How clean is the air your employees breathe?

Take steps to remove invisible but dangerous indoor air hazards

Are you a manufacturing employer with an industrial hygienist on staff, or at least one on speed dial? Or do you run a service or retail business with no known air quality problems? Either way, it’s your duty to assess the air your workers breathe and take steps to keep it free of pollutants.

Indoor air quality (IAQ) is the subject of this Compliance Report. We review OSHA requirements and get the latest from air quality experts who specialize in industrial and office settings. Learn about hazards and remediations, and the challenges of balancing energy savings with the need for adequate ventilation.

Every breath you take

Most Americans spend about 90 percent of their time indoors. On average, office workers log 40 hours a week in office buildings. Employees also eat and sometimes sleep in enclosed environments where makeup air (the fresh air added to recirculated air) may be compromised.

That’s why some experts believe that more people may suffer from indoor air pollution than from outdoor air pollution.

IAQ is affected by many factors, including the site of the building, its original design, renovations that have been made, maintenance of air-handling systems, how densely the building is occupied, activities that take place inside, and the level of satisfaction of building occupants with their environment.

According to OSHA, many IAQ problems are associated with improperly operated and maintained heating, ventilating, and air-conditioning (HVAC) systems, overcrowding, radon, moisture incursion and dampness, and the presence of outside air pollutants. Then there are internally generated contaminants like cleaning supplies, aerosol products, mechanical contaminants, and improper temperature and humidity levels.

When air quality is good, workers have a sense of comfort, health, and well-being. Studies have also shown significant increases in productivity.

Poor IAQ, on the other hand, can cause all kinds of ailments and discomforts, including many that can mimic symptoms of allergies, stress, colds, and flu.

OSHA explains that the usual clue that the building is the problem is that people feel ill while inside, and their symptoms go away shortly after leaving the building, or when away from work for a weekend or a vacation.

Ignoring IAQ problems can be costly to workers and employers. Health effects from indoor air pollutants can be felt soon after exposure or years later. These include eye, nose, and throat irritation; headache; dizziness; rashes; muscle pain; and fatigue.

Asthma and hypersensitivity pneumonitis are also associated with poor IAQ. Personal factors that influence how an employee will react to an exposure include age, frequency and duration of the exposure, and preexisting health conditions, especially asthma and allergies.

Indoor air pollutants typically fall into three categories. Biological pollutants include bacteria, viruses, fungi, dust mites, animal dander, and pollen. They can be caused by inadequate maintenance and housekeeping, water spills, inadequate humidity control, condensation of water, or water from leaks.

Dampness in buildings has been linked with significant health effects. Varieties of bacteria and fungi, especially mold, can contribute to asthma, cough, wheezing, shortness of breath, congestion, sneezing, and sinusitis.

Chemical pollutants include gases and vapors from products used in the building. Among these products are office equipment, furniture, wall and floor coverings, pesticides, and cleaners.

Other sources of chemical irritants are construction activities and gases such as carbon monoxide.

The third category is particle or nonbiological pollutants. These are solid or liquid substances like dust or dirt that can be drawn into the building from outside. Particles can also be produced by activities such as construction, sanding, printing, copying, and operating equipment.

A management approach

OSHA recommends a systematic approach of the type employers use to address other safety and health problems. Familiar components include management commitment, training, employee involvement, hazard identification and control, and program audits.

“Management,” OSHA suggests, “needs to be receptive to potential concerns and complaints, and to train workers on how to identify and report air quality concerns.” The Environmental Protection Agency (EPA) has recommended flexible and specific activities that can help building owners and managers develop an IAQ plan. You can access this information at the EPA publications site, http://www.epa.gov/iaq/pubs.

OSHA and many experts advise a team approach to solving building problems. An IAQ team should include—but not be limited to—building occupants, administrative staff, facility operators, custodians, contract service providers, safety and health personnel, and health-care staff.

The first step is to identify and assess the situation. Steps can include:

- Identifying pollutant sources;
- Evaluating the HVAC system;
- Observing production and work processes;
- Measuring contamination levels and employee exposures;
- Conducting medical testing, physical exams, and employee interviews; and
- Reviewing medical tests, job histories, and injuries and illnesses.

Control measures include:

- Source management—removal, substitution, and enclosure of sources.
- OSHA calls this the most effective control method when it can be practically applied. An example is installing

(continued on page 4)
carpets that emit low amounts of volatile organic compounds (VOCs).

- Engineering controls—local exhaust, such as a canopy hood to remove sources of pollutants, general dilution ventilation systems, and testing and rebalancing HVAC systems.

- Air cleaning—removal of particles from the air as it passes through the HVAC equipment.

- Administrative controls—work schedules that reduce the time a worker is exposed to a pollutant or the amount of chemicals being used near workers, employee education, and good housekeeping.

To prevent IAQ problems, building managers should know and understand the history of the building (construction, uses, maintenance, etc.). If possible, maintain blueprints and construction documents that include information about renovations.

An important consideration is when to call in an air quality professional and/or government agency for assistance or direction. Types of experts include structural engineers, architects, mechanical engineers, and industrial hygienists.

**IAQ challenges in the manufacturing environment**

Donald M. Weekes is a certified industrial hygienist and certified safety professional. He is a partner with InAIR Environmental Ltd. in Ottawa, Canada, and is a member of the American Industrial Hygiene Association’s (AIHA) indoor air quality committee.

One of the growing concerns he sees for industrial workplaces is the production and use of nanomaterials. These are tiny particles whose beneficial properties have made them desirable in electronics, agriculture, cosmetics, fuel additives, and many other applications.

