens, and correction fluids.

Health Effects Short-term effects include eye, nose and throat irritation; headaches; and nausea. On a long-term basis, exposure to high levels of some of these substances may produce damage to the liver, kidney and the central nervous system.

Other Pollutants

With today's new, ever-changing business equipment, additional dangers can confront the office worker. Copying machines, for example, can emit ozone, which causes coughing, choking, headache, fatigue, and lowers the body's resistance to infection. Office buildings are likely to contain asbestos in ceiling and floor tiles and acoustic and heating insulation. Asbestos fibers can be inhaled into the lungs and remain in the lung tissue, where they can cause scarring, or asbestosis, and cancer.

Air Pollution in the Office Building



1. **Carbon Monoxide**
   Garages, Motor Vehicles, Loading Docks
2. **Formaldehyde**
   Glues, Partitions, Carpet, Paneling, Drapery Fabric, Particleboard Furniture, Upholstery Fabric
3. **Biological Agents**
   Humidifiers, Air Conditioners, Dehumidifiers, Washrooms, Ventilation Pipes and Ducts
4. **Tobacco Smoke**
   Cigarettes, Cigars, Pipes
5. **Volatile Organic Compounds**
   Felt-Tip Markers and Pens, Cleaning Compounds, Paint, Copy Machines, Solvents
6. **Ozone**
   Copy Machines

What Can Be Done About It?

Four Basic Requirements to Restore Health to Sick Buildings:

1. Eliminate tobacco smoke. A smoke-free policy is the best way to protect the health of all employees. If that is not currently feasible, smoking should be allowed only in a separately-ventilated area reserved exclusively for that purpose, where no nonsmoker is required to enter or pass through. (Your local American Lung Association can provide materials to help companies develop and implement no-smoking policies.)

2. Provide adequate ventilation. Guidelines for office buildings set by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) require circulation of fifteen to sixty cubic feet of outside air per minute per person, depending upon the activities that normally occur in that room. If air circulation in large open spaces is hampered by partitions, raise the partitions approximately six inches off the floor.

   To assure adequate ventilation in a modern building, adjustments can be made to the ventilating system. In older buildings, windows can be opened, ceiling fans can be installed to help circulate the outside air, and humidifiers or dehumidifiers can be added. Relative humidity should be kept between thirty and sixty percent.

3. Maintain the ventilation system. Regularly clean and disinfect every part of a ventilating, heating or cooling device or system, including humidifiers and dehumidifiers, air filters, air circulation pumps and blowers.

4. Remove sources of pollution. It is important to keep up to date with the chemical components and health effects from exposure to equipment, furnishings and supplies in your office. Change or remove sources that cause problems for workers.

Other Ways to Cure Sick Buildings

Ask the building manager or other responsible person to:

- In new or renovated buildings, increase the ventilation rate for the first few weeks of occupancy. This will dilute possible emissions from new polluting sources.
- Alter or remove office equipment, furnishings, and supplies that continue to cause trouble for workers. Some formaldehyde sources, for example, can be eliminated by the use of a coating or sealer.
- Obtain assurances from the seller that new furnishings and equipment are free of irritating gases and can be returned if found to cause symptoms among workers.
- If the building contains an attached or underground garage, make sure the ventilating system operates so as to prevent auto exhaust fumes from entering the offices. Also, check air ducts for leaks.
- Locate loading docks or dumpster areas far from the building's air supply inlet vents.
- Check cleaning agents for dangerous components. If possible, use nontoxic materials. If not, ventilate offices during and after using cleaning agents.
- If, in spite of these measures, workers continue to have symptoms, hire an environmental indoor air quality professional to test the air and identify the problem.

RICOSH FACT SHEET

INDOOR AIR POLLUTION

THE PROBLEM

Are you working in a sick building? When you're at work do you get headaches? Sneeze or cough excessively? Do your eyes burn? Do you feel better when you leave the office? If so, you may be working in a "sick" building.

To save energy costs, new tightly-sealed office buildings and modern ventilation systems recycle a portion of inside air over and over again without adequate cleaning or the addition of fresh outside air. In older buildings, insulation is added, windows are air-tight, and outside dampers are often closed.

Whether the building is old or new, the same recirculated air is breathed again and again by people working inside. Workers suffer a variety of symptoms ranging from drowziness and decreased alertness to respiratory infection.

The problem is worsened by the many pollutants that exist inside the workplace.

