INDOOR AIR QUALITY ASSESSMENT

Richardson/Olmstead Middle School
101 Lothrop Street
Easton, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of the Easton Board of Health, an indoor air quality assessment was done at the Richardson/Olmstead Middle School in Easton, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). On March 1, 2000, a visit was made to this school by Cory Holmes, Environmental Analyst, in the Emergency Response/Indoor Air Quality Program (ER/IAQ), BEHA to conduct an indoor air quality assessment. Mr. Holmes was accompanied by Suzan Donahue, Research Assistant, BEHA.

The school is a two-story brick building built in 1996. The building houses the H. H. Richardson School and the F. L. Olmstead School. Both middle schools are combined within this single building. Each school consists of a wing of classrooms, with a shared/common area containing the cafeteria, library, gymnasium and administrative offices. Above the second floor is a penthouse, containing ventilation equipment [i.e., air handling units (AHUs) and exhaust motors].

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer.

Results

The building houses grades four through six and has a total student population of approximately 800 and a staff of approximately 70. Tests were taken under normal operating conditions. Test results appear in Tables 1-4.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million (ppm) in all areas surveyed, except the gymnasium. These levels are indicative of an overall ventilation problem in the school. Fresh air in classrooms is supplied by a mechanical unit ventilator (univent) system (see Figure 1). Ventilation for the common areas (e.g., gymnasium, cafeteria, library, etc.) is provided by AHUs located in the ventilation penthouse. It was reported by school maintenance staff that outside air dampers had been temporarily closed due to mechanical/electrical problems. Closed dampers minimize fresh air draw by univents and could contribute to the elevated carbon dioxide levels measured in this building. Reportedly, the fresh air dampers were malfunctioning. Dampers were reported to remain open, which can lead to freezing of pipes and can result in flooding. School officials reported that a heating, ventilating and air conditioning (HVAC) vendor has been contracted to repair the fresh air dampers. BEHA staff has offered to return to the school to conduct follow-up air testing once repairs are complete.

Mechanical exhaust ventilation is provided by ceiling or wall-mounted intake grills connected by ductwork to exhaust motors located in the ventilation penthouse. As with the univent systems, a number of exhaust vents were experiencing mechanical/electrical

problems and were not operating. The HVAC contractor is also reported to be working to repair this system.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a univent and exhaust system, these systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. The system should be balanced by a ventilation engineer once it is fully operational.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (BOCA, 1993, SBBRS, 1997). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this occurs a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the

majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings were within a range of 71^0F to 77^0F, which is within BEHA's recommended comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70^0F to 78^0F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in this building was below the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 17 to 28 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Several classrooms had a number of plants. Moistened plant soil and drip pans can serve as a source of mold growth. Several classrooms had flowering plants on top of univents. Plants should be equipped with drip pans and located away from univents to prevent the aerosolization of dirt, pollen or mold.

Other Concerns

Several other conditions were noted during the assessment, which can affect indoor air quality. Most classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

The teacher's lounge contains a photocopier. Excess heat, volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). Local exhaust ventilation should be activated while equipment is in use to help reduce excess heat and odors in this room.

Conclusions/Recommendations

In view of the findings at the time of our inspection, the following recommendations are made:

1. Continue with plans to work with the HVAC contractor to correct mechanical/electrical problems.
2. Once the school's HVAC systems are operational they should be balanced by the HVAC contractor; increase the percentage of fresh air intake, if necessary.
3. Operate AHUs, univents and exhaust vents during periods of school occupancy.
4. Remove all obstructions from univents and mechanical exhaust vents to facilitate airflow.

5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Move plants away from univents in classrooms. Ensure drip pans are placed underneath plants in classrooms. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary.
7. Ensure that exhaust vents are functioning whenever photocopiers or other odor producing office equipment is in use.
8. Upon completion of repairs, contact the BEHA for a follow up IAQ evaluation.

References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

TABLE 1

Indoor Air Test Results –Richardson Middle School, Easton, MA – March 1, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in A	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	406	56	30					
A 222	1639	75	25	26	yes	yes	yes	exhaust off
A 224	1610	75	23	1	yes	yes	yes	univent and exhaust off
A 218	1353	73	26	26	yes	yes	yes	2 windows open
A 208	1059	71	25	25	yes	yes	yes	exhaust off, window open, plant
A 114	1397	75	25	23	yes	yes	yes	exhaust off
A 122	1119	75	23	6	yes	yes	yes	exhaust off, 2 CT, 1 ceiling tile ajar, 6+ plants
A 102 (Music)	1206	75	25	22	yes	yes	yes	door open
Cafeteria	1070	75	23	~350	yes	yes	yes	exhaust off
A 221	1800	77	17	25	yes	yes	yes	exhaust off, door open
A 219	1517	77	20	26	yes	yes	yes	exhaust off

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –Richardson Middle School, Easton, MA – March 1, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in A	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Computer A				0	yes	yes	yes	window open, exhaust on
A 207	1246	75	18	25	yes	yes	yes	exhaust off
A 209	1155	75	17	26	yes	yes	yes	window and door open
A 103 (Art A)	1246	73	20	27	yes	yes	yes	5 plants-near univent
A 125	1143	72	19	5	yes	yes	yes	2 plants-near univent, 1 missing ceiling tile, door open
Gymnasium	787	72	18	~25	no	yes	yes	

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	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results –Olmstead Middle School, Easton, MA – March 1, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in B	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	406	56	30					
B 215	2000+	76	24	26	yes	yes	yes	exhaust off
B 221	2000+	74	24	30	yes	yes	yes	exhaust off
B 201	1350	75	18	20	yes	yes	yes	exhaust off, window and door open
B 127	860	72	19	6	yes	yes	yes	exhaust on, door open
B 113	1310	73	21	23	yes	yes	yes	exhaust off, door open
B 119	1295	75	19	24	yes	yes	yes	exhaust off, 1CT
B 206	1419	75	27	24	yes	yes	yes	exhaust off, cleaning products on counter (Fantastic/Windex), odor-plug in air freshener, student complaints-buzzing noise from light fixtures
B 226	1413	75	24	20	yes	yes	yes	30 computers
Teacher's Lounge	1004	75	25	21	yes	yes	yes	6+ plants

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Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results –Olmstead Middle School, Easton, MA – March 1, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in B	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
B 117	1170	72	27	27	yes	yes	yes	exhaust off
B 120	1233	74	28	19	yes	yes	yes	exhaust off
Library	863	74	25	21	yes	yes	yes	photocopier, 8 computers

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%