NEW JERSEY DEPARTMENT OF HEALTH AND SENIOR SERVICES

INDOOR AIR QUALITY

NEW JERSEY DEPARTMENT OF LWD LABOR AND WORKFORCE DEVELOPMENT nj.gov/labor

Public Employees Occupational Safety and Health Program

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INTRODUCTION

The average person sends approximately 90% of their time indoors. Studies have indicated that indoor air is often dirtier and/or contains higher levels of contaminants than outdoor air. Because of this and increased awareness regarding poor indoor air quality (IAQ), it is not surprising that the number of reported employee complaints of discomfort and illness in non-industrial workplaces is increasing.

WHEN DID POOR INDOOR AIR QUALITY BECOME A PROBLEM?

Beginning in the mid-1970s, IAQ complaints increased for two reasons. The main reason was the impact of the energy crisis. To reduce heating and cooling costs, buildings were made “airtight” with insulation and sealed windows. In addition, the amount of outside air introduced into buildings was reduced. The second reason is that more chemical-containing products, office supplies, equipment, and pesticides have been introduced into the office environment increasing employee exposure. These changes created IAQ health problems known as Sick Building Syndrome (SBS) or Building-Related Illnesses (BRI).

WHAT IS SICK BUILDING SYNDROME?

A workplace is characterized with SBS when a substantial number of building occupants experience health and comfort problems that can be related to working indoors. Additionally, the reported symptoms do not fit the pattern of any particular illness, are difficult to trace to any specific source, and relief from these symptoms occurs upon leaving the building.

WHAT ARE THE SYMPTOMS OF SICK BUILDING SYNDROME?

Employee symptoms of SBS may include headaches; eye, nose, and throat irritation; dry or itchy skin; fatigue; dizziness; nausea; and loss of concentration.

WHAT ARE BUILDING-RELATED ILLNESSES?

A workplace is characterized with BRI when a relatively small number of employees experience health problems. Symptoms associated with BRI are generally different from those associated with SBS and are often accompanied by physical signs that are identified by a physician and/or laboratory findings. Relief from the illness may not occur upon leaving the building. BRI are caused by microbial contamination and/or specific chemical exposures that can result in allergic and/or infectious responses. Microbial contamiantion occurs when viruses, bacteria, or molds accumulate in areas such as heating, ventilation, and air conditioning (HVAC) systems, water-damaged ceiling tiles and carpets, hot water heaters, and humidifiers. Chemical exposures can be generated from specific sources within the workplace, such as formaldehyde emitted from newly installed carpets.

WHAT ARE THE SYMPTOMS OF BUILDING-RELATED ILLNESSES?

Employee symptoms of BRI may include eye, nose, throat, and upper respiratory irritation; skin irritation or rashes; chills; fever; cough; chest tightness; congestion; sneezing; runny nose; muscle aches; and pneumonia. Examples of BRI include asthma; hypersensitivity pneumonitis; multiple chemical sensitivity; and Legionnaires' Disease.

WHAT ARE THE SPECIFIC CAUSES OF SBS AND BRI?

The IAQ problems that cause SBS and/or BRI may include:

Lack of fresh air;

If insufficient fresh air is introduced into occupied spaces, the air becomes stagnant and odors and contaminants accumulate. Lack of fresh air in occupied areas is the number one cause of SBS.

Poorly maintained or operated ventilation systems;

Mechanial ventilation systems must be properly maintained and operated based on the original design or prescribed procedures. If these systems are neglected, their ability to provide adequate IAQ decreases. One problem associated with poorly maintained systems is missing, overloaded, or inefficient filters. This can cause higher levels of dust, pollen, and cigarette smoke to enter occupied spaces. Another problem is clogged condensate drain pans and drain lines in HVAC systems, which allow water to accumulate. The accumulation of water can lead to microbial contamination. Poorly maintained ventilation systems can contribute to both SBS and BRI.

Disruption of air circulation throughout the occupied spaces;

The quality of the air depends on the effectiveness of air distribution. If the air circulation is disrupted, blocked, or otherwise does not reach occupied areas, it can become stagnant. File cabinets, bookshelves, stored boxes, dropped ceiling tiles, added office walls, cubicles, and partitions can block or divert the supply of air to occupied spaces.

Poorly regulated temperature and relative humidity levels;

If the temperature and/or relative humidity levels are too high or too low, employees may experience discomfort, loss of concentration, eye and throat irritation, dry skin, sinus headaches, nosebleeds, and the inability to wear contact lenses. If relative humidity levels are too high, microbial contamination can build up and can cause BRI.

