Building Air Quality: Basics

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This course was adapted from the Tab I "Basics" of the EPA's Publication "Building Air Quality" publication (A Guide for Building Owners and Facility Managers)", which is in the public domain.

I) FACTORS AFFECTING INDOOR AIR QUALITY

The indoor environment in any building is a result of the interaction between the site, climate, building system (original design and later modifications in the structure and mechanical systems), construction techniques, contaminant sources (building materials and furnishings, moisture, processes and activities within the building, and outdoor sources), and building occupants.

The following four elements are involved in the development of indoor air quality problems:

Source: there is a source of contamination or discomfort indoors, outdoors, or within the mechanical systems of the building.

HVAC: the HVAC system is not able to control existing air contaminants and ensure thermal comfort (temperature and humidity conditions that are comfortable for most occupants).

Pathways: one or more pollutant pathways connect the pollutant source to the occupants and a driving force exists to move pollutants along the pathway(s).

Occupants: building occupants are present.

It is important to understand the role that each of these factors may play in order to prevent, investigate, and resolve indoor air quality problems.

SOURCES OF INDOOR AIR CONTAMINANTS

Indoor air contaminants can originate within the building or be drawn in from outdoors. If contaminant sources are not controlled, Indoor Air Quality (IAQ) problems can arise, even if the HVAC system is properly designed and well-maintained. It may be helpful to think of air pollutant sources as fitting into one of the categories that follow. The examples given for each category are not intended to be a complete list.

Sources Outside Building

Contaminated outdoor air

- Pollen, dust, fungal spores
- Industrial pollutants
- General vehicle exhaust

Emissions from nearby sources

- Exhaust from vehicles on nearby roads or in parking lots, or garages
- Loading docks
- Odors from dumpsters

- Re-entrained (drawn back into the building) exhaust from the building itself or from neighboring buildings
- Unsanitary debris near the outdoor air intake

Soil gas

- Radon
- Leakage from underground fuel tanks
- Contaminants from previous uses of the site (e.g., landfills)
- Pesticides

Moisture or standing water promoting excess microbial growth

- Rooftops after rainfall
- Crawlspace

Equipment

HVAC system

- Dust or dirt in ductwork or other components
- Microbiological growth in drip pans, humidifiers, ductwork, coils
- Improper use of biocides, sealants, and/ or cleaning compounds
- Improper venting of combustion products
- Refrigerant leakage

Non-HVAC equipment

- Emissions from office equipment (volatile organic compounds, ozone)
- Supplies (solvents, toners, ammonia)
- Emissions from shops, labs, cleaning processes
- Elevator motors and other mechanical systems

Human Activities

Personal activities

- Smoking
- Cooking
- Body odor
- Cosmetic odors

Housekeeping activities

- Cleaning materials and procedures
- Emissions from stored supplies or trash
- Use of deodorizers and fragrances
- Airborne dust or dirt (e.g., circulated by sweeping and vacuuming)

Maintenance activities

- Microorganisms in mist from improperly maintained cooling towers
- Airborne dust or dirt
- Volatile organic compounds from use of paint, caulk, adhesives, and other products
- Pesticides from pest control activities
- Emissions from stored supplies

Building Components and Furnishings

Locations that produce or collect dust or Fibers

- Textured surfaces such as carpeting, curtains, and other textiles
- Open shelving
- Old or deteriorated furnishings
- Materials containing damaged asbestos

Unsanitary conditions and water damage

- Microbiological growth on or in soiled or water-damaged furnishings
- Microbiological growth in areas of surface condensation
- Standing water from clogged or poorly designed drains
- Dry traps that allow the passage of sewer gas

Chemicals released from building components or furnishings

- Volatile organic compounds or
- Inorganic compounds

Other Sources

Accidental events

- Spills of water or other liquids
- Microbiological growth due to flooding or to leaks from roofs, piping
- Fire damage (soot, PCBs from electrical equipment, odors)

