WHITE PAPER:

Effective Solutions to Improve Indoor Air Quality in Schools

AIR•ROW FANS
Efficiency and Comfort at a Savings

Most schools today do not provide acceptable levels of indoor air quality for their students, teachers, or staff. This is mostly due to inadequate ventilation, poor filtering, and the lack of air cleaning in school environments. Poor indoor air quality can have a negative effect on a child's health and academic performance. It has been estimated that more than 25 million children, over 50% of the students in the United States, attend schools without an adequate indoor air quality management plan.[1]

In solving air quality problems in schools, most look to costly replacements and upgrades of HVAC systems. It is estimated that 54% of districts need to update or replace multiple building systems and features in their schools. An estimated 41% of districts need to update or replace in at least half of the systems their schools. As many as 136,000 schools nationally need HVAC updates.

However, costly new systems are not necessarily the answer. Drastic improvements to air quality can be made without even touching the HVAC system. Air-Row destratification fans, outfitted with Bi-Polar Ionization cartridges, can neutralize 90% or more (for some 99%) of the particles of dust, mold, viruses and other pathogens that cause disease.

It is to these solutions school administrators are looking to in securing the academic performance of children in their schools but also in maintaining a healthy environment.

What is in Your Indoor Air?

The air around us is filled with particles of dust, dander, pollen, and smoke, as well as gases and vapors that emit from building materials and mold. Indoor air could be much more harmful than the worst outdoor air, according to the Environmental Protection Agency.

This is significant in that most of us spend more time indoors than out. In fact, 96% of buildings surveyed recently by the EPA had indoor air quality issues. Of these, 86% had high levels of dust, pollen, viruses, and other pollutants. The air in 71% had potentially harmful chemicals and gases.[2]

Air is made up of particulates, gases, and vapors, and can become polluted by a number of factors, leading to poor air quality. Indoor air quality (IAQ) is actually measured by the concentrations of various pollutants including:

- Dust and dust mites
- Carbon dioxide (CO2)
- Mold and mildew
- Airborne fungi
- Volatile Organic Compounds (VOC's)
- Bacteria and viruses
- Pathogens that cause disease

The presence of these kinds of pollutants is attributed to a number of sources and causes, including:

- Low ventilation rates.[13]
- Moisture or dirt in an HVAC system, filters, and humidification devices.[18]
- Outdoor pollutants or vehicle exhaust.[14]
- Presence of water damage or microbiological pollutants (such as mold and bacteria).[15]
- Animal and other biological allergens.[16]
- Combustible byproducts like nitrogen or carbon monoxide from heat sources using fossil fuels.[17]
- Formaldehyde.[19]
- Chemicals in cleaning products.[20]
- VOCs (volatile organic compounds) used in paints and lacquers or glues and adhesives.
- Asbestos found in buildings built before 2000.
- Ozone and fugitive chemical emissions from electronic equipment.

A high concentration of these pollutants can pose health threats of varying levels of severity – from lethargy, lack of attention, drowsiness, headaches, sore throat, dry and itchy skin, eye dryness, and sinus infections, to respiratory distress and other more severe health conditions. Severe concentrations in a building are defined as "Sick Building Syndrome" (SBS).[2] Children are more prone to SBS than adults because they inhale more pollutants per body weight and have higher breathing rates.[3]

Indoor Air Quality Affects Children's Health and Comfort

1. Indoor exposure to VOCs has been associated with SBS symptoms in school children.[4]
2. Elevated CO2 levels have been linked to symptoms of wheezing among children.[5]
3. Increased rates of asthma and asthma-related illnesses cause over 14 million missed school days per year in the United States.
4. Mold and mildew in classrooms can lead to irritations, coughing, wheezing, exhaustion, headaches and other breathing illnesses that are especially detrimental to young people with compromised immune systems. High levels of humidity in a building can promote mold and mildew growth.
5. Students regularly miss class because of respiratory infections, allergies, or an adverse reaction to chemicals used in classrooms for cleaning.
6. Higher CO2 levels cause many students to easily lose focus during school, hurting their performance on standardized tests.
7. Low ventilation rates have been associated with increased nurse visits by school children.[6]
8. Teachers and staff face all of the negative impact of poor indoor air quality too, and have the added difficulty of trying to teach children in an environment where they it hard to pay attention.