Indoor and outdoor sources of contamination;

Chemical emissions can contribute to BRI and SBS. Chemical contaminants in an office environment either originate from indoor sources or are introduced from outdoor sources. Common sources include emissions from office machinery or photocopiers; cigarette smoke; insulation; pesticides; wood products; synthetic plastics; newly installed carpets; glues and adhesives; new furnishings; cleaning fluids; paints; solvents; boiler emissions; vehicle exhaust; roof renovations; and contaminated air from exhaust stacks. Contaminants found in indoor environments can also include radon; ozone; formaldehyde; volatile organic compounds; ammonia; carbon monoxide; particulates; nitrogen and sulfure oxides; and asbestos.

WHAT IS CONSIDERED ACCEPTABLE IAQ?

The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) defines acceptable IAQ as:

> "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction."

WHAT CAN BE DONE IF THE AIR QUALITY IS UNACCEPTABLE?

In order to understand and resolve IAQ problems and concerns, standard investigative procedures should be followed. Investigating IAQ complaints, however, can be very complicated due to employee concerns, unknown sources of contamination, and the complexities of buildings and their ventilation systems. The New Jersey Department of Health and Senior Services, Public Employees Occupational Safety and Health (PEOSH) Program recommends the following general investigative procedures:

- Conduct employee interviews to obtain pertinent information regarding what symptoms are being experienced, how many employees are affected, when they are affected, where they work, what they do, etc. - this information may identify possible IAQ problems;

- Review building operations and maintenance procedures to determine when and what type of chemicals are being used during cleaning, floor waxing and stripping, painting, gluing, pesticide spraying, roofing operations, and renovation and construction activities, etc. - also determine when deliveries occur, which may generate vehicle exhaust, or if furniture, drapery, or office equipment has been recently installed;

- Conduct a walk-through inspection to evaluate possible sources that may contribute to IAQ complaints;

- Inspect the HVAC system, window air conditioners, office dehumidifiers, etc., in order to determine if the systems are working properly and are in good condition;

- Review the building blueprints of the ductwork and ventilation system to determine if the system is adequately designed;

- Conduct air sampling, if necessary, to determine if specific contaminants are present or if adequate fresh air is being supplied.

HOW CAN IAQ PROBLEMS BE CORRECTED AND/OR PREVENTED?

ENSURE ADEQUATE FRESH AIR SUPPLY

This has been shown to be the single most effective method for correcting and preventing IAQ problems and complaints. To ensure that adequate fresh air is supplied to occupied spaces, the following is recommended:

- A preventive maintenance schedule must be developed and followed in accordance with the manufacturer's recommendations or with accepted practice to ensure that the ventilation systems are properly checked, maintained, and documented.

- The preventive maintenance schedule should include the inspection and maintenance of ventilation equipment and/or system, making sure that:

  – outdoor air supply dampers are opened as designed and remain unobstructed;

- fan belts are operating properly, in good condition, and replaced when necessary;
- equipment parts are lubricated;
- motors are properly functioning and in good operating condition;
- diffusers are open and unobstructed for adequate air mixing;
- the system is properly balanced;
- filters are properly installed and replaced at specified intervals;
- components that are damaged or inoperable are replaced or repaired as appropriate; and
- condensate pans are properly draining and in good condition.

- To achieve acceptable IAQ, outdoor air should be adequately distributed to all office areas at a minimum rate of 20 cubic feet per minute (cfm) per person OR the concentration of all known contaminants of concern be restricted to some specified acceptable levels as identified in ASHRAE's "Ventiliation for Acceptable Indoor Air Quality" Standard.

- To determine if the ventilation system is effectively providing adequate fresh air, carbon dioxide (CO_2) levels should be measured; ASHRAE sets the standard (ASHRAE 62-1989) of 1000 ppm of CO_2 as the maximum recommended level for acceptable IAQ; CO_2, a byproduct of human respiration, is an indicator of the lack of fresh outdoor air and is not considered harmful at this level.

- If possible, gauges should be installed to provide information on air volumes delivered by supply and return fans. Maintenance staff should be trained to read the gauges and respond appropriately.

- A sufficient supply of outside air should be provided to all occupied spaces. An insufficient supply can cause the building to be at negative pressure, allowing untreated air and/or contaminants to infiltrate from outside. This can be determined by observing the direction of air movement at windows and doors. In order to prevent this problem, the air supply and exhaust system must be properly balanced.

- If the office layout is changed (e.g., by erecting partitions or new walls), ensure that adequate air flow and distribution is maintained.

- Ventilation system filters should have a moderate efficiency rating (60% or more), as measured by the ASHRAE atmospheric dust spot test, and be of an extended surface type. To determine if the filters have the appropriate efficiency rating, check with the manufacturer. Prefilters (e.g., roll type) should be used before air passes through higher efficiency filters.

- Avoid overcrowding of employees, and make sure that the proper amount of outdoor air is provided based on the number of occupants.

