

INDOOR ENVIRONMENTAL QUALITY INVESTIGATION

**NEW HOPE Elementary School
R.R. #4
Fairfield, Wayne County, Illinois
IDPH File No. 505020301**



Illinois Department of Public Health
Division of Environmental Health
Toxicology Program
May 2003

PURPOSE

The Illinois Department of Public Health (IDPH) performed an indoor environmental quality (IEQ) investigation at the New Hope Elementary School in response to concerns from administration and staff about musty odors and stuffiness in the newly constructed building addition. Our investigation included a visual inspection of the school building and its heating, ventilating, and air conditioning (HVAC) system and environmental monitoring.

BACKGROUND AND STATEMENT OF ISSUES

On Friday, May 2, 2003, staff from the IDPH Marion Regional Office Toxicology Section conducted an inspection at the New Hope School in rural Fairfield, IL. The inspection was initiated after receiving a request for assistance from the Wayne County Health Department and the school Superintendent.

According to the Superintendent, a 12,000 ft² addition to the school was recently constructed and occupied in August 2002. Since occupying the building; however, staff have complained of a noticeable odor in various areas of the building. The odor has been described as musty, ammonia-like, and dusty. Interviews with various staff at the time of the inspection also revealed complaints of stuffiness, temperature fluctuations, and complaints from students such as headaches and fatigue particularly during afternoon classes.

New Hope School is a rural elementary school approximately 4 miles south of Fairfield, Illinois just off of Route 45. Agricultural fields are directly north of the building. The building houses Kindergarten through 8th grade with a population of 164 students and 22 staff. The new building addition includes 7 classrooms, a kitchen, cafeteria, and hallway. A new gymnasium was also constructed but this is on a separate HVAC system and was not implicated as a complaint area.

Carpeting covers the floors in the hallway and tile covers the floors in the classrooms. The walls are a block construction with operable windows to the outside. Exterior doors are on the north and south ends of the hallway. The addition is built on a concrete slab with all the HVAC ductwork and units in the attic area. The attic area is easily accessible for convenience of servicing the units. Air filters are changed monthly. At the time of the May 2nd inspection, IDPH staff inspected this area with school maintenance staff. Units and filters were inspected. The filters were all generally clean; however, the return air side of the filter on the fresh-air units were heavily dust covered. The maintenance supervisor indicated this side of the filter is always very dusty at the time of each monthly changing. He also indicated it is a constant challenge to keep birds from making nests in the fresh-air intake grills on the outside of the buildings.

The HVAC system for this area is a Carrier brand geothermal heat pump system. Forty wells at depths of 225 feet supply water for the system. Two large units (one on the north end; one on the south end) with outside air intakes supply fresh-air to 10 heat pump HVAC units. Each room and

the hallway have separate HVAC units/controls to heat/cool its designated area. Four supply air diffusers and one return air vent are in the ceiling in each classroom. A fifth supply diffuser is in each classroom. Air flows from this diffuser from the fresh-air supply unit which operates a blower constantly when the building is occupied. When the HVAC unit kicks on to heat/cool the room, the air supply to this vent shuts off.

A visible inspection of the interior and exterior of the building did not identify any areas of water damage or active water leaks. Some of the classrooms did appear stuffy (warm/humid) while other classroom occupants complained of the air being too cool. The maintenance supervisor indicated the system was supposed to have been balanced and each classroom unit adjusted but he did admit he responds to temperature complaints from building occupants daily.

RESULTS

Ventilation assessment monitoring for carbon dioxide (CO₂), temperature (°F), and relative humidity (%RH) was conducted from May 2 - 14, 2003. Machines were placed in the following rooms:

1. 6th Grade Classroom
2. 5th Grade Classroom
3. 2nd Grade Classroom
4. Office

Graphs illustrating results of the monitoring are attached to this report in Appendix 1. (Note: The monitor in the 2nd grade classroom was placed near the window causing the temperature readings to be abnormally high from the heat of the sun. The CO₂ monitor in the office malfunctioned disqualifying the CO₂ results for this area).

