INDOOR AIR QUALITY IN SCHOOLS IS NECESSARY

A healthy school environment contributes to a better learning environment.

By Anthony Rossi

IT IS A WELL-KNOWN fact that the environment affects human performance, both physically and mentally. This is especially true for our children, who are impacted by the quality of air in their learning environment. School officials are encouraged to invest a portion of their ESSER funds in improving classroom indoor air quality (IAQ).

The School IAQ Problem

In the 1970s, the increasing cost of energy required to operate buildings—including schools—became a concern. One solution was to make buildings "tighter" and reduce ventilation, lowering the energy usage needed to heat and cool the building. However, more tightly constructed buildings and reduced ventilation led to mold, increased VOCs (Volatile Organic Compounds) and CO_2 (carbon dioxide) levels, as well as building occupant health issues. The term Sick Building Syndrome originated, leading to indoor air quality concerns.

In addition, HVAC systems in schools vary greatly by equipment type as well as age. Over the past 30 years, the focus has been on improving IAQ as well as conserving energy. However, at times, these focus items have conflicted with each other, resulting in poor IAQ at the expense of reducing energy.

The School IAQ Solution

Improving air filtration is one way to improve indoor air in schools. Replacing lower efficiency filters with higher efficiency filters in existing HVAC systems to capture very small respiratory droplets and virus particles may help. However, an obstacle to increasing filter efficiency is that many commercial HVAC systems cannot deliver the increased airflow needed to compensate for the higher resistance (pressure drop) that higher efficiency filters cause. Another filtration solution is to install additional recirculation HEPA (High Efficiency Particulate Air) filter units in classroom spaces.

Either or both filter solutions are good, but they still solve only one part of improving IAQ. The second and more important part of improving IAQ is the removal of airborne particulates, such as VOC gaseous pollutants and CO_2. Without the proper amount of oxygen-rich air in schools, students become tired and lethargic.

The solution to this second (and more important) issue of improving IAQ in schools is adequate ventilation of the space by introducing a sufficient amount of oxygen-rich, conditioned, outdoor air into the classrooms and exhausting the stale, spent, oxygen-depleted air. This also reduces harmful levels of VOCs. It is the oxygen-rich and conditioned (that is, heated, cooled, humidified, dehumidified and filtered) outdoor air that will assist in improving student learning ability.

The amount of outdoor airflow brought into a building, room or indoor space is the ventilation rate per unit time, typically expressed in cubic feet of air per minute (cfm). For K-12 schools, the ASHRAE 62.1 regulation code stipulates the minimum outdoor ventilation rate is 10-20 cfm of fresh outdoor air per student.

The fact that increased ventilation rates improve both students' ability to learn and teachers' ability to teach was confirmed in a 2016 Harvard study entitled "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures." This research study revealed that lower indoor CO_2 levels resulting from greater amounts of outdoor (ventilation) air raised cognitive scores between 61% and 101%. The increase in cognitive scores was achieved by increasing the ventilation rate of outdoor air from 20 cfm to 40 cfm per person.

Another 2021 investigation by Ty Newell, Ph.D., PE, Emeritus Professor of Mechanical Engineering at the University of Illinois entitled "Indoor SARS-CoVid-2 Herd Immunity and Infection Probability Estimates Based on Ventilation, Vaccinations, Infections and Face Masks" echoes the findings of the 2016 Harvard study and makes the following recommendations:

1. Control fresh air ventilation (to maintain 800 ppm of CO_2), equivalent to doubling current building ventilation standards from 20 cfm per person to 40 cfm per person.
2. Recirculate indoor air through high efficiency filters (MERV-13 or better) with a combination of whole building air recirculation and room space filtration systems. Recirculation airflow levels should be similar to fresh air ventilation levels.

Finally, in June 2020, the U.S. Government Accountability Office published a report (GAO-20-494) entitled "K-12 Education: School Districts Frequently Identified Multiple Building Systems Needing Updates or Replacements." Of the school districts surveyed, the findings of this report stated:

- About half of districts needed to update or replace multiple systems like HVAC or plumbing.
- An estimated one-third of schools needed HVAC system updates.
- An estimated 41% of districts need to update or replace heating, ventilation, and air conditioning (HVAC) systems in at least half of their schools, representing about 36,000 schools nationwide needing HVAC updates.

Reputable HVAC manufacturers and their representatives can assist and offer recommendations to improve school indoor air quality.

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