Indoor Air Quality in Connecticut Schools

EXECUTIVE SUMMARY

Statement of Inquiry

Protection of Connecticut school children, and of adults who use or work at our schools, from indoor air pollution has been identified by the Environment Committee of Connecticut's General Assembly as an issue of high interest. The Committee invites CASE to conduct an investigation on this issue: 1) to assess health hazards to school children and adults from indoor air pollution in Connecticut schools, 2) to identify protective measures, and 3) to assign priorities among these measures.

Summary of Response

FINDINGS:

Exposure to outdoor air pollution and its effects on human health have been of significant concern to the citizens of the United States since the early part of the 20th Century. On the other hand, concern about indoor air quality (IAQ) has developed only over the past 30 years. This is surprising since people in this country spend most of their time indoors. Furthermore, concentrations of certain important pollutants may be significantly higher indoors than outdoors as a result of the many sources of these pollutants indoors.

The IAQ of schools is especially important for a number of reasons. Young children tend to be more sensitive than adults to irritating air contaminants. There is an increased risk of asthma episodes among children, due to elevated levels of agents found in indoor air that are capable of triggering asthma attacks. Symptoms of exposure to indoor air pollutants reduce students' and teachers' ability to concentrate, impairing the overall teaching and learning experience.

When serious IAQ problems develop in a school, parents want immediate action to solve the problem. Under this pressure, school officials and the consultants they hire may not be able to identify correctly the fundamental reasons for the problem, resulting in inappropriate advice on solutions. School districts often have limited funds for proper preventive maintenance in the mistaken belief that this will reduce their operating and maintenance costs. Unfortunately, when IAQ problems arise, as they will from improper operation and maintenance, the costs for remediation (through consultants' fees, emergency corrective action and litigation) will be many times the money the school districts thought they were "saving" in their misguided cost cutting efforts.

Many activities in schools emit air pollutants, e.g., laboratories, machine and wood working shops, kitchens, copy and printing shops, art studios and the like. One of the most frequent problems affecting IAQ in schools, however, is moisture intrusion from such routes as leaking roofs, penetration through the slabs on which many schools are built, or improper moisture control by heating, ventilating and air conditioning (HVAC) equipment. Such moisture on and in indoor surfaces encourages microbiological growth such as mold spores and bacteria. These biologically active agents may cause a number of serious allergic reactions including asthma attacks.

There is a wide range of health effects caused by poor IAQ. The two main categories of health effects experienced indoors are: Sick Building Syndrome and Building Related Illness. The former tends to cause a range of symptoms such as eye, nose and throat irritation, headaches and feelings of lethargy, while in the latter, there tends to be a clear cut relationship between symptoms and exposure to one or more infectious, toxic or immunologic agents. Sick Building Syndrome tends to disappear once the affected person leaves the particular building in which the symptoms are experienced. Nevertheless, Sick Building Syndrome affects a significant portion of a building's occupants and, at the very least, affects their mental concentration and overall well being while in the building.

Since the symptoms associated with Building Related Illness tend to be more severe and persistent, it is a much more serious situation than Sick Building Syndrome. Agents in the indoor environment can cause and/or exacerbate serious immunologic diseases, such as asthma and hypersensitivity pneumonitis. Children and teachers with these ailments may experience chronic, even life threatening, disease if the problems creating them are not recognized and corrected at early stages.

There are no legally enforceable standards for IAQ similar to the National Ambient Air Quality Standards developed for the outdoor atmosphere by the US Environmental Protection Agency (EPA) and which each state is required to meet. The American Society of Heating, Ventilating and Air Conditioning Engineers (ASHRAE) has developed Standard 62-1999 "Ventilation for Acceptable Indoor Air Quality" which has been widely adopted in state and local building codes. One application of the standard, the one most frequently used, requires minimum flow rates of fresh outdoor air into buildings for specific occupancy patterns. In the other application, various air quality standards applied in a number of countries throughout the world are used to calculate the required ventilation rate. In Connecticut there is no designated or funded "Indoor Air Quality Program" in any of the state agencies to encourage the use of ASHRAE guidelines or to provide other direct assistance to schools.

