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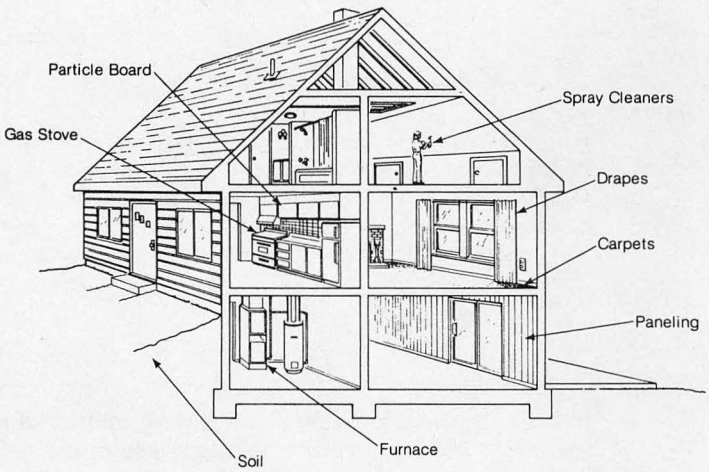
Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA
BUILDING VENTILATION AND INDOOR AIR QUALITY PROGRAM

AIR POLLUTION IN BUILDINGS

Air pollution is usually considered a problem of outside air. However, researchers discovered during the 1970's that pollutant levels are often higher indoors. Since many people spend a large amount of time inside buildings, the long term exposures to these pollutants can have serious health effects. Every occupied building has the potential for indoor air pollution. The emphasis in the past ten years on tightly-sealed, energy-efficient buildings has aggravated the problem. These buildings, both new buildings and improved existing buildings, have reduced the amount of ventilation air that can be important in flushing out odors and pollutants. When these substances are unable to escape they can collect to potentially dangerous levels. Other factors that have an effect on pollutant levels include:



Sources of Pollutants

XBL 8311-665

- Types and condition of combustion appliances (gas ranges, kerosene heaters, etc.)
- Age and type of building materials (plywood, particle board, some insulations)
- Occupants that smoke
- Type of building substructure (crawlspace, basement)
- Soil composition around the building

Types of Pollutants

Following is a brief description of pollutants that are thought to be most significant indoors.

Respirable Airborne Particles

These very tiny airborne particles are not removed by normal lung and nasal activity and can irritate lung tissue either by chemical action or physical intrusion. Cancer-causing chemicals may make-up or attach themselves to the particles. Health effects can be lung cancer, emphysema, heart disease, respiratory irritations, and infections. Sources are typically tobacco smoke, wood smoke, unvented gas appliances, and kerosene space heaters.

Nitrogen Dioxide

This gas, formed during combustion, may cause chronic respiratory disease after long exposure to low levels. Sources are kerosene space heaters and unvented gas appliances (gas stoves, ovens, and space heaters). Outdoor sources include nearby motor vehicle traffic.

Carbon Monoxide

Carbon monoxide is a colorless combustion-produced gas that reduces the oxygen-carrying capacity of the blood. While it only rarely reaches lethal levels in houses, at high concentrations it can impair vision, brain functioning, and awareness. Carbon monoxide is generated by kerosene heaters, wood stoves, unvented gas appliances (especially those not properly adjusted), tobacco smoking, idling autos in attached garages, and outside motor vehicle traffic.

Formaldehyde

Formaldehyde is a pungent, colorless gas. Even at low concentrations it can cause eye, nose, throat irritation, and headaches in some individuals. It is a component in fabrics, numerous consumer products, in the glues of some building materials, and furniture. Emission from these materials is high when they are new and decreases with time. Consequently, levels are expected to be higher in new tightly sealed buildings, mobile homes, or extensively remodeled older buildings. It is also a concern in homes that have improperly installed urea-formaldehyde wall insulation.

Radon

This radioactive gas results from the disintegration of radium. Radium is found in small concentrations in common rock and soil. Radon will, in turn, transform into products that are physically and chemically active and often attach themselves to fine airborne particles that may be breathed and retained in the respiratory system. Long term exposure to low levels of radon decay products will result in a higher risk of lung cancer. Entry into a house is through foundation cracks, open sumps, crawlspace floors, well and spring water, and occasionally, from earth-derived building materials (stone, concrete aggregates, etc.).

Humidity

In excess, humidity is considered an indoor pollutant. It can support the growth of molds, airborne microorganisms, odors, cause structural damage to buildings, and create a feeling of discomfort. Common sources are found in bathrooms, kitchens, and attached greenhouses.