ELIMINATE OR CONTROL ALL KNOWN AND POTENTIAL SOURCES OF CONTAMINANTS, BOTH CHEMICAL AND MICROBIAL

To Control Chemical Contamination:

- Hazardous chemicals should be removed or substituted by less hazardous or non-hazardous chemicals, where possible.

- Properly store all chemicals to minimize exposure hazards.

- Use local exhaust ventilation to capture and remove contaminants generated by specific processes where appropriate. Ensure that local exhaust does not recirculate the contaminated air, but directly exhausts the contaminant outdoors. Check with the manufacturer of your office machines for guidance on ventilation requirements for their equipment.

- Check to be sure that HVAC fresh air intakes or other building vents or openings are not located in close proximity to potential sources of contamination (e.g., places where motor vehicle emissions collect, downwind of exhausts, cooling towers). If necessary, raise stacks or relocate intakes or exhausts.

- Isolate areas of renovation such as painting, carpet installation, etc., from occupied nonconstruction areas, through use of physical barriers and isolation of involved ventilation systems. If possible, perform this type of work in the evening or on weekends. Supplying the maximum amount of fresh air to these areas can assist in the dispersion of contaminant levels.

- Use a licensed pesticide applicator for pesticide applications and follow their recommendations regarding appropriate ventilation controls.

- Eliminate or reduce cigarette smoke. Smoking restrictions or designated smoking areas should be considered. The air from designated smoking areas must not be recirculated to non-smoking areas of the building.

To Control Microbial Contamination:

- Promptly detect and permanently repair all areas where water collection or leakage has occurred.

- Maintain relative humidity at less than 60% in all occupied spaces and low air-velocity plenums. During the summer, cooling coils should be run at a low enough temperature to properly dehumidify conditioned air.

- Check for, correct, and prevent further accumulation of stagnant water by maintaining proper drainage of drain pans under the cooling coils.

- Due to dust or dirt accumulation or moisture-related problems downstream of heat exchange components (as in ductwork or plenum), additional filtration downstream may be necessary before air is introduced into occupied areas.

- Heat exchange components and drain pans should be accessible so maintenance personnel can easily inspect and clean them. Access panels or doors should be installed where needed.

- Non-porous surfaces where moisture collection has promoted microbial growth (e.g., drain pans, cooling coils) should be properly cleaned and disinfected. Care should be taken to ensure that these chemical cleaners are removed before ventilation systems are reactivated.

- Porous building materials contaminated with microbial growth, such as carpets and ceiling tiles, must be replaced or disinfected to effectively eliminate contamination. Note that the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that contaminated porous materials should be discarded.

RESOURCES

Agencies and organizations that provide information on indoor air quality:

New Jersey State Department of Health and Senior Services
PEOSH Program, 7th Floor
PO Box 360
Trenton, NJ 08625-0360
(609) 984-1863

The PEOSH Program has an Indoor Air Quality Standard (N.J.A.C. 100-13) for public employees in New Jersey. The following publications, including a copy of the standard and additional information may be obtained from the above address or the PEOSH web site at www.nj/gov/health/eoh/peoshweb:

* PEOSH "Indoor Air Quality Model Program";
* The American Industrial Hygiene Association's Consultants' List;
* PEOSH Information Bulletin, "Mold in the Workplace, Prevention and Control";
* PEOSH Information Bulletin, "Renovation and Construction in Schools, Controlling Health and Safety Hazards".

U.S. Environmental Protection Agency
Indoor Air Quality Information Clearinghouse
PO Box 37133
Washington, D.C. 20013-7133
(800) 438-4318

The United States Environmental Protection Agency (USEPA) has various publications on indoor air quality in the home, at schools, and in offices. The publications can be obtained from the address above or from the USEPA IAQ Information Clearinghouse web site at www.epa.gov/iaq/iaqxline.html.

American Conference of Governmental Industrial Hygienists
Kemper Woods Center
1330 Kemper Meadow Drive
Cincinnati, OH 45240
(513) 742-2020

The American Conference of Governmental Industrial Hygienists (ACGIH) has a publication that addresses indoor bioaerosols issues, "Bioaerosols-Assessment and Control" Publication #3180. This publication can be obtained from the above address.

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329
(404) 636-8400

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has two publications that are especially useful:

* ASHRAE 62-2001 "Ventilation for Acceptable Indoor Air Quality" Standard, and
* ASHRAE 55-1992 "Thermal Environmental Conditions for Human Occupancy" Standard.

The publications can be obtained from the address above or from the ASHRAE web site at www.acgih.org/store.

PEOSH PROGRAM
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Please take a few minutes to help us evaluate this publication. Please check the following:

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Which section did you find most useful?

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Other occupational health topics on which you would like to see the PEOSH Program develop an information bulletin:

Other comments and suggestions:

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