COMMON OFFICE TOXINS

Source	Hazard	Effect
Duplicating machines solvent	Ammonia and Methanol	Irritation to eyes, nose, throat
Ventilation shafts, ceilings or ceiling tiles	Asbestos	Mesothelioma (tumours), cancer—asbestosis (from high exposure)
Rubber cement and some cleaners, stencil fluid, copier toner, liquid eraser	Benzene and Toluene	Drowsiness, headaches, dizziness, liver damage. Benzene has been linked to leukemia and other blood disorders
Adhesives, waxes, inks, rubber, carbon, typewriter ribbons, photo-copying papers, cleaning fluids.	Common Office Irritants	Skin problems, dermatitis, allergic reactions
Insulation, glues in new carpeting, building materials	Formaldehyde	Irritation of eyes, nose, mouth, throat, allergic reactions. Suspected cancer-causing agent
Copying machines, electrical equip-ment	Ozones	Irritation to eyes, nose, throat, coughing, chest pains, drowsiness, headaches.
Correcting fluids, inks, adhesives, compounds	Trichlorethylene	Lower levels — headaches, fatigue, dermatitis. Higher levels — nausea, vomiting, confusion
Toner in photocopying machines	Trinitro-fluorenone (TFN) & Nitropyrenes	Suspected cancer-causing agents.
Humidifying and air-conditioning systems	Micro-organisms (viruses, bacteria, and fungi)	Respiratory infections, allergic responses
Spraying of plants and premises	Insecticides and pesticides	Depending on chemical com-ponents: from liver disease to eye ir-

WHAT CHANGES CAN BE MADE?

Improvements can be made in office ventilation systems through regular maintenance, increasing the percent of fresh air in each air change, increasing the frequency of air changes, locating roof intake vents where they will draw in the cleanest air available, and efficient cleaning of recirculated air and "fresh air" if neccessary.

Office equipment which produces pollutants must be properly maintained. It can also be isolated to one area that has special ventilation.

Buildings can have volatile pollutants "baked out" of them by turning up the heat to maximum and venting the fumes to the outside over a weekend or longer shut-down period.

Dangerous materials such as asbestos can be removed entirely and safer materials substituted. Solid insulation can be sealed in to the walls; formaldehyde from particleboard can be chemically sealed or coated with a formaldehyde-absorbing paint.

Heat recovery, which also saves energy, can be used as a safe alternative to air recirculation.

AKING ACTION TO GUARANTEE A HEALTHY WORK ENVIRONMENT

UNION ACTION: (If your workplace is not unionized, work cooperatively with co-workers to make the needed changes.)

- Survey your workplace for pollution sources and reports of health problems or discomfort. The survey can be done by walking through each work area, observing operations and interviewing workers. Alternatively, a questionnaire can be distributed to union members.

- Investigate how the ventilation system operates. Find out answers to these questions:

  * Who is responsible for operation and maintenance of the ventilation system?

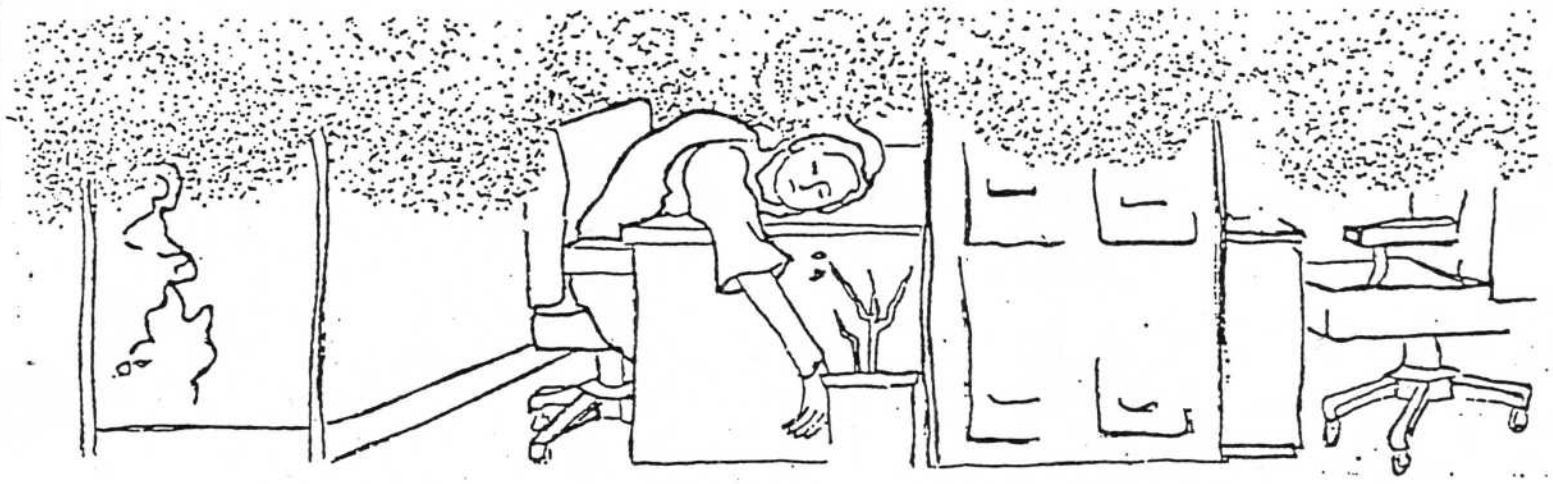
  * Are there written standard procedures for the operation and maintenance of the system? If there are, you should obtain and review a copy

  * Are their written procedures in case of breakdown of part, or all of the ventilation system? These procedures should be in writing and available for review. If there are none they should be implemented. If they are inadequate they should be upgraded.