“The industry is growing rapidly and everybody is excited about the innovative uses for these products,” says Weekes. “What’s less certain is the impact of the tiny particles on safety and health, including potential inhalation hazards.

Another hot IAQ topic involves components and finished products imported from China, India, Vietnam, and other countries with significant pollution problems. “The problem is that these products may be coming in with contaminants we are not aware of,” suggests Weekes.

They can affect consumers as well as production employees who further process the components. An example is wheat brought into the United States to be processed into cereal. Weekes says manufacturers need to conduct vendor audits to ensure the safety of the ingredients in imported products.

An ongoing problem in commercial and industrial buildings is mold, which may be getting worse as a result of events like Superstorm Sandy. “You have these large storms not only in America, but all over the world that are creating problems in areas nobody ever suspected,” says Weekes. For example, some buildings in Lower Manhattan were once considered safe, but are now seeing mold problems as a result of the intrusion of unclean flood water. “It accumulates in basements, subways, garages, and can be a very destructive force.”

Because of the increased risk due to the frequency of such storms, building owners must ensure that their emergency plans address the issue. They also have to focus on how to seal basements and parking garages and ways of keeping water out.

Tightly sealed indoor environments create another challenge for building owners. Weekes calls the early 2000s the tipping point—the time when people went from reacting to building problems to taking a proactive approach. Contemporary building designs are incorporating features like green roofs, green interior walls, and a higher flow rate to ensure better ventilation. Also, today’s carpeting and other building materials give off fewer VOCs and off gases.

In addition, buildings are being designed to better resist water. Porous walls are one example. These allow water that enters to flow back outside without penetrating the interior of the building.

**IAQ challenges in the office environment**

David Zeidner is director of indoor air quality and emergency response for Hygieneering, a Chicago-area environmental consulting firm.

He specializes in nonindustrial environments, primarily offices. These are the places “where you’re not expecting to
find use of chemicals or production of by-products that you’d see in a manufacturing setting.” Zeidner says the typical call he gets is from a building engineer or property manager who’s received a complaint from an employee or other occupants about building-related health effects.

A typical cause is a lack of ventilation and insufficient outside air. Many modern buildings are designed to be highly energy efficient because HVAC systems are one of the biggest energy users in a building. “But the other end of that,” says Zeidner, “is that you can be potentially affecting the amount of outside air coming into the building. And with that you start getting symptoms.” Employees may also smell odors, such as those from VOCs that would be diluted if the correct amount of outside air was present.

### Find and fix

The process of identifying and remedying the problem starts with a building investigation, including interviews with occupants, the building engineer, and anyone else who may have insight. “Then we start gathering data on temperature, humidity, and amounts of carbon monoxide and carbon dioxide in the air.”

A common finding is the slow increase in levels of carbon dioxide (produced when people breathe) that is not being adequately displaced with fresh air. Symptoms can include sore throat, watery eyes, and difficulty concentrating. Some structures feature building automation systems that make it easy to punch in commands and increase the amount of outside air. Hardware systems or components of the HVAC system must be adjusted in other buildings.

Zeidner agrees with Donald Weekes that mold is a persistent problem, and it may not be as apparent as identifying moisture that results from flooding. Sometimes, the source of moisture or a leak is hidden behind furniture, in a wall cavity, or in a tenant space next door. In other cases, a long-ago moisture source was never properly addressed and worsened over time.

Remediation steps include a visual inspection, a moisture survey, and possible collection of airborne spores. The mold must be cleaned and/or physically removed and the moisture issue must be solved to avoid a recurrence of the problem.

### Role of technology

Another problem Zeidner sees in his practice is indirectly related to the huge advancements in technology since the 1980s. He explains that buildings constructed after that time were designed to accommodate an influx of computer monitors that gave off a good bit of heat. HVAC systems also were designed to respond to the heat that resulted from occupants’ respiration and incandescent light.

Today’s monitors do not emit heat, and in many cases, the buildings are less occupied than in the past. As a result, temperature fluctuation issues arise in many of these buildings, and office occupants fight the well-documented daily temperature wars.

### What can you do?

IAQ experts, including Zeidner, agree with OSHA that the best approach to address workplace problems is to be proactive. Consider calling in a specialist or take other action when you see a persistent (or perceived) problem with some regularity, Zeidner suggests.

He also urges employers to communicate with their employees—find out how they feel and listen to their concerns. Other ideas are to conduct an IAQ survey, establish a safety committee IAQ subcommittee, and consider earning Leadership in Energy and Environmental Design (LEED) or other green-building certification.

OSHA offers the following best practices for employers and others conducting IAQ investigations.

- Inspect and assess the building “envelope,” including roof, walls, and foundations, and promptly respond to identified problems. Routinely check for water leaks, seals around doors and windows, and any visible damp or moist areas. Clean and dry damp or wet building materials and furnishings within 24 to 48 hours to prevent mold.
- Ensure and validate that the building is maintained under a slight positive pressure (air comes out of the building when exterior doors are opened).
- Keep temperature and humidity in a recommended comfort range (68 to 76 degrees temperature and 30 percent to 60 percent humidity).
- Monitor CO₂ levels as a rough indicator of the effectiveness of ventilation and overcrowding.
- Consistently apply good housekeeping practices.
- Stay on top of routine preventive maintenance and building upkeep.
- Ensure that scheduled renovations are isolated from the building’s general dilution ventilation system when occupants are in the building.