A Union of Professionals

Health and Safety Program

WHAT YOU SHOULD KNOW ABOUT

INDOOR AIR QUALITY

WORK shouldn't HURT

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SICK BUILDING SYNDROME

The year 1973 was marked by an important event: the nation was struck by an oil embargo that made us realize how finite and precious our energy supplies were. We recognized, that year, that commercial buildings accounted for nearly ¼ of all energy consumption. A new challenge to the nation was the rapid development of energy "efficient" buildings. State and public agencies as well as school districts made special efforts to conceive model programs.

Building engineers took radical steps to cut energy consumption in commercial buildings. They chose such strategies as sealing windows, reducing the amount of outdoor air in ventilation systems and shutting down ventilation systems periodically. This approach cut down energy consumption, but it brought an epidemic of "sick building syndrome".

What is Sick Building Syndrome?

Sick Building Syndrome is a host of physical complaints experienced by a large percentage of building occupants. Common symptoms include headache; eye, nose and throat irritation; dry or itchy skin; dizziness; nausea; and sensitivity to odors. Workers often complain of chronic fatigue and the inability to concentrate. Some suffer from allergic reactions and asthma. Most workers report relief when leaving the building.

When complaints escalate to illnesses with coughing, chest tightness, fever, chills and muscle aches, occupants or workers are suffering from a "building related-illness". It may take long periods of time to recover from the illnesses.

What Causes Sick Building Syndrome?

In most cases, indoor air pollution accounts for these problems. The pollution can come from several sources, most notably:

> **Inadequate Ventilation** – Since 1973, owners of commercial buildings with heating, ventilating and air conditioning systems (HVAC0 have reduced the amount of outdoor (fresh) air mixed into the circulation systems to save energy. Most systems were originally designed to provide as much as 15 cubic feet per minute (cfm) of outside air for every building occupant. Now, most systems have been reduced to 5 cfm per building occupant.

The most immediate effect is that the level of carbon dioxide, a gas that we all exhale, rises. High carbon dioxide levels are a sure indicator of the lack of fresh air and the possible presence of other contaminants. Although this gas is not dangerous in levels found in most buildings, high concentrations [over 1500 parts per million (ppm)] have been associated with fatigue, drowsiness and the inability to concentrate.

Indoor Pollutants – These pollutants can come from all types of sources within a building. For instance, certain insulation materials can give off formaldehyde, an irritating and sensitizing chemical. Adhesives, carpeting, pesticides, copying machines and cleaners can emit irritating or toxic organic compounds into the office atmosphere.

Outside Sources – Indoor air can be contaminated from sources outside the building. The outside air intakes are often placed in improper positions, e.g., next to loading docks, plumbing vents and other building exhausts. As a result, motor vehicle exhausts fumes, toilet gas and other contaminants can be drawn into the building. Several cases of sick building syndrome have involved carbon monoxide and nitrogen dioxide entering a building from an attached or underground garage.

Biological Contamination – Bacteria, molds, pollen and viruses can be a troubling source of contamination. HVAC systems are often the culprit. Biological organisms may breed in stagnant water pooled in humidifiers and cooling coil condensate pans. Often small leaks in pipes and roofs permit water to accumulate behind walls or in ceiling tiles – bacteria and molds can grow unnoticed until symptoms begin. Coughing, chest tightness, chills, fever and allergies are the most common complaints related to biological contamination.

What about Radon and Asbestos?

Radon and asbestos are generally not considered a cause of sick building syndrome and building-related illnesses. The health effects of radon and asbestos are long-term as opposed to the acute or short-term nature of sick building syndrome.

Radon and asbestos are, however, an important indoor air quality problem and can pose a serious health risk. Both should be included in comprehensive programs to evaluate a building's indoor air quality.

What Can You and Your Local Do?

Indoor air pollution is a topic management people often try to avoid. Many don't have a clue to how their building's ventilation system functions.

There are several steps that you and your local can take to get action from reluctant management:

1. Don't let management isolate you if you are having sick building syndrome symptoms. Talk to your co-workers and students; do a simple survey and encourage people to keep a diary of when symptoms occur. Once you have gathered that information, approach management and ask for an investigation.
2. Ask for union involvement in the investigation of the ventilation and source of the pollution. Invite management to form a joint labor-management committee.

3. Do a work-around of your building to look for suspicious sources of contamination, e.g., wet or water-stained ceiling tiles, copying machines that are unventilated, etc.