Special use areas and mixed use buildings

- Smoking lounges
- Laboratories
- Print shops, art rooms
- Exercise rooms
- Beauty salons
- Food preparation areas

Redecorating/remodeling/repair activities

- Emissions from new furnishings
- Dust and fibers from demolition
- Odors and volatile organic and inorganic compounds from paint, caulk, adhesives
- Microbiologicals released from demolition or remodeling activities

Indoor air often contains a variety of contaminants at concentrations that are far below any standards or guidelines for occupational exposure. Given our present knowledge, it is difficult to relate complaints of specific health effects to exposures to specific pollutant concentrations, especially since the significant exposures may be to low levels of pollutant mixtures.

HVAC SYSTEM DESIGN AND OPERATION

The HVAC system includes all heating, cooling, and ventilation equipment serving a building: furnaces or boilers, chillers, cooling towers, air handling units, exhaust fans, ductwork, filters, and steam (or heating water) piping. Most of the HVAC discussion in this document applies both to central HVAC systems and to individual components used as stand-alone units.

A properly designed and functioning HVAC system:

- Provides thermal comfort
- Distributes adequate amounts of outdoor air to meet ventilation needs of all building occupants
- Isolates and removes odors and contaminants through pressure control, filtration, and exhaust fans

Thermal Comfort

A number of variables interact to determine whether people are comfortable with the temperature of the indoor air. The activity level, age, and physiology of each person affect the thermal comfort requirements of that individual. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 55 describes the temperature and humidity ranges that are comfortable for most people engaged in largely sedentary activities. The ASHRAE standard assumes “normal” indoor clothing. Added layers of clothing reduce the rate of heat loss.

Uniformity of temperature is important to comfort. When the heating and cooling needs of rooms within a single zone change at different rates; rooms that are served by a single thermostat may be at different temperatures. Temperature stratification is a common problem caused by convection, the tendency of light, warm air to rise and heavier, cooler air to sink. If air is not properly mixed by the ventilation system, the temperature near the ceiling can be several degrees warmer than at floor level. Even if air is properly mixed, un-insulated floors over unheated spaces can create discomfort in some climate zones. Large fluctuations of indoor temperature can also occur when controls have a wide "dead band" (a temperature range within which neither heating nor cooling takes place).

Radiant heat transfer may cause people located near very hot or very cold surfaces to be uncomfortable even though the thermostat setting and the measured air temperature are within the comfort range. Buildings with large window areas sometimes have acute problems of discomfort due to radiant heat gains and losses, with the locations of complaints shifting during the day as the sun angle changes. Large vertical surfaces can also produce a significant flow of naturally-convecting air, producing complaints of draftiness. Adding insulation to walls helps to moderate the temperature of interior wall surfaces. Closing curtains reduces heating from direct sunlight and isolates building occupants from exposure to window surfaces (which, lacking insulation, are likely to be much hotter or colder than the walls).

Humidity is a factor in thermal comfort. Raising relative humidity reduces the ability to lose heat through perspiration and evaporation, so that the effect is similar to raising the temperature. Humidity extremes can also create other IAQ problems. Excessively high or low relative humidity levels can produce discomfort; while high relative humidity can promote the growth of mold and mildew.

Ventilation to Meet Occupant Needs

Most air handling units distribute a blend of outdoor air and recirculated indoor air. HVAC designs may also include units that introduce 100% outdoor air or that simply transfer air within the building. Uncontrolled quantities of outdoor air enter buildings by infiltration through windows, doors, and gaps in the exterior construction. Thermal comfort and ventilation needs are met by supplying "conditioned" air (a blend of outdoor and recirculated air that has been filtered, heated or cooled, and sometimes humidified or dehumidified).

