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Use of UV for Preserving IAQ

ANSI/ASHRAE Standard 62-2001, “Ventilation for Acceptable Indoor Air Quality”, specifies minimum ventilation rates and indoor air quality (IAQ) acceptable to humans in occupied areas, i.e., buildings. Its intentions are for designers of HVAC systems to minimize the potential for adverse health effects in occupied spaces through the use of outside air dilution.

This document stipulates that “acceptable” outdoor air meets the National Primary Ambient-Air Quality Standards for Outdoor Air as set by the US EPA. The contaminants listed in the standard include; Particles (PM₁₀), Sulfur Dioxide, Carbon Monoxide, Ozone, Nitrogen Dioxide, and a heavy metal, Lead. If the measured contaminant levels exceed the respective limits for “acceptable” air, then the use of air cleaning systems is recommended.

As of today, there are no federal or state standards for microorganism “concentrations” as they relate to their impact on human health.

A study indicated that one in five Americans have some form of environmental allergies, and one in ten suffers from allergy-related asthma. Indoor cases of infections most likely happen to people that are immune-compromised, i.e., patients in healthcare facilities, commonly referred to as Nosocomial infections. Molds produce mycotoxins that cause more severe complications since they attack the respiratory and nervous systems, among other targets of the human body.

Two types of mold species that cause a majority of the IAQ problems are *Aspergillus* and *Stachybotrys chartarum*.

The average size of spores of either fungi is about 5-10 microns in diameters, which can be filtered by High-Efficiency ASHRAE filters, i.e., MERV Rating of 7 or higher. However, as found by Healthy Buildings International, 46% of filters are either inefficient, or poorly installed. Their twenty years of experience has lead to a finding that 25% of 2,500 buildings have inappropriate levels of fungi. Further, 12% of these buildings have high bacteria levels. Bacteria are much smaller than fungal spores, and can pass through the ASHRAE filters.

Ultraviolet (UV) light is an engineering control that can be used to supplement the existing filtration device(s) in a building’s HVAC system. UV technology has been used for decades for disinfecting water for drinking, and ultrapure water for costly pharmaceutical and semiconductor manufacturing.

UV systems are typically comprised of a series of lamps and ballasts. They can be mounted inside air ducts and placed adjacent to cooling coils and condensate drip pans where biological growth can easily occur and induce energy losses due to heat transfer reduction caused by fouling.

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In the past years, designers have installed low-pressure (LP) UV lamps in HVAC duct and air handlers. LP lamps are efficient with respect to electrical input and UV output, however, most likely will not provide the proper UV dose (recently referred to as “fluence” by the UV community) since cooler air temperature and relative humidity affect their performance. Also, their primary output is limited to the 254 nm spectra, or UV-C range. Some bacteria can self-repair the damage incurred by UV-C when re-exposed to visible light, i.e., after being diffused into a room.

The following table lists common microorganisms and their respective UV doses for 99.9% inactivation (prevent duplication through splitting of DNA).

Microorganism	UV (mJ/cm ²)
Bacillus Anthracis	9
Bacillus Subtilis (vegetative)	11
Bacillus Subtilis (SPORES)	58
Clostridium Tetani	22
Escherichia Coli	7
Legionella	6
Mycobacterium Tuberculosis (TB)	10
Staphylococcus (various)	10
Streptococcus Lactia	7
Influenza Virus	7
Rota Virus	24
Aspergillus Flavus	99

Catalyx engineers have explored and tested medium-pressure (MP) UV lamps as an effective alternative to LP systems. MP lamps produce a broad band of UV that includes, UV-A, UV-B, and UV-C. The combination of the various UV wavelengths produces several photobiological impacts on a microorganism. Their single lamp *UV* output can be as high as 1,760 watts, as compared to a 25 to 50-watt LP lamp. This is extremely important, as the amount of time a microorganism takes to pass through the UV zone is only a fraction of a second.

MP lamps are more compact, and an in-duct or air handler installation would require less of them for a comparable LP installation, therefore, permitting flexibility in installation, and cost savings when replacements are needed.

An option created by Catalyx is the use of an electronic ballast that can vary the UV light output, based on operating parameters such as airflow rate and humidity. Temperature is not a concern to



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MP systems due to their high output. This option can dramatically reduce energy consumption during low airflow and humidity conditions.

Feel free to contact Catalyx directly for more information.

Catalyx's Titan Aire™ Air Purification systems are manufactured to ISO 9001 standards and meet the European CE guidelines for electrical components. To the best of our knowledge, the information contained herein is accurate, however, we do not assume any liability whatsoever for the accuracy or completeness of the information contained herein. Titan Aire™ is a trademark of Catalyx technologies, LLC.