# Genesis Air Purification Technology is Effective at Inactivating SARS-CoV-2

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In response to the COVID -19 pandemic, Genesis Air subjected their patented air purification technology to challenge testing with the SARS-CoV-2 active virus in the BSL-4 Galveston National Laboratory located on the campus of the University of Texas Medical Branch (UTMB) in Galveston, TX in June 2021. SARS-CoV-2, an enveloped RNA virus, has the potential to exist in both droplet and aerosol forms. It has also been studied and confirmed to be infective six to seven feet from the source (1-7). Therefore, technologies that can inactivate the virus in spaces where individuals are within close proximity is essential to creating safer indoor environments. Most transmission of the SARS virus occurs indoors and between people in close proximity to each other (8). Technologies that either clean the air and surfaces (i.e., disinfectants) and/or cannot be used when people are present (i.e., exposed ultraviolet (UV) radiation) have limited application and cannot treat the indoor environment when it is most critical, i.e., when it is occupied.

Genesis Air PCO technology is fundamentally safe because the PCO reaction is extremely fast (~ $10^{-9}$ sec.), occurs inside the panel and does not emit UVradiation into occupied spaces. It does not create ozone or use chemicals or ions broadcast into occupied spaces as cleaning agents. The technology is currently in use in office buildings, commercial spaces, long-term care facilities, hospitals, schools, and residences, to name a few. Additionally, Genesis Air has been proven to reduce airborne chemical and biological contaminants (i.e., VOCs, odors, molds including mildew, etc.) and is effective at eliminating MS2 bacteriophage (a viral surrogate), *Aspergillus niger* (fungal spores) and multi-drug resistant organisms such as MRSA from the indoor environment (9, 10, 11).

The SARS-CoV-2 challenge testing experimental design included culturing of virus, aerosolization of virus using a nebulizer, and detection of viable virus before and after a single pass through the Genesis Air unit. The Genesis Air unit consists of a Minimum Efficiency Reporting Value (MERV) 13 pre-filter, photocatalytic oxidation (PCO) media panel, and a 254 nm Ultraviolet light energy source. Viable virus was collected using a Biosampler and viability was quantified with plaque assays. Three experimental configurations were tested:

1) Genesis Air unit present but turned off, with no pre-filter – no intervention control (test runs 1-3).
2) Genesis Air unit present and turned on, with no pre-filter – panel alone intervention (test runs 4-6).
3) Genesis Air unit present and turned on, with MERV 13 pre-filter present – panel plus filter intervention (test runs 7-9).

Each experimental configuration was tested in triplicate. Aerosolized concentrations ranged from $3x10^6$ to $2x10^7$ viral particles per milliliter (ml) which equates toa range TCID50* per ml of 4.65 to 5.37 pre-unit as 280 liters of air passed through the PCO media at 125 feet per minute** face velocity. Biosampler 1 was placed upstream of the unit to collect aerosols as they traveled from the nebulizer to the unit. Biosampler 2 was placed downstream of the unit to collect aerosols after they passed through the unit. Ambient reduction in viable virus from the nebulizer to Biosampler 1 resulted in $4x10^4$ to $2x10^5$ viral particles/ml which equates to a range TCID50/ml of 4.57 to 3.37 with no statistically significant difference for all nine nebulizer sprays. For sprays 1-3 (control) there was also no statistically significant reduction in viral activity between Biosampler 1 and 2 and the average net reduction

was 0.31 log TCID50/ml (less than half of one log reduction). For sprays 4-6 (Genesis Air panel on/no filter), there was a significant reduction in active virus between Biosampler 1 and 2, with significantly less viable virus detected after the aerosol passed through the Genesis Air panel, p=.0453, and a 1.55 log TCID50/ml reduction. For sprays 7-9 (Genesis Air on with MERV 13 filter) there was also a statistically significant reduction in viable virus from Biosampler 1 to 2, p=.0195, bringing the viable virus detection below the lower limit of detection (LLOD) with an average log reduction TCID50/ml greater than or equal to 3.37.