Large buildings often have interior ("core") spaces in which constant cooling is required to compensate for heat generated by occupants, equipment, and lighting, while perimeter rooms may require heating or cooling depending on outdoor conditions. Two of the most common HVAC designs used in modern public and commercial buildings are *constant volume* and *variable air volume* systems. Constant volume systems are designed to provide a constant airflow and to vary the air temperature to meet heating and cooling needs. The percentage of outdoor air may be held constant, but is often controlled either manually or automatically to vary with outdoor temperature and humidity. Controls may include a minimum setting that should allow the system to meet ventilation guidelines for outdoor air quantities under design conditions.

Variable air volume (VAV) systems condition supply air to a constant temperature and ensure thermal comfort by varying the airflow to occupied spaces. Most early VAV systems did not allow control of the outdoor air quantity, so that a decreasing amount of outdoor air was provided as the flow of supply air was reduced. However, current designs ensure a minimum supply of outdoor air with static pressure devices in the outdoor air stream. Additional energy-conserving features such as economizer control or heat recovery are also found in some buildings. Good quality design, installation, and testing and balancing are critically important to the proper operation of all types of HVAC systems, especially VAV systems, as are regular inspections and maintenance. The amount of outdoor air considered adequate for proper ventilation is described in ASHRAE Standard 62.

Control of Odors and Contaminants

One technique for controlling odors and contaminants is to dilute them with outdoor air. Dilution can work only if there is a consistent and appropriate flow of supply air that mixes effectively with room air. The term "ventilation efficiency" is used to describe the ability of the ventilation system to distribute supply air and remove internally generated pollutants.

Another technique for isolating odors and contaminants is to design and operate the HVAC system so that pressure relationships between rooms are controlled. This control is accomplished by adjusting the air quantities that are supplied to and removed from each room. If more air is supplied to a room than is exhausted, the excess air leaks out of the space and the room is said to be under *positive pressure*. If less air is supplied than is exhausted, air is pulled into the space and the room is said to be under *negative pressure*.

Control of pressure relationships is critically important in mixed use buildings or buildings with special use areas. Lobbies and buildings in general are often designed to operate under positive pressure to prevent or minimize the infiltration of unconditioned air, with its potential to cause drafts and introduce dust, dirt, and thermal discomfort. Without proper operation and maintenance, these pressure differences are not likely to remain as originally designed.

A third technique is to use local exhaust systems (sometimes known as dedicated exhaust ventilation systems) to isolate and remove contaminants by maintaining negative pressure in the area around the contaminant source. Local exhaust can be linked to the operation of a particular piece of equipment (such as a kitchen range) or used to treat an entire room (such as a smoking lounge or custodial closet). Air should be exhausted to the outdoors, *not* recirculated, from locations which produce significant odors and high concentrations of contaminants (such as copy rooms, bathrooms, kitchens, and beauty salons).

Spaces where local exhaust is used must be provided with make-up air and the local exhaust must function in coordination with the rest of the ventilation system. Under some circumstances, it may be acceptable to transfer conditioned air from relatively clean parts of a building to comparatively dirty areas and use it as make-up air for a local exhaust system. Such a transfer can achieve significant energy savings.

Air cleaning and filtration devices designed to control contaminants are found as components of HVAC systems (for example, filter boxes in ductwork) and can also be installed as independent

units. The effectiveness of air cleaning depends upon proper equipment selection, installation, operation, and maintenance. Caution should be used in evaluating the many new technological developments in the field of air cleaning and filtration.

POLLUTANT PATHWAYS AND DRIVING FORCES

Airflow patterns in buildings result from the combined action of mechanical ventilation systems, human activity, and natural forces. Pressure differentials created by these forces move airborne contaminants from areas of relatively higher pressure to areas of relatively lower pressure through any available openings.