Indoor Air Quality Affects Children's Performance at School

1. In a study of over 100 US elementary classrooms, there was a 2.9% and 2.7% increase in math and reading scores, respectively, for each liter per second per person increase in ventilation rates.[7]
2. Higher ventilation rates have been associated with faster and more accurate student responses for color, picture memory, and word recognition.[8]
3. A 1000 part per million (ppm) increase above ambient levels of CO2, has been linked to a 10 - 20% increase in absenteeism.[9]
4. Every 100 PPM increase in CO2 was associated with roughly 1/2 day per year reduction in school attendance.[10]
5. Studies have shown that children perform better in classrooms as the speed of ventilation rate increases or pollutants are removed from the building.[11]
6. Performance on standardized tests also increases in both math and reading as ventilation rates increase in classrooms.[12]

Barriers to an Effective Solution

Most air quality problems are blamed on antiquated ventilation that calls for replacement or upgrades to the current HVAC system. These are costly capital expenses that are delayed or deferred because they are unaffordable. The truth is that drastic improvements can be made to air quality without even touching the current HVAC system. Features from Air-Row Fans can bring about pure air quality with a small investment that can have a short-term return.

The Solution to Your Indoor Air Quality

The solution from Air-Row Fans is a 3-Step Approach – Ventilation, Purification, and Filtration.

1. **Ventilation**. The installation of Air-Row fans provide an immediate change to air quality. Air-Row fans for Open or Grid ceilings capture the air that is already there – including stale air trapped at the ceiling – and treat it and circulate it for a change at least once every hour.

2. **Purification**. Air-Row fans can now be equipped with a Bi-Polar Ionization Cartridge that improves air quality even further and targets impurities in the air and sends them to the floor. Nearly all particulates, gases and vapors are captured and neutralized, sending dust, mold spores, bacteria, viruses, and other pathogens to the floor.

3. **Filtration** (and added purification). Air-Row recommends two effective tools at the air exchanger –
   - A filter with at least a MERV-13 rating, as MERV 13 filters are 99% effective in trapping particles as low as 0.3 microns in size; and
   - A UV-PCO (ultra-violet photocatalytic) bulb. Bulbs should only be used within the air exchanger where they can be shielded from sight. As rays are dangerous to human view, bulbs used in fans are discouraged.

Commercial Applications

- Hospitals and Health Care Facilities
- Veterinary Offices
- Schools and Colleges
- Restaurants and Food Prep Facilities
- Retail Stores and Shopping Malls
- Fitness Centers and Gyms

Buildings can also benefit with the installation of CO2 and VOC sensors.

- CO2 sensors continually monitor the space for adequate ventilation, and
- VOC monitor the level of potential pollutants in the indoor air of school buildings.

Solutions from Air-Row Fans

Air-Row Fans manufactures its high-performance destratification fans with Bi-Polar Ionization technology neutralizes the air to be free of ozone and other harmful byproducts.

Our fans use Bi-Polar Ionization to neutralize airborne particulates, gases and vapors that spread disease. In the process, we save up to 30% on HVAC-related energy consumption and lower your carbon footprint.

What is Air Ionization?

Clean air is achieved with an electrical balance of positive and negative ions. An ion is a molecule or atom that is positively or negatively charged, meaning it must either gain or relinquish electrons to become neutral. Since air quality contaminants are positively charged particles, when these contaminants are exposed to negative ions, they are neutralized electrically.

Bi-Polar Ionization is the process that happens when an air ionizer or ion generator releases negative ions into the air to attach to these positive ion contaminants. These bonded molecules then have an increased weight that forces them to fall to the ground. Air is purified as a result, sending all the unwanted particles to the surface to be cleaned, disinfected and eliminated.

Air ionization is a safe process, producing no ozone. The cartridges are low maintenance, easy-to-install, and energy efficient, as they consume very little power. They are highly effective on pollutants such as particulate matter, bacteria, viruses, mold spores, odors, and VOCs found in carpet, upholstery, and building products. According to numerous scientific studies, ionization is the best method to ensure a healthy indoor air quality for human occupancy.