4. If simple solutions cannot be found, an indoor air quality (IAQ) consultant should be called in to study the building. IAQ consultants will try to identify the nature of existing problems by having confidential discussions with workers, walking through the building and examining key parts of the ventilation system. After this phase, they can often give recommendations for correcting the situation.

   Further investigation may be needed. Consultants may sample for pollutants and test air flow. An engineering analysis of the HVAC system may be recommended.

5. Ask that the recommendations of the consultant be acted upon in a reasonable amount of time. For instance, contaminated filters in the HVAC system may need to be replaced or cleaned, water leaks may need repair, and water-stained carpet and/or tile may need to be removed. Repair and remodeling work could be performed after hours or on weekends, and ventilation could be boosted to remove paint and solvent contaminants.

Some state federations are going a step further and are pursuing legislation and/or state guidelines for checking and maintaining ventilation systems of publicly-owned and leased buildings. This may be an important step in protecting the health and well-being of our members.

Indoor Air Quality (IAQ) Investigation Checklist

Every indoor air quality (IAQ) problem is unique. There may be several steps to unraveling the cause from a multitude of possibilities in any given building. A typical investigation of a school or commercial building will include:

- Identifying occupant complaints that they associate with poor indoor air quality.
- Evaluating the adequacy of building ventilation (the heating, ventilation and air conditioning [HVAC] system).
- Inspecting special areas (art, vocational, science, maintenance areas, smoking lounges) that might be contributing to the problem.

Since an investigation may be lengthy and eventually require the services of an expert, your local should consider inviting management participation in the process.

Here are some recommended steps in pursuing an investigation:

1. The first important clues to IAQ problems in a building come from the occupants. We do not yet have the surveillance and monitoring technology that matches their sensitivity to an IAQ problem.

   Survey occupants of the building (including older children in a school setting) about their complaints and comfort levels at different times of the day. You can design your own survey; there are several good models that you can borrow from (see the AFT sample indoor air quality survey).

   A committee should evaluate the surveys to ascertain if the entire building is "sick" or if there are problem areas or times when symptoms are more prominent.

2. Meet with the building engineer to discuss the heating, ventilation and air conditioning (HVAC) system and bring a list of questions as follows:

   A. What are the possible sources of contaminated outside air in our building? For instance, are any of these problems:
      _____ smog
      _____ emissions from nearby industrial and commercial sources (factories, dry cleaners, etc.)

_____ vehicle exhaust from busy roadways or parking garages
_____ exhaust from the loading dock entering outside air intakes
_____ the possibility of "reentrained" exhaust from the building itself re-entering the outside intakes
_____ unsanitary debris near the outside air intakes

B. How well is the HVAC system maintained?
_____ Is the system run according to manufacturer's specification?
_____ How often is the system checked and maintained, i.e., fans, air diffusers and other devices to distribute air?
_____ Is there regular calibration of automatic controls (i.e., controls that switch fans on and off, regulate temperature of air and modulate air flow, etc)?
_____ What is the efficiency of filters? (Filters remove dust, bacteria, pollen, soot, dirt, etc. Efficiency should be between 70-85%.)
_____ How often are filters replaced or cleaned?
_____ Is there any accumulated dust or dirt in the duct work or other components?
_____ Is there any microbiological growth at drip pans and humidifiers?
_____ How much fresh air (outside air) is brought in? This is measured in cubic feet per minute (cfm) per occupant (a good range is 15-20 cfm per person).
_____ Is the outside air intake rate adjusted when there are changes in building occupancy?
_____ Where are the outside air intakes located?

If the building engineer or maintenance personnel cannot answer these questions, contact the manufacturer or consider consulting an HVAC engineer (see expert section). Compare the answers that you receive to these questions to the **AFT "Elements of an Ideal HVAC System"** fact sheet).

Step 3: Do your own walk around of the building to look for potential trouble spots.

- Locate outside air intakes, if possible, and determine if contaminants can enter through the intakes.
- Look for sources of contaminated air from human activities:
  _____ smoking

_____ pesticide use
_____ cleaning agents & housekeeping activities
_____ volatile organic compounds (VOC's) emitted from painting, caulking, application of adhesives, etc.
_____ overcrowded offices or classrooms (too many occupants with inadequate ventilation may lead to a build-up of carbon dioxide (respiration), cosmetics, etc.

- Inspect equipment throughout the building

_____ Are copying machines in a well-ventilated area? Is there special local ventilation for copying machines?
_____ Do copying machines, mimeo machines or printing operations use and/or emit solvents, toners, ozone, etc.?