The HVAC system is generally the predominant pathway and driving force for air movement in buildings. However, all of a building's components (walls, ceilings, floors, penetrations, HVAC equipment, and occupants) interact to affect the distribution of contaminants. For example, as air moves from supply registers or diffusers to return air grilles, it is diverted or obstructed by partitions, walls, and furnishings, and redirected by openings that provide pathways for air movement. On a localized basis, the movement of people has a major impact on the movement of pollutants. Some of the pathways change as doors and windows open and close. It is useful to think of the entire building — the rooms and the connections (e.g., chases, corridors, stairways, elevator shafts) between them — as part of the air distribution system.

Natural forces exert an important influence on air movement between zones and between the building's interior and exterior. Both the *stack effect* and *wind* can overpower a building's mechanical system and disrupt air circulation and ventilation, especially if the building envelope is leaky.

Stack effect is the pressure driven flow produced by convection (the tendency of warm air to rise). The stack effect exists whenever there is an indoor-outdoor temperature difference and becomes stronger as the temperature difference increases. As heated air escapes from upper levels of the building, indoor air moves from lower to upper floors, and replacement outdoor air is drawn into openings at the lower levels of buildings. Stack effect airflow can transport contaminants between floors by way of stairwells, elevator shafts, utility chases, or other openings.

Wind effects are transient, creating local areas of high pressure (on the windward side) and low pressure (on the leeward side) of buildings. Depending on the leakage openings in the building exterior, wind can affect the pressure relationships within and between rooms. The basic principle of air movement from areas of relatively higher pressure to areas of relatively lower pressure can produce many patterns of contaminant distribution, including:

- Local circulation in the room containing the pollutant source
- Air movement into adjacent spaces that are under lower pressure (*Note*: Even if two rooms are both under positive pressure compared to the outdoors, one room is usually at a lower pressure than the other.)
- Recirculation of air within the zone containing the pollutant source or in adjacent zones where return systems overlap

- Movement from lower to upper levels of the building
- Air movement into the building through either infiltration of outdoor air or reentry of exhaust air

Air moves from areas of higher pressure to areas of lower pressure through any available openings. A small crack or hole can admit significant amounts of air if the pressure differentials are high enough (which may be very difficult to assess.)

Even when the building as a whole is maintained under positive pressure, there is always some location (for example, the outdoor air intake) that is under negative pressure relative to the outdoors. Entry of contaminants may be intermittent, occurring only when the wind blows from the direction of the pollutant source. The interaction between pollutant pathways and intermittent or variable driving forces can lead to a single source causing IAQ complaints in areas of the building that are distant from each other and from the source.

BUILDING OCCUPANTS

The term "building occupants" is generally used in this course to describe people who spend extended time periods (e.g., a full workday) in the building. Clients and visitors are also occupants; they may have different tolerances and expectations from those who spend their entire workdays in the building, and are likely to be more sensitive to odors. Groups that may be particularly susceptible to effects of indoor air contaminants include, but are not limited to:

- Allergic or asthmatic individuals
- People with respiratory disease
- People whose immune systems are suppressed due to chemotherapy, radiation therapy, disease, or other causes
- Contact lens wearers

Some other groups are particularly vulnerable to exposures of certain pollutants or pollutant mixtures. For example, people with heart disease may be more affected by exposure at lower levels of carbon monoxide than healthy individuals. Children exposed to environmental tobacco smoke have been shown to be at higher risk of respiratory illnesses and those exposed to nitrogen dioxide have been shown to be at higher risk from respiratory infections.

Because of varying sensitivity among people, one individual may react to a particular IAQ problem while surrounding occupants have no ill effects. (Symptoms that are limited to a single person can also occur when only one work station receives the bulk of the pollutant dose.) In other cases, complaints may be widespread.

A single indoor air pollutant or problem can trigger different reactions in different people. Some may not be affected at all. Information about the types of symptoms can sometimes lead directly to solutions. However, symptom information is more likely to be useful for identifying the timing and conditions under which problems occur.