Carbon Dioxide

Carbon dioxide is a normal constituent of exhaled breath and is commonly used as a screening tool to evaluate whether adequate volumes of fresh outdoor air are being introduced into a building. The outdoor level of CO₂ is usually 300 - 400 parts per million (ppm). If indoor levels are more than 1,000 ppm, there is probably inadequate ventilation; and complaints such as headaches, fatigue, and eye and throat irritation may be prevalent. The CO₂ itself is not responsible for the complaints; however, high CO₂ levels may indicate that other contaminants in the building may also be present at elevated levels and could be responsible for occupant complaints.

Carbon dioxide levels recorded in the monitored classrooms in the school consistently exceeded 1,000 ppm during periods of occupancy. The CO₂ levels generally peaked at approximately 1,400 ppm around 2:00 pm.

The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) has developed standards for indoor air quality which can be found in the document *Ventilation for Acceptable Indoor Air Quality* (ASHRAE 55-1992). These guidelines recommend that school classroom areas be supplied with 15 cubic feet per minute (CFM) of outside air per person.

Temperature

Temperature is frequently identified in indoor air complaints because it is directly linked to occupant comfort. Excessively high or low temperatures can lead to general thermal discomfort and occupant dissatisfaction. ASHRAE (Standard 55-1992 section 5.1.2) recommends that temperatures be maintained between 68 and 75 °F (71 °F is optimal) during the winter months and between 73 and 79 °F (76 °F is optimal) during the summer months. These ranges are generally acceptable for sedentary or slightly active persons.

The temperatures recorded in the school ranged from approximately 69 °F to 75 °F. The recorded temperature for each monitored area can be seen on the corresponding graph (Appendix 1).

Relative Humidity

Relative humidity (%RH) is an important factor in indoor air quality because moisture levels are linked to occupant comfort and other considerations. High moisture levels impair the body's ability to lose heat, and can lead to microbial growth. This growth may lead to irritating odors, cause permanent damage to building components, and result in a variety of infectious or allergic illnesses for building occupants. Excessively low moisture levels result in dry air that can irritate the lungs, eyes, nose and throat. ASHRAE (Standard 55-1992) recommends that %RH be maintained between 30% and 60%.

The %RH recorded inside the school ranged from approximately 37% to 74%. The recorded %RH for each monitored area can be seen on the corresponding graph (Appendix 1).

CONCLUSIONS AND RECOMMENDATIONS

Based on the information gathered during a visual inspection of the school building and its HVAC systems, environmental monitoring for CO₂, temperature and %RH, and discussions with the building maintenance staff, we have the following conclusions and recommendations:

1. The amount of dust on the fresh-air return side of the filter for the two large units appears to be an unusually large accumulation if the filters are changed monthly. This accumulation of dust may be a source of the "dusty" odor described by building occupants. Consultation with the HVAC contractor should be completed to ensure the units are functioning properly.

2. A barrier should be placed over the fresh air intake outside grills to prohibit birds from nesting in this area but does not restrict the flow of fresh-air.
3. As illustrated on the enclosed graphs, there were periods when CO₂ levels measured in the classrooms exceeded 1,000 ppm when the classrooms were occupied. Consultation with the HVAC contractor should be completed to ensure the fresh-air intakes for the HVAC units are set at the recommended ASHRAE guidelines for the number of building occupants.
4. Relative humidity levels recorded inside the school exceeded 60% on several occasions. The elevated relative humidity suggests the air conditioning system on the HVAC unit is not functioning properly to dehumidify the air. This issue should also be discussed with the HVAC contractor.
5. The U.S. Environmental Protection Agency has developed the *Indoor Air Quality (IAQ) Tools for Schools* kit. This kit shows schools how to carry out a practical plan of action to improve indoor air problems at little or no cost using straight forward activities and in-house staff. The kit includes checklists for school employees, a guide for coordinating the checklists, fact sheets on indoor air pollution issues, and sample policies and memos. Information in this kit may be helpful to the district in your continuing effort to address indoor air concerns. A kit is included with this report.

Preparer of Report

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APPENDIX 1

Graphs illustrating **CO₂, temperature, %RH** in 6th, 5th, 2nd Grade Classrooms and Office