- Look at special use areas (as they apply to your situation):

_____ print shops. How well is the printing operation ventilated, i.e., local ventilation? Is there a possibility that fumes escape into general ventilation?
_____ laboratories. Are there hoods and local ventilation over experiment areas? Are they functioning properly and ventilated to the outside?
_____ vocational education. Are operations (auto painting and repair, carpentry wood dust, solvents, etc.) ventilated properly? (There should be local ventilation to the outside). Is there any possibility that fumes may be escaping into the general ventilation?
_____ smoking lounges. Are smoking lounges adequately ventilated; does smoke escape into the general ventilation?
_____ maintenance areas. Are repair and painting operations well-ventilated? are toxic chemicals and products stored properly to avoid leakage?

- Look at building components that might be a source of contamination:

_____ Are curtains and carpeting contributing to a dust and emissions problem? (New carpet may be emitting volatile organic compounds.)
_____ Has there been recent renovation in the building that might be contributing to emissions (particle board, wall treatments, adhesives etc.)?
_____ Is there any new furniture in the building? (Upholstered furniture and furniture made of particle board may be emitting sensitizing quantities of VOC's and formaldehyde.)

- Look for possible sources of water damage and unsanitary conditions:

_____ microbiological growth on surface areas such as walls, ceilings, ceiling tile and water-damage surfaces
_____ any surface condensation or indicator of leaking behind walls
_____dry traps passing sewer gas

After you do a walk around, prepare a list of potential or suspected problem areas; see if there is any association between complaints of occupants in these areas and suspected problems.

Step 4: Develop a plan of action based on your initial investigation. After you do an initial investigation, make a list of potential remedies and actions.

One important remedy will the establishment of a permanent IAQ management plan. Management and/or the building owner should be encouraged to develop this plan and designate a well-trained person to implement it. At a minimum, an IAQ building management plan should provide for:

- Regular maintenance of HVAC systems
- Oversight of activities of staff, tenants, contractors and other building occupants that might have an impact on indoor air quality
- Reasonable smoking policies
- Pest control
- Resolution of complaints about the environment
- Education of building occupants

- Management of projects so that they do not jeopardize good air quality (redecorating, renovation, new construction, rearranging partitions or moving staff of functions in a building)

If the problem appears to need expert attention, decide what kind of expert you might need to help evaluate the problem and/or come up with the solution. Your state health department may be able to assist you in your investigation; the National Institute for Occupational Safety and Health may be able to do a health hazard evaluation. (Contact the AFT health and safety program for referrals).

Other consultants could include:

- Industrial hygienists who are trained to evaluate exposure; an industrial hygienist experienced in indoor air quality problems will typically interview occupants, measure levels of carbon dioxide throughout the building at different times of the day, and look for other potential sources of contamination.
- HVAC engineers who understand the operations of ventilation systems and can be instrumental in designing a mitigation plan.

Consult AFT or EPA for the names of firms and advice on selecting the right kind of firm for your problem.

Step 5: Educate your members on your findings every step of the way.

Elements of an Ideal Heating, Ventilation and Air Conditioning (HVAC) System

1. The outside air intakes are far above ground level, preferably at roof-top height.

2. Air intakes are 25 feet or more away from the nearest exhaust outlet.

3. Air intakes are always open during occupancy, a building engineer or representative understands the HVAC (heating, ventilation and air conditioning) system and can readily determine that the intakes are open.

4. Air intakes are protected from rain or snow, at least 20 feet from standing water and 20 feet from a cooling tower.

5. There are at least 15 cubic feet of outside air per minute (cfm) per person entering through air intake; adjustments are made when occupancy rates change; i.e., more people or students come into the building.

6. Air filters are 70-85% efficient, located upstream from the heating components and changed upon reaching the pressure differential recommended by the manufacturer.

7. If smoking is permitted in a designated room, the air from the room is exhausted directly to the outside of the building, smoking rooms should maintain a ventilation rate of 50 cfm per person and the room should be under negative pressure (i.e. when the door, air is pulled into the room and no smoke can escape into non-smoking areas).

8. Cooling coils and drip pans are easily accessible for inspection and cleaning.

9. Drip pans are slanted towards a drain and the drainage tubes are flush with the lowest area of the pans.

10. Drainage tubes draining water from the pan have a U-shaped vertical bend that is 2 inches greater than the static pressure of the system at that point.