Benefits of Negative Ion Generation

- Elimination of microbes such as Virus or Bacteria
- Reduction of pollen levels
- Elimination of mold spores
- Reduction of dust and dust mite levels
- Elimination of smoke
- Reduction of hay fever and asthma symptoms
- Mood improvement
- Improvement in depression and seasonal affective disorder symptoms
- Improvement in chronic fatigue symptoms
- Reduction in odors

Independent Laboratory Testing

The AR-Clean is an advanced Needlepoint Bipolar Ionization device that carriers two precise brush emitters made from carbon fiber that supplies an ion count of 49.8 Million ions/cm3 @ 115V. With the help of our 630+ CFM producing axial destratification fans, our BPI units can help clean and neutralize areas up to 1,200 square feet per application.

Negative ionization has been tested by independent, accredited laboratories to determine its effectiveness. Below are the results, listing the incubation period and the rate of reduction of specific pathogens tested. Tests were conducted by EMSL Analytical, a platinum-rated lab used by The Center for Disease Control.


Norovirus -- **93.5%** after 30 minutes of activation


Human Coronavirus 229E -- **90%** after 60 minutes of activation


Legionella -- **99.7%** after 30 minutes of activation


Clostridium Difficile -- **86.8%** after 30 minutes of activation


Tuberculosis -- **69%** after 60 minutes of activation


MRSA -- **96.2%** after 30 minutes if activation


Staph – **96%** after 15 minutes activation


E. coli -- **96.2%** after 30 minutes of activation

The Fight Against COVID-19?

Bi-Polar Ionization has been tested on Sars-CoV-2 (COVID-19) and test results showed a 99.4% inactivation of viral particles at 30 minutes under conditions replicating an occupied building. Research shows that bipolar ionization, specifically NPBI (Needlepoint Bipolar Ionization) provides fast and continuous microbe inactivation in climate-controlled spaces. Studies have shown that ten minutes of exposure to needlepoint bipolar ionization dropped virus levels by 84 percent.

Federal and State Legislation

Federal - The US House voted to approve a $1.9 trillion stimulus package proposed by President Joe Biden that would dedicate an additional $170 billion for K-12 schools and higher education. Most of the money will be used to stabilize K-12 schools and will go directly to school districts based on the proportion of funding they received through Title I of the Federal "Every Student Succeeds" Act. The legislation discusses repairing school facilities, especially ventilation systems, to improve air quality to reduce the spread of COVID.

Section 13 of the "Coronavirus Response and Relief Supplemental Appropriations Act, Congress approved $82 billion for the Elementary and Secondary School Emergency Relief Fund to make adjustments to help deal with the pandemic including updates ands maintenance to HVAC equipment.

Under the bill, schools will be able to inspect, test, maintain, repair, replace, or upgrade their HVAC systems with the intention to improve indoor air quality in the school facilities. These Section 13 funds can be used for HVAC systems, filtering, purification, and other cleaning, fans, control systems, and window and door repair and replacements.

California - Since SARS-2 is primarily spread through air droplets, teachers' unions and state authorities are influencing schools to improve their indoor air quality by installing modern air filters or air purifiers, or replacing their outdated heating, cooling and air ventilation (HVAC) systems. However, costs can be very expensive, depending on the region, the condition of the existing buildings and the size of the school. Gov. Gavin Newsom announced a $2 billion plan to reopen schools, beginning as soon as February for younger students and gradually phasing in older grades. The proposal provides for ventilation upgrades. Low-income students are more likely to attend schools with poor air quality and with facilities in poor condition. Many districts are hoping for money for HVAC upgrades from Assembly Bill 841, which Newsom signed in September. The law sets aside $600 million for public school energy improvements, including HVAC systems.

Conclusions and Recommendations

Air-Row Fan products are created and designed to change and improve air distribution and ventilation, and have a successful track record in capturing and mixing trapped air, targeting air strategically, making regular air changes, and reimagining the thermal balance of air in buildings.

Air-Row recommends a 3-Fold Approach to improving air quality:

1) Ventilate -- Our F-18 and LA-248 destratification fans to provide regular air rotations;
2) Purify – Add our BPI Bi-Polar Ionization Cartridge to neutralize particulates, gases, and vapors, and throw pollutants to the floor where they may be disinfected and eliminated; and

3) Filtrate -- At the front end of the air handling system, Air-Row Fans recommends our UV-PCO (Ultra-Violet Photocatalytic Oxidation) Bulbs and HEPA filters with at least a MERV-13 rating.

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