

Breathe

INDOOR AIR
QUALITY IN
SCHOOLS

Most IAQ problems in schools can be avoided by (1) providing adequate outdoor air ventilation on a continuous basis (15 cfm per student), (2) controlling the space relative humidity between 30 and 60% and (3) providing effective particulate filtration of the outdoor air.



Schools are facing an epidemic of asthma among children

What is your school's IAQ report card?

There are many reasons to consider IAQ a priority in the school environment. Asthma is the principal cause of school absences, accounting for 20% of lost school days in elementary and high schools (Richards 1986). Richard also notes that allergic disease (nasal allergy, asthma, and other allergies) is the "number one" chronic childhood illness, accounting for one-third of all chronic conditions occurring annually and affecting 20% of school children.

School facilities, by design, are densely populated, making the task of maintaining an acceptable IAQ more difficult than in many other types of facilities. Another consideration

is that the sole purpose of a school facility is to foster the learning process, which is impacted directly by the quality of the indoor environment (HPAC 1990; Dozier 1992; Boone et al. 1997). Most individuals have experienced drowsiness, lack of concentration, or headaches in a classroom or auditorium environment and understand the impact these symptoms have on comprehension and motivation.

Understanding the primary causes of IAQ problems and how controllable factors - proper HVAC system design, allocation of adequate outdoor air, proper filtration, effective humidity control, and routine maintenance - can avert the problems and help all students, faculty, and school personnel to be more productive.

School facilities are more susceptible to developing IAQ problems than other types of facilities; and the occupants, children, are more significantly affected than adults (EPA 1998).

One in five U.S. schools have IAQ problems

- ✓ children are still developing physically and are more greatly affected by pollutants
- ✓ the number of children with asthma is up 49% since 1982
- ✓ children up to the age of 10 have three times as many colds as adults
- ✓ poor IAQ can lead to drowsiness, headaches, and a lack of concentration



Formaldehyde, total volatile organic chemicals (VOCs), CO₂, and bioaerosols are the most commonly measured pollutants in schools. The few scientific studies on causes of symptoms in complaint schools indicate that exposure to molds and allergens in schools contributes to asthma, Sick Building Syndrome, and other respiratory symptoms. The major building-related problem in schools has been inadequate outdoor air ventilation. Water damage to the building shells of schools, leading in turn to mold contamination and growth, has been the second most frequently reported building-related problem.

Contact CAL-IN at (916) 367-7630 or info@calintec.com for a walk-through of your facility.

Added costs for desirable IAQ

CASE 1: Hot, humid climate
DWERS approach:
\$142/student

CASE 2: Moderately humid/cold climate
TERS approach:
\$95/student

DWERS = dual-wheel desiccant-based total energy recovery system

TERS = single-wheel total energy recovery system

Added cost reflects increase in overall mechanical cost of either approach providing 15cfm/person

Benefits from maintaining desirable IAQ

- ✓ Improved effectiveness of the learning process
 - ✓ Impacts on comprehension, alertness, drowsiness, allergies, respiratory illness
- ✓ Reduced absenteeism
 - ✓ Funding increase based on reduced absenteeism
 - ✓ Savings due to fewer substitute teachers
 - ✓ Health care savings, reduced doctor visits
- ✓ Avoid property damage
 - ✓ Carpet replacement
 - ✓ Ceiling tile replacement
 - ✓ Book replacements
- ✓ Reduced maintenance
 - ✓ Increased time between filter changes
- ✓ Avoid remediation
 - ✓ Reduced dust cleaning, facility IAQ investigation, legal expenses

Significant savings/student
Invaluable

\$57/student/year
\$5/student/year
\$107/student/year

\$37/student
\$22/student
\$3/student

\$5/student/year

Significant \$/student

HVAC equipment selection

Typically, schools use packaged HVAC equipment because of its low cost, compact size, and ease of installation and maintenance. Unfortunately, packaged equipment is far more limiting with respect to outdoor air delivery and humidity control capability. Packaged systems have been designed to provide only a modest percentage of outdoor air on an intermittent basis in order to minimize cost. When they are operated with continuous outdoor air or an increased percentage of outdoor air, comfort and humidity control is often lost (Downing & Bayer 1993).

Frequently, schools are not designed or operated in accordance with industry ASHRAE standards. Besides the inability of packaged equipment to accommodate increased outdoor air ventilation rates and maintain space comfort, reasons include the perception that there is a significant first-cost premium, potentially high operating costs, and general unfamiliarity of IAQ on the part of many installation contractors, who usually design with the primary objective of minimizing the HVAC system installation cost versus from an engineering perspective of maintaining IAQ.

Cost effective options

Desiccant-based energy recovery systems, dehumidification, cooling systems and various other overcooling with reheat approaches can dehumidify the outdoor air stream provided to the occupied space or to the intake of the conventional HVAC equipment. Thus, the benefits of improved IAQ can be achieved by linking downsized packaged equipment with a preconditioning system as a cost-effective means of accommodating the ventilation and humidity control needs recommended by industry ASHRAE standards.

CASE 1 assumes the use of the dual-wheel, total energy recovery preconditioner directly to and from each occupied area, decoupling the outdoor air load from space load, which is typically handled by a 2-ton conventional HVAC.

CASE 2 assumes the use of a single-wheel energy recovery preconditioner ducted to space or to the return air side of a conventional HVAC unit.

The added costs are compared to a 5 cfm/person with a conventional HVAC while continuously controlling space relative humidity.



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