  * Is exhaust air recirculated? If so, what percent fresh air gets added? (33% if the Swedish guideline) What cleaning is performed on air before recirculation? Is the cleaning method capable of removing all types and amounts of contaminants which may be present?

  * How often is the air in the room changed? (Rates are specified as air changes per hour, minutes per air change, and airflow rate per floor area)

- Take a physical tour of the ventilation system - requiring visits to both the basement and roof - preferably with someone who operates or maintains the system. You can also contact an outside heating and cooling contractor. Locate,



OFFICE VENTILATION SURVEY GUIDE

SYSTEM COMPONENTS	THINGS TO NOTICE OR ASK
fresh air intake	-are there sources of contaminated air which could enter, such as roof tar vapors, incinerator combustion products, exhaust air, flue gases, auto fumes -damper setting, open to closed -is filtration provided
heater, boiler	-type of fuel -are combustion products properly vented to outside
humidifier	-cleanliness of water resevoir
air conditioner	-type of refrigerant (unless cooling tower is used, which uses water as refrigerant)
air distribution and return ductwork	-type of insulation on inside or outside surfaces -frequency of cleaning of ductwork; observe inside if possible
room air distribution and air return vents	-test to see which way and how fast air is moving by watching to see how smoke is drawn from a cigarette or smoke tube (available from safety equipment suppliers - see Yellow Pages) -cleanliness
heat exchanger	-type - heat wheel, runaround liquid, air to air, waste-heat boiler
exhaust air discharge	-percent discharge vs. percent recirculated -location far enough from fresh air intake
air cleaner for recirculated air	-type *filtration through paper, cloth or fiber glass is for dusts *incineration, wet scrubbing, adsorbtion on activated carbon is for gases and vapors

GETTING MANAGEMENT TO ACT:

- After you complete the hazard the complaint survey and the survey of the ventilation system, the union should consider one or more of these follow-up actions:

* Meet with management with the results of your surveys. Issue a list of demands which the union believes will address office pollution problems with a deadline for action.

* File a grievance, specifiying the union demands as the remedy.

* Develop contract language on indoor air pollution and incorporate the language in you next contract negotiations.

* Take direct action to reinforce your demands. For example workers could wear buttons calling attention to the problem. The union could arrange for everyone to take a fresh air break outside, or to call in sick with stale lung disease.

IAQ INFO

Indoor Air Quality Information Clearinghouse

A service of the U.S. Environmental Protection Agency

DOCUMENTS CURRENTLY AVAILABLE FOR DISTRIBUTION

To receive a copy of any of the following publications, please mark an X next to the document's publication number, then complete reverse side and fax or mail to the Indoor Air Quality Information Clearinghouse (IAQ INFO) at the address noted.

General Information

_____ (IAQ-0009) The Inside Story: A Guide to Indoor Air Quality
_____ (IAQ-0029) Targeting Indoor Air Pollution: EPA's Approach and Progress
_____ (IAQ-0059) Secondhand Smoke: What You Can Do As Parents, Decisionmakers, and Building Occupants
_____ (IAQ-0046) Fact Sheet: Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders
_____ (IAQ-0003) Fact Sheet: Ventilation and Air Quality in Offices
_____ (IAQ-0004) Fact Sheet: Sick Building Syndrome
_____ (IAQ-0006) Fact Sheet: Report to Congress on IAQ (Summary of 1989 Report)
_____ (IAQ-0007) Fact Sheet: Residential Air Cleaners
_____ (IAQ-0008) Fact Sheet: Use and Care of Home Humidifiers
_____ (IAQ-0040) Fact Sheet: Carpet and Indoor Air Quality
_____ (IAQ-0061) Fact Sheet: Flood Cleanup: Avoiding Indoor Air Quality Problems
_____ (IAQ-0010) Residential Air Cleaning Devices: A Summary of Available Information
_____ (IAQ-0060) Current Federal Indoor Air Quality Activities
_____ (IAQ-0015) What You Should Know About Combustion Appliances and Indoor Air Pollution
_____ (IAQ-0023) Asbestos in Your Home
_____ (IAQ-0025) Biological Pollutants in Your Home

Technical Information

_____ (IAQ-0019) EPA TEAM Study Summary
_____ (IAQ-0020) IAQ in Public Buildings: Volume I Project Summary
_____ (IAQ-0021) IAQ in Public Buildings: Volume II Project Summary
_____ (IAQ-0022) Compendium of Methods for the Determination of Air Pollutants in Indoor Air – Project Summary

Limited number of *Survey of Indoor Air Quality Diagnostic and Mitigation Firms* available. Please call for further information.

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Documents Available from Other Sources

Building Air Quality: A Guide for Building Owners & Facility Managers

This document (Stock # 055-000-00390-4) may be obtained for $24.00 from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402-9325, (202) 783-3238.

Introduction to Indoor Air Quality: A Reference Manual
Introduction to Indoor Air Quality: A Self-Paced Learning Module

This set of documents may be obtained for $47.00 by nonmembers and $40.00 by members. Contact the National Environmental Health Association, 720 Colorado Blvd., #970 South Tower, Denver, CO 80222, (303) 756-9090.

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