The most effective methods to achieve good IAQ are adequate ventilation with a properly designed and operated HVAC system that provides an adequate amount of outdoor air, removal of pollutants in recirculated air, and control of the emission of pollutants generated indoors. There are many available HVAC system designs that may be installed in a variety of configurations to provide good IAQ in schools, but this is rarely done in school construction due to cost reduction pressures in design and construction. However, even the best of system designs may not be effective unless diligently operated and maintained.

A number of schools in Connecticut experience IAQ problems. Several of the state agencies and private consultants have conducted studies of these problems. The state agencies include the Departments of Public Health, Labor, and Environmental Protection. In addition, the Occupational and Environmental Health Clinics of Yale University and the University of Connecticut medical schools, and several local health departments, have been heavily involved where health effects of exposure to indoor pollutants have been investigated.

EPA has produced a useful guide, the full title of which is "Indoor Air Quality Tools for Schools Action Kit". or "Tools for Schools" for short. This guide provides schools with step-by-step guidance to identify IAQ problems. An unofficial steering committee has been formed of representatives from the above stated agencies to assist schools in implementing the "Tools for Schools" (TFS) program in the schools of Connecticut.

The Department of Education has conducted surveys of the general condition of the schools of Connecticut, but little information is available on those specific conditions of facilities that are most closely related to IAQ problems such as the HVAC system. In a recent survey of the state's schools it was found that over 400 of the schools had not had a major code update within ten years. Currently, schools cannot apply to the state for reimbursement for mitigation of IAQ problems.

CONCLUSIONS:

The following conclusions are drawn from this cooperative effort of Academy members, representatives from a number of state and federal agencies, and private consultants who made up the Study Committee:

1. Poor indoor air is an extremely important environmental issue since people spend most of their lives indoors where air quality is usually quite different than that outdoors. Indoor concentrations of certain pollutants are often much higher indoors than outdoors. Indoor air quality in schools is an especially complex topic since it includes elements of a variety of disciplines: chemistry and physics in identifying and measuring indoor contaminants and studying their release mechanisms; medical science in defining the effects of the indoor environment on the health of school occupants; engineering in selecting and designing the most cost-effective methods to improve indoor air quality (e.g., improved ventilation and air cleaning); administration, both in schools and in state agencies who must implement plans and enforce regulations for improving indoor air quality. Another factor that complicates the evaluation of indoor air quality complaints is the potential psychological effect that tends to exacerbate the perception of such problems.

2. Poor indoor air quality in schools is an especially serious problem since it can have a deleterious effect on the health of students, teachers and other school staff. At the very least, it produces symptoms, while not life threatening, which can negatively affect the mental concentration of students and teachers.

3. A report by the US General Services Administration on the condition of schools nationwide indicates that in Connecticut 68 percent of schools reported indoor environmental problems. While not a great deal is known about the number of specific indoor air quality problems among schools in Connecticut, hundreds of calls have been received by state agencies and consultants requesting assistance in solving these problems. From those studies carried out in Connecticut schools in response to complaints about poor indoor air quality, such problems commonly arise from poor design and construction, not adhering to established codes, inadequate ventilation, moisture intrusion and poor maintenance and operation of HVAC systems. The most important direct cause of poor indoor air quality is inadequate fresh air ventilation, regardless of what other factors may contribute to this condition. Another problem that has been identified is the carrying out of renovations during the school year. Such activities create large quantities of indoor pollutants which can disperse throughout the school unless measures are taken to isolate and contain such emissions.

4. There are countless types of indoor pollution, both chemical and biological, but the most frequent problems encountered appear to be those related to moisture intrusion in schools that encourages the growth of molds and other microorganisms. These agents can produce serious allergic reactions and other symptoms in sensitive subjects. Schools built with poorly designed and maintained flat roofs and constructed on concrete slabs with their inevitable cracks and other penetrations, are susceptible to moisture intrusion. This set of conditions, together with poorly designed, operated and maintained HVAC systems, account for most of the reported indoor air quality problems in Connecticut's schools.

5. Connecticut's schools are heated, ventilated and air conditioned using a variety of HVAC systems. These systems are often selected based on cost and are therefore usually inadequate in many respects. Poor maintenance and operation by untrained personnel exacerbate indoor air quality problems related to HVAC systems. Modular portable classrooms present a unique set of indoor air quality problems, largely because of the inadequate HVAC systems incorporated in such units.

6. Aside from problems related to moisture intrusion and the development of microbiological contaminants indoors, the selection of various materials used indoors such as carpeting, carpet adhesives and synthetic materials that emit odorous and irritating volatile organic vapors further degrade indoor air quality.