Types of Symptoms and Complaints

The effects of IAQ problems are often nonspecific symptoms rather than clearly defined illnesses. Symptoms commonly attributed to IAQ problems include:

- Headache
- Fatigue
- Shortness of breath
- Sinus congestion
- Cough
- Sneezing
- Eye, nose, and throat irritation
- Skin irritation
- Dizziness
- Nausea

All of these symptoms, however, may also be caused by other factors, and are not necessarily due to air quality deficiencies.

"Health" and "comfort" are used to describe a spectrum of physical sensations. For example, when the air in a room is slightly too warm for a person's activity level, that person may experience mild discomfort. If the temperature continues to rise, discomfort increases and symptoms such as fatigue, stuffiness, and headaches can appear.

Some complaints by building occupants are clearly related to the discomfort end of the spectrum. One of the most common IAQ complaints is that "there's a funny smell in here." Odors are often associated with a perception of poor air quality, whether or not they cause symptoms. Environmental stressors such as improper lighting, noise, vibration, overcrowding, ergonomic stressors, and job-related psychosocial problems (such as job stress) can produce symptoms that are similar to those associated with poor air quality.

The term *Sick Building Syndrome (SBS)* is sometimes used to describe cases in which building occupants experience acute health and comfort effects that are apparently linked to the time they spend in the building, but in which no specific illness or cause can be identified. The complaints may be localized in a particular room or zone or may be widespread throughout the building. Many different symptoms have been associated with SBS, including respiratory complaints, irritation, and fatigue. Analysis of air samples often fails to detect high concentrations of specific contaminants. The problem may be caused by any or all of the following:

- The combined effects of multiple pollutants at low concentrations
- Other environmental stressors (e.g., overheating, poor lighting, noise)
- Ergonomic stressors
- Job-related psychosocial stressors (e.g., overcrowding, labor-management problems)
- Unknown factors

Building-Related Illness (BRI) is a term referring to illness brought on by exposure to the building air, where symptoms of diagnosable illness are identified (e.g., certain allergies or infections) and can be directly attributed to environmental agents in the air. Legionnaire's disease and hypersensitivity pneumonitis are examples of BRI that can have serious, even life threatening consequences.

A small percentage of the population may be sensitive to a number of chemicals in indoor air, each of which may occur at very low concentrations. The existence of this condition, which is known as *Multiple Chemical Sensitivity (MCS)*, is a matter of considerable controversy. MCS is not currently recognized by the major medical organizations, but medical opinion is divided, and further research is needed. The applicability of access for the disabled and worker's compensation regulations to people who believe they are chemically sensitive may become concerns for facility managers.

Sometimes several building occupants experience rare or serious health problems (e.g., cancer, miscarriages, Lou Gehrig's disease) over a relatively short time period. These *clusters* of health problems are occasionally blamed on indoor air quality, and can produce tremendous anxiety among building occupants. State or local Health Departments can provide advice and assistance if clusters are suspected. They may be able to help answer key questions such as whether the apparent cluster is actually unusual and whether the underlying cause could be related to IAQ.

II) EFFECTIVE COMMUNICATION:

This section discusses establishing and maintaining a communication system that can help prevent indoor air quality problems and resolve problems cooperatively if they do arise.

COMMUNICATING TO PREVENT IAQ PROBLEMS

Effective communication can encourage building occupants to improve their work environment through positive contributions. The following objectives should be kept in mind while reviewing and revising your current approach to communicating with occupants:

- Provide accurate information about factors that affect indoor air quality
- Clarify the responsibilities of each party (e.g., building management, staff, tenants, contractors)
- Establish an effective system for logging and responding to complaints should they occur

Provide Accurate Information

Many indoor air quality problems can be prevented if staff and building occupants understand how their activities affect IAQ. You may already have a health and safety committee functioning to promote good working conditions. If so, it is easy to add indoor air quality to their list of concerns. If you do not have a health and safety committee, consider establishing one or setting up a joint management-tenant IAQ task force. Whatever its official designation, such a group can

help to disseminate information about indoor air quality, bring potential problems to the attention of building staff and management, and foster a sense of shared responsibility for maintaining a safe and comfortable indoor environment.