Other Pollutants

Pollutants that are just beginning to be investigated include chemical compounds given off while using cleaning products, glues, paints, strippers, polishes, and pesticides. Health effects can range from mild irritation and discomfort to severe distress and suspected cancer formation.

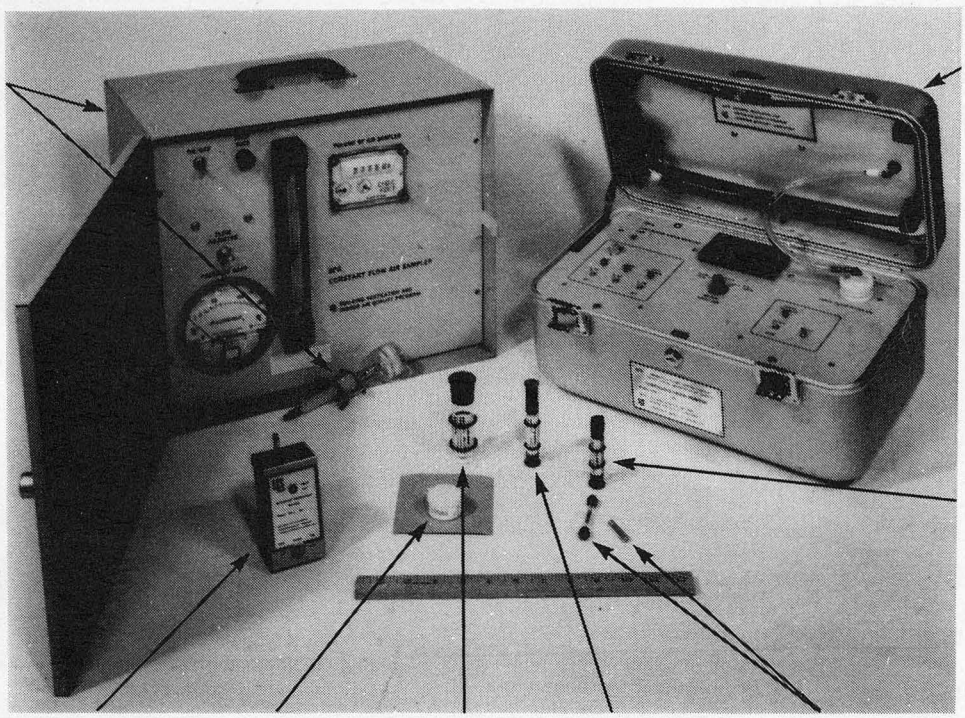
Measurements

Acceptable levels of these indoor pollutants are yet to be established. To provide this information, research by government agencies and private organizations is emphasizing measurements of actual conditions in occupied buildings. The information derived from these measurements will be used to:

a) Inventory typical levels of pollutants inside houses, offices, and schools.
b) Identify the factors that affect the concentrations, i.e., types of appliances, house weatherization, and occupant activities.
c) Devise new methods of controlling or reducing the high concentrations of pollutants that exist in some buildings.

Testing for some pollutants (humidity, formaldehyde, nitrogen dioxide, and radon) can be done simply with small test tube-like samplers that are left uncapped for periods from a week up to three months. The samplers are then analyzed in a laboratory. The amount of ventilation air entering a building can also be measured in this manner.

Indoor Air Pollution Test Equipment



Detailed minute-by-minute or hourly measurements require that elaborate equipment be brought into the building. Nitrogen dioxide, radon, carbon monoxide, and humidity can be tested in this way by storing the information on a recording device.

Airborne particles are collected by pumping air through a filter that captures the small particles. The filters are then weighed and analyzed at a laboratory.

Controlling Indoor Pollution

Measures to reduce or eliminate indoor air pollution are still being investigated. However, enough is known to formulate the following basic guidelines.

1) Attempt to *prevent* the pollutants from occurring or collecting in the building in the first place. During new construction seal buildings to stop radon from entering. Use low formaldehyde building materials and properly vented appliances. In existing homes, reduce or eliminate the use of toxic household products and tobacco smoking.

2) If practical, *remove* existing pollutant-producing material or equipment. For instance, replace or repair improperly operating combustion appliances or eliminate the use of kerosene space heaters.

3) *Control* the levels of pollutants, often by increasing ventilation. This includes opening windows when using potentially toxic household products. Use kitchen exhaust fans while cooking with a gas range and/or install an air-to-air heat exchanger that provides fresh outside air while conserving a portion of the heating or cooling energy.

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