7. There is no formal organization in Connecticut with overall responsibility for indoor air quality issues. However, an *ad hoc* group has been formed, including personnel from the Department of Public Health, the Connecticut Council on Occupational Safety and Health, the University of Connecticut Health Center, the Yale Occupational Health Center, the Department of Labor and the Department of Education. The primary role of this group has been to encourage the application of the EPA's "Tools for Schools" program in the state's schools.

8. Except for some funding made available in recent years to a limited number of school districts, existing Connecticut laws permit state grant reimbursement only for code corrections, new construction, or for new features added to existing facilities. However, costs for the repair and maintenance of existing facilities (e.g., cleaning and repairing of HVAC systems) are not eligible for reimbursement at this time.

9. A number of other states have implemented formal programs with enforcement powers to control indoor air quality problems in schools. These programs could be models for Connecticut.

10. New construction and renovation of schools present unique opportunities to prevent indoor air quality problems before they develop. Renovation projects while the school is occupied must be carefully controlled to prevent exposure to students and teachers. With the large numbers of new schools currently planned or under construction, there is a great need to provide guidance to prevent future indoor air quality problems in buildings. EPA is about to release "Tools for New Schools" which should provide a basis for guidance in new construction (site selection, materials selection, roof design, ventilation design, and the like).

RECOMMENDATIONS:

It is the general policy of the Academy to avoid providing recommendations for action to the elements of state government, unless it is asked to do so. In this instance, the Inquirer, Representative Jesse Stratton, has asked the Academy to make specific recommendations to the General Assembly for dealing with the identified problems.

The following RECOMMENDATIONS are based on the FINDINGS and the CONCLUSIONS of this project:

1. As pointed out in Section VI of the main text, there are several Connecticut state agencies already involved in important aspects of indoor air quality evaluations in schools and other public buildings and in evaluating possible health effects on the occupants of these buildings. Therefore, the General Assembly should establish a formal organization to improve and coordinate all of these activities and provide adequate funding to support these efforts. The key responsibilities of such an organization should include but not be limited to the following:

a. Develop guidelines, management practices and/or regulations for maintaining acceptable indoor air quality in schools. Such guidelines should establish minimum operating standards for HVAC systems (e.g., ASHRAE 62-1999), air cleaning as required, maintenance schedules and annual inspections of HVAC systems and other features of the schools that affect indoor air quality.

b. Establish guidelines and standards for new construction and renovations that minimize deleterious effects on indoor air quality from the materials and methods used in the construction. Such guidelines are available from the indoor air quality programs in other states and from certain construction trade associations.

c. Provide training to those who would be involved in carrying out various facets of the indoor air quality program in the state's school systems such as administrators, maintenance personnel, teachers, local health departments, consultants and state agency personnel.

d. Require schools and school districts to establish indoor air quality management plans and operational manuals, and designate an Indoor Air Quality Coordinator for each school or school district. Many of these requirements would be covered by mandatory implementation of EPA's "Tools for Schools."

e. Develop and implement a system to assess on a routine and "as needed" basis the indoor air quality in schools and the features of the building and its mechanical systems that affect indoor air quality. This system would provide for inspections of the school that would include evaluating the HVAC system, indoor air monitoring as required for air contaminants, including bioaerosols, and assessment of any health effects of students and other occupants of the school. This effort should include a system to evaluate and certify private consulting firms that provide inspection, monitoring and consulting services.

2. There are a number of possible approaches to the organization of a program to deal with indoor air quality in the schools of Connecticut. Two possible approaches are presented as follows:

a. Formalize the existing *ad hoc* committee identified in CONCLUSION 7., design a management structure to coordinate and oversee these operations, and provide adequate funding to support this effort. The scope of work to be done would be the same as that outlined above.

b. Designate one of the state's agencies currently involved on one of the key activities to be the lead agency for indoor air quality evaluation and control in schools and other public buildings, and provide adequate funding to support this effort. The scope of work to be done would be the same as that outlined above.

3. Once an organization has been formed in state government to address indoor air quality in schools, the plans that have been developed in other states should be critically evaluated to determine those elements most appropriate for Connecticut.

4. The General Assembly should empower and provide funding to the Department of Education to make Indoor Air Quality improvements and provide maintenance in both new and existing schools.

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