Figure 1. Laboratory hood set up with aerosolization and detection equipment and the Genesis Air technology.

From right to left: nebulizer, Biosampler 1 (upstream), MERV 13 filter, Genesis Air PCO panel, and Biosampler 2 (downstream).

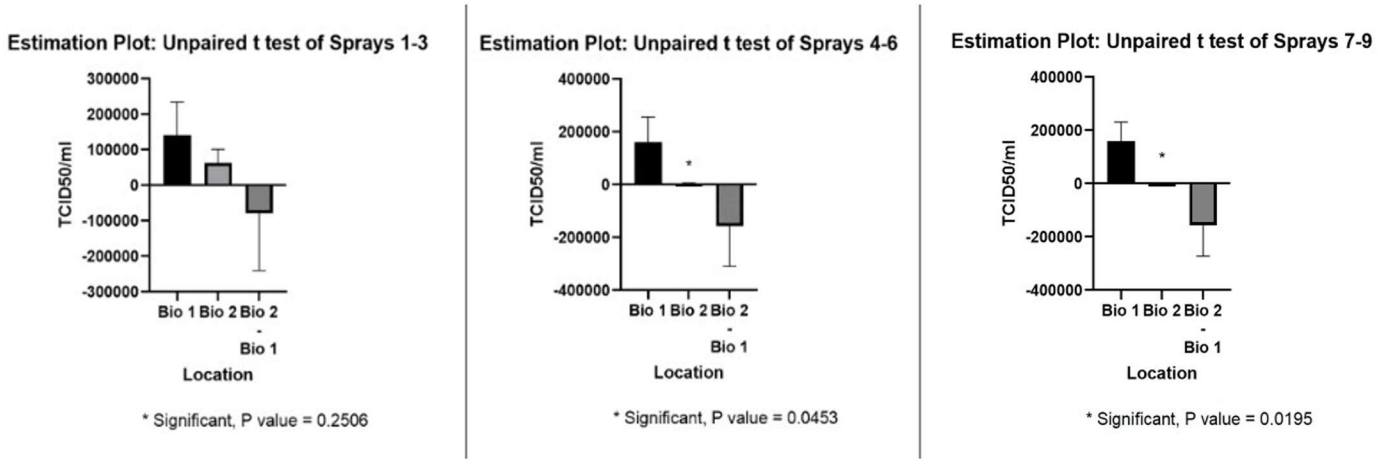
Table 1. Nebulizer sprays 1-9 with viral concentration per ml at the source nebulizer and at both the upstream Biosampler 1 and downstream Biosampler 2. LLOD – Lower Limit of Detection

| | Dose applied through nebulizer | Biosampler 1 (Upstream) | Biosampler 2 (Downstream) | Average % Reduction |
|---|---|---|---|---|
| Spray 1 | 3,290,000 | 232,000 | 107,000 | 63 |
| Spray 2 | 14,000,000 | 45,100 | 45,100 | |
| Spray 3 | 8,920,000 | 147,000 | 36,900 | |
| Spray 4 | 6,810,000 | 55,100 | 6,520 | 95 |
| Spray 5 | 14,700,000 | 237,000 | 2,320 | |
| Spray 6 | 23,700,000 | 192,000 | 3,690 | |
| Spray 7 | 4,990,000 | 94,000 | <60 (LLOD) | >99.99 |
| Spray 8 | 6,810,000 | 23,700 | <60 (LLOD) | |
| Spray 9 | 14,700,000 | 14,700 | <60 (LLOD) | |

Table 2. Aerosol SARS-CoV-2 Challenge Testing Log Reduction Data

| Aerosol run | Test parameter | Pre-unit viral concentration (log $TCID_{50}$/ml) | Post-unit viral concentration (log $TCID_{50}$/ml) | Net viral reduction (log $TCID_{50}$/ml) | Average net viral reduction (log $TCID_{50}$/ml) |
|---|---|---|---|---|---|
| 1 | Unit OFF; panel present; no filter | 5.37 | 5.03 | 0.34 | 0.31 |
| 2 | | 4.65 | 4.65 | 0