The group will be most successful if it represents the diverse interests in the building, including:

- Building owner
- Building manager
- Facility personnel
- Health and safety officials
- Tenants and/or other occupants who are not facility staff
- Union representatives (or other worker representatives)

Clarify Responsibilities

It is important to define the responsibilities of building management, staff, and occupants in relation to indoor air quality. These responsibilities can be formalized by incorporating them into documents such as employee manuals or lease agreements.

Use of Space: Educate occupants about the permitted uses and maximum occupancy of different areas within the building and make sure that appropriate ventilation is provided for the activities that are permitted. Indoor air quality complaints often arise in mixed-use buildings. For example, kitchen staff expect food odors as part of their work, but nearby office workers may find cooking odors distracting and unpleasant. Problems can also arise when old tenants leave and new arrivals introduce new uses of the building.

Occupancy Rate: Inform occupants about the importance of keeping the building management informed about significant changes in the number of people regularly using particular areas of the building. The ventilation systems in buildings are designed and operated to supply air to projected ranges of occupants. If the occupancy rate becomes a problem, it may be helpful to refer to a standard reference such as ASHRAE Standard 62 to show occupants that keeping occupancy within the ventilation capacity serves the goal of providing a quality work environment and is not an arbitrary decision by building management.

Modifications: Review plans that may involve increases in the number of occupants, relocation of walls or partitions, installation of new equipment, or changes in the use of space. Building owners, facility managers, and occupants share responsibility for monitoring new equipment installation and changes in the use of space. The review process allows potential indoor air quality problems to be identified so that the HVAC system can be modified as needed. Only authorized maintenance personnel should adjust air supply or exhaust vents; however, if occupants are expected to follow such a “hands-off” policy, facility management must respond promptly to IAQ complaints.

Notification of planned activities: Establish a procedure for informing tenants before the start of activities that produce odors or contaminants (e.g., maintenance, pest control, repair, remodeling, redecorating).

Establish a System for Responding to Complaints

Many organizations have established procedures for responding to occupant complaints that can be modified to include indoor air quality concerns. To avoid frustrating delays, building occupants need to know how to express their complaints about IAQ. More importantly, they need to know how to locate responsible staff and where to obtain complaint forms. This information can be posted on bulletin boards, circulated in memos or newsletters, or publicized by some other means.

Complaints should be handled promptly, with every incident given serious attention. It is advisable to establish a recordkeeping system that cross-references documentation on complaints with records of equipment operation and maintenance. The recordkeeping system can help to resolve complaints by collecting information in a form that highlights patterns of problems (for example, complaints that occur at a regular time of day or in the same area of the building).

COMMUNICATING TO RESOLVE IAQ PROBLEMS

In many cases, building managers may be alerted to potential indoor air quality problems by complaints from occupants. The complaints can be vague, to the effect that one or more people feel “sick” or “uncomfortable” or that someone has noticed an unusual odor. They may be specific, blaming a particular material as the cause of discomfort or health problems. People are usually reacting to a real problem, so their complaints should be taken seriously. However, they may attribute their symptoms to the wrong cause, so their theories about the problem should be heard respectfully but weighed cautiously.

Indoor air quality problems can sometimes be identified and resolved quickly. On other occasions, complaints originate from the interaction of several variables, and detailed investigation may be necessary in order to resolve the problem.

The Importance of Responding to IAQ Complaints

Listening and responding to building occupants is critical to achieving a successful resolution of indoor air quality complaints. IAQ complaints may be grounded in poor indoor air quality, thermal conditions, noise, glare, or even job stresses. However, it is in the building manager’s best interest to respond to all complaints about the indoor environment promptly and seriously and to establish credibility through open communication with building occupants. The biggest mistake that building managers can make in the face of an IAQ complaint is to underestimate the problems that can result if building occupants believe that no action is being taken or that important information is being withheld. Without open communication, any IAQ problem can become complicated by anxiety, frustration, and distrust, delaying its resolution.