11. Air velocity through cooling systems is less than 500 linear feet per minute.

12. Cooling systems, hot water systems and steam systems utilize water which is not treated by chemicals.

13. The water system temperatures are always greater than 140 degrees F. (heating) or less than 42 degrees F. (cooling).

14. Relative humidity is always between 20% and 40%; never above 50%.

15. The only system of humidification is live, untreated steam.

16. Air is continuously distributed to all occupied areas at the rate of 6 or more air changes per hour.

17. There is adequate number of air supply, return and exhaust outlets or grilles provided: simply, return and exhaust outlets should be properly located to insure a uniform distribution of air) no short-circuiting).

18. Toilet rooms exhaust air directly to the outside of the building at the rate of 60 cfm per fixture (water closets and urinals).

19. There is nearly an equal volume of air exhausted from the building compared to air intake, providing a slight positive pressure.

20. Loading docks have a positive pressure relative to the outdoors when vehicles dock outside the building (i.e., exhaust is not drawn into the building).

21. Double entrances to underground parking have a positive pressure relative to the garage.

22. The carbon dioxide concentration in occupied areas is less than 700 parts per million of air (ppm).

23. Woodworking, automotive, metal working, science, arts and crafts activities are provided with local exhaust ventilation and activity areas have a negative pressure relative to other occupancies in the building.

Adapted from: *American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) guidelines*
DILHR, Safety & Buildings Division, State of Wisconsin

Indoor Air Quality Survey

The union is conducting this survey to determine the existence, extent and possible causes of indoor air quality problems at your facility. Please take a few minutes and complete it. All responses are anonymous.

1. **Do you currently have any illnesses, symptoms or discomfort that you attribute to conditions in your room or building?** Yes No

   How is your general comfort at school? Please identify any complaints that apply to you, and describe their frequency below.

	Frequency of Occurence		
	Never	**Once a week or less**	**More than once a week**
Room is too hot?			
Room is too cold?			
Stuffy air?			
Air is too moist?			
Air is too dry?			
Air is too dusty?			
Noticeable odors?			

2. **How is your health at school? Please indicate which of the following symptoms you experience at work, as well as the frequency of their occurrence?**

	Frequency of Occurence		
	Never	**Once a week or less**	**More than once a week**
Dry skin/skin irritation?			
Eye irritation?			
Contact lens discomfort?			
Headache?			
Fatigue?			
Drowsiness?			
Sinus congestion/infection?			
Throat irritation?			

	Frequency of Occurence		
	Never	**Once a week or less**	**More than once a week**
Runny nose?			
Chest tightness/wheezing?			
Allergies?			
Difficulty breathing?			
Recurrent fever?			
Nausea?			
Muscle weakness?			
Loss of coordination?			
Heart palpitation?			

3. **Do any of your symptoms occur more frequently at certain times of day?** Yes No

   If so, when? (Check all that apply)

	Yes	**No**
Morning		
Midday		
Afternoon		

4. **If you have health symptoms while in this building, how long do they last after you have left the building?**

	Yes	**No**
Less than one hour		
1-12 hours		

Overnight		
Over the weekend		
Longer than two days		

5. **Have you been diagnosed by a healthcare provider with any of the following since beginning work at your present facility? (Check all that apply)**

	Yes	Dates	No
Asthma			
Chronic bronchitis			
Chronic sinusitis or sinus infection			
Sarcoidosis			
Allergies			
Other illness you associate with your workplace			

6. **Does your room have any visible mold growth?** Yes No

If so, where in the room is the mold growing?

_____

_____

7. **Is there evidence of water leaks in your room? (i.e., water stains on tile, walls, or carpet)** Yes No

   If so, where in the room are the water leaks?

   _____

   _____

8. **Has there been any renovation work in your room or facility over the last year?**

   (carpet replacement, painting, window replacement, etc.)0 Yes No

   If so, please describe

   _____

   _____

   Please describe any other conditions/problems that may be contributing to your discomfort and/or symptoms

   _____

   _____

   Classroom or office location _____

   Job classification _____

9. **How many years have you worked at your current location?**

	Yes	No
Less than one year		
1-5 years		
6-10 years		
11-15 years		
16-20 years		
More than 20 years		

10. **How many years have you worked at your current location?**

	Yes	No
Less than one year		
1-5 years		
6-10 years		
11-15 years		
16-20 years		
More than 20 years		

11. Age?

	Yes	No
Under 20		
20-25		
26-30		
31-35		
36-40		
41-50		
51-55		
55-60		
Over 60		

12. Sex

	Yes	No
Male		
Female		

13. **Do you have Internet access?** Yes No

If so, is it through:

	Yes	No
Work		
Home		
Both		