GREENHECK
Building Value in Air.

DC-5 with Northern Light | HVLS

Executive Summary

MEASURING VIRUS INACTIVATION BY THE NORTHERN LIGHT® SYSTEM: UV-C LIGHT INTEGRATED INTO THE FAN BLADES OF AN HVLS FAN

AS INTERPRETED BY GREENHECK ENGINEERS

BACKGROUND

Greenheck DC-5 overhead fans with Northern Light® technology combine the air movement of a high volume low speed (HVLS) fan with the air cleaning benefits of UV-C light. UV-C light has been scientifically proven to inactivate airborne viruses, bacteria, and pathogens (including coronaviruses) for over 70 years and is recommended by the Centers for Disease Control (CDC), ASHRAE, and other organizations as an effective solution to reduce the risk of transmission of COVID-19. To determine the virus inactivation efficacy of the Northern Light® system, Greenheck's European partner, Denmark-based manufacturer Nordicco, authorized independent third-party research through the Danish Technological Institute.

METHODOLOGY

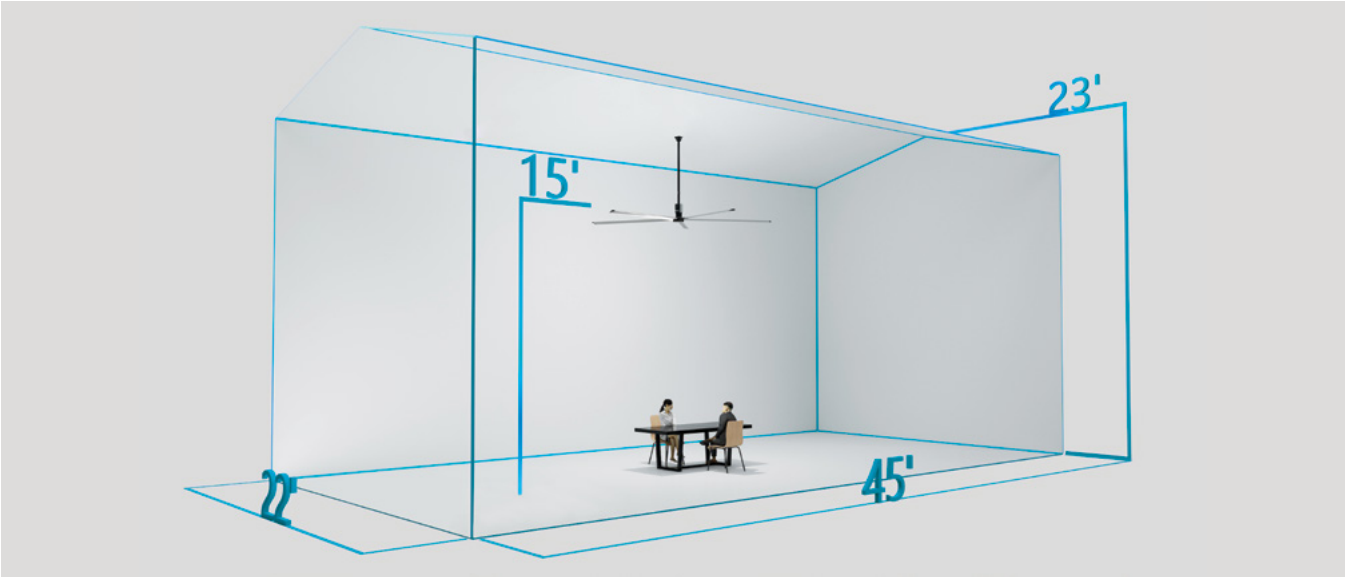
Full-scale testing of the Northern Light system was performed using an experimental design that simulated a real-world application for an HVLS fan. A large room with the following dimensions was selected to represent a typical commercial or industrial space like a classroom or automotive garage: 13.91 meters (45 feet) long x 6.78 meters (22 feet) wide x 7.05 meters (23 feet) in height. The 3-meter (10 foot) diameter HVLS fan was mounted from the ceiling at a height of 4.64 meters (15 feet) above the floor which is typical for these applications. Laboratory test equipment was then arranged below the fan to simulate two people sitting across a table from one another, with one person serving as the source of an airborne virus.