Paying attention to communication, as well as problem-solving, helps to ensure the support and cooperation of building occupants as the complaint is investigated and resolved. The messages to convey are that management believes it is important to provide a healthy and safe building that good indoor air quality is an essential component of a healthful indoor environment, and that complaints about indoor air quality are taken seriously.

Communications, whether they occur in conversations or in writing, should include the following information:

- What types of complaints management has received
- Management's policy in regard to providing a healthy and safe environment and responding to occupant complaints
- What management has done to date (e.g., collecting data, responding to the problem)
- What management plans to do in order to further investigate and correct the problem (including the fact that outside consultants have been called in, if they have been)
- The names and telephone numbers of appropriate facility management, medical, or health and safety staff to whom the occupants should turn if they have additional complaints or questions, or if they have information that may help in resolving the complaints

Maintaining the Lines of Communication

Make certain that occupants know how to contact the responsible personnel who can receive and respond to IAQ complaints. Tenants may also have an internal system for channeling complaints, for example through a health and safety representative, supervisor, or company doctor.

Indoor air quality complaints that can be resolved quickly and that involve small numbers of people (e.g., annoying but harmless odors from an easily-identified source) can be handled matter-of-factly like other minor problems without risking confusion and bad feeling among other building occupants. Communication becomes a more critical issue when there are delays in identifying and resolving the problem and when serious health concerns are involved.

If the problem seems to be widespread or potentially serious, it is advisable to work with your health and safety committee. If you do not have a health and safety committee, consider forming one, or establishing a joint management-tenant IAQ task force.

Productive relations will be enhanced if occupants are given basic information during the process of investigation and mitigation. Potential critics can become allies if they are invited to be part of the problem-solving process and become better educated about IAQ and building operations. Building managers may be understandably reluctant to share test results or consultants' reports with their tenants or employees, but secrecy in such matters can backfire if information leaks out at a later time.

Building management staff can be encouraged to talk directly with occupants both at the time a complaint occurs and later during a diagnostic investigation. Their observations about patterns of symptoms or building conditions may provide helpful information.

Confidentiality of records can be important to occupants, especially if they are concerned that IAQ complaints will lead to negative reactions from their employers. There may be legal penalties for violating confidentiality of medical records. By reassuring occupants that privacy will be respected, investigators are more likely to obtain honest and complete information.

It is advisable to explain the nature of investigative activities, so that rumors and suspicions can be countered with factual information. Notices or memoranda can be delivered directly to selected occupants or posted in general use areas. Newsletter articles or other established communication channels can also be used to keep building occupants up-to-date.

Problems can arise from saying either too little or too much. Premature release of information when data-gathering is still incomplete can produce confusion, frustration, and mistrust at a later date. Similar problems can result from incorrect representation of risk — assuming the worst case (or the best). However, if progress reports are not given, people may think nothing (or something terrible) is happening. It is good practice to clear each piece of information with the facility manager, building owner, or legal counsel. Management should attempt to be factual and to the point when presenting information such as:

- The definition of the complaint area based upon the location and distribution of complaints (this may be revised as the investigation progresses)
- The progress of the investigation, including the types of information that are being gathered and ways that occupants can help
- Factors that have been evaluated and found not to be causing or contributing to the problem
- How long the investigation might take
- Attempts that are being made to improve indoor air quality
- Work that remains to be done and the schedule for its completion

Vague discomfort, intermittent symptoms, and complex interactions of job stress with environmental factors, which make IAQ problems difficult to investigate, can also obscure the effects of mitigation efforts. Even after the proper mitigation strategy is in place, it may take days or weeks for contaminants to dissipate and symptoms to disappear. If building occupants are informed that their symptoms may persist for some time after mitigation, the inability to bring instant relief is less likely to be seen as a failure.