Testing was conducted in two pairs of one-hour trials with the fan on and UV-C lights either off (trials 1 and 4) or on (trials 2 and 3). Before each trial, the room was swept clean and completely vented with outdoor air. All windows and doors were closed 15 to 30 minutes before each trial to stabilize the air temperature, relative humidity, and air movement in the room. The HVLS fan had a constant rotational speed of 33.5 rotations per minute (rpm) ± 1.5 rpm during each trial and the rotational direction of the HVLS fan was set to blow air downward. The air temperature in the room during all trials was 21°C ± 1°C (70°F). Relative humidity was 25% ± 1% during trials 1 and 2 and 40% ± 1.5 % during trials 3 and 4.

METHODOLOGY CONT.

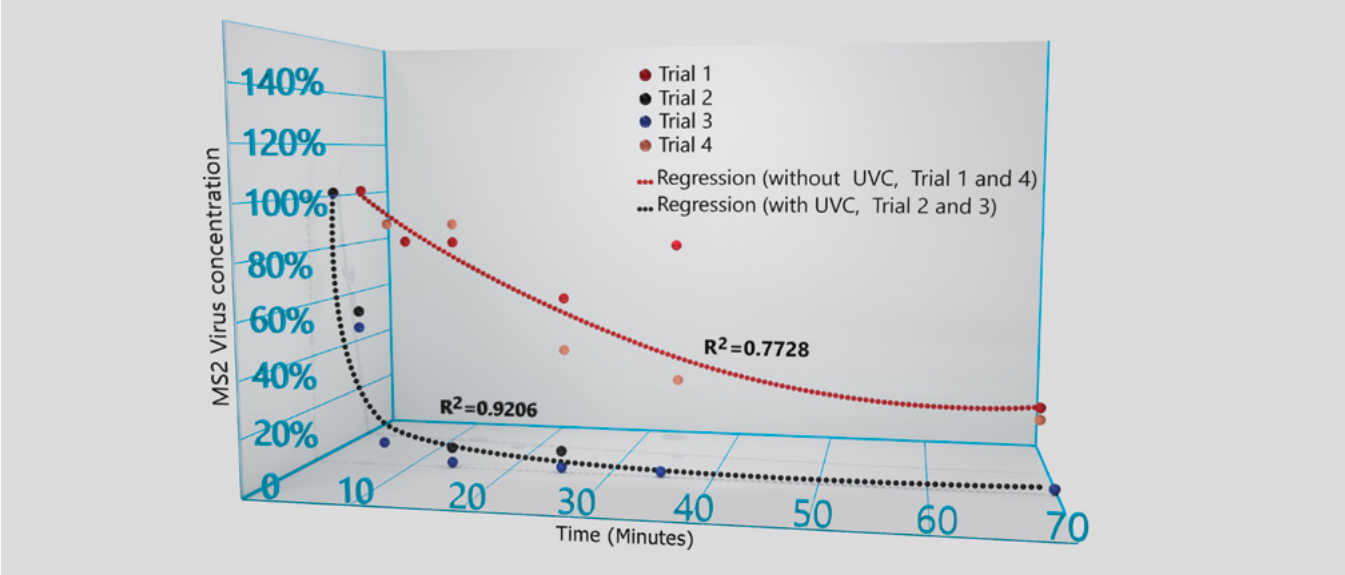
Bacteriophage-MS2, commonly called MS2 virus, was used as the sample pathogen in the experiment. MS2 virus contains an ssRNA (Single Stranded Ribonucleic Acid) genome similar to SARS-CoV-2 (coronavirus that causes COVID-19) making it a viable surrogate virus for the purpose of this research. The MS2 virus was transported to DTI's test facility in a cooler box to ensure that it was preserved during transport. A nebulizer was used to introduce the MS2 virus into the room, simulating an infected person exhaling viral particles during respiration. Before each trial, the nebulizer was run for exactly one hour, releasing 20 mL of MS2 virus suspension into the airstream in order to build up virus concentration in the room. The virus particles traveled up through a drying column in a spiral motion and emerged as a barely visible, very fine mist with a velocity of 1.2 meters/second. This mist was released at the average head-height for a seated person (1.1 meters or 3.6 feet).

Across from the nebulizer, aerosol monitors and glass impingers were positioned to collect air samples for analysis. This equipment was arranged at a distance of 0.8 meters (2.6 feet) from the nebulizer, simulating a noninfected person sitting across the table from the virus source. The monitors and impingers were also positioned so that air samples were collected at average head-height for a seated person (1.1 meters or 3.6 feet). The aerosol monitors were used to measure aerosol particle concentrations in size segregated mass fractions for PM_1, $PM_{2.5}$, respirable, and PM_{10} (particle sizes ranging from 1 µm to 10 µm in diameter). Concentrations of ultrafine particles (diameters less than 0.1 µm) and total particle concentration across all particle sizes were also measured. The glass impingers were used to collect air samples in order to determine the amount of active MS2 virus in the air. Air was sampled in 10-minute intervals at a flow rate of 4 Liters/minute such that the volume of each sample was 40 L ± 1 L. After each trial, the impingers were transported to the laboratory in a cooler box for analysis. The concentration of active virus particles was determined by mixing dilutions of the collected samples with host organism cells, incubating to allow growth of noninfected host cells, and then counting the number of plaques (area of infection caused by virus particles) that are formed. From there, the number of plaque forming units (pfu) per sample volume and the concentration of active virus particles can be calculated.



RESULTS

DTI's results demonstrated that the MS2 virus concentration after 10 minutes was 86% (relative to the start concentration) with UV-C lights turned off and 9% (relative to the start concentration) with UV-C lights turned on. After 15 minutes, the MS2 virus concentration was 75% with UV-C lights turned off and 5% with UV-C lights turned on. Comparing the UV-C light sensitivity of MS2 virus to SARS-CoV-2 virus, the Northern Light® system would very likely have an even higher inactivation rate of SARS-CoV-2 virus according to published articles known to the Danish Technological Institute researchers.



CONCLUSION

At the time of publishing their report, the Danish Technological Institute determined that this was the largest controlled experiment ever conducted to analyze the inactivation of airborne viruses using UV-C light. Using an experimental design that simulated a real-world application in a commercial or industrial building, DTI's testing results show a significant reduction in virus concentration when the Northern Light® system is in operation. As a result, the Danish Technological Institute concluded that the Northern Light® system is "the most efficient system for disinfection and distribution of large air volumes while occupants are present in the room."

RESOURCES

To view the complete study prepared by the Danish Technological Institute in June 2021:

https://nordicco.eu/wp-content/uploads/2021/11/Measuring-virus-inactivation-by-the-NORDICCO-Northern-Light-system-EN-1st-edition.pdf

To learn more about Greenheck DC-5 Overhead Fans with Northern Light® Technology:

https://www.greenheck.com/products/air-movement/fans/overhead-hvls-fans/dc-5-with-northern-light

About the Danish Technological Institute:

Founded in 1906, the Danish Technological Institute (DTI) promotes the use of technological progress to the benefit of industry and society through development, consultancy and education. The DTI's key initiative is the continuous advancement of new knowledge through research and development activities. One of seven government-approved research and technology organizations (RTOs) in Denmark, the DTI delivers more than 40,000 advanced technological solutions a year in response to specific needs and problems of its more than 12,000 customers. Approximately 1,000 specialists work in close consultation with 800 research and development partners to help enterprises of all sizes remain competitive and innovative.

To learn more about the Danish Technological Institute:

https://www.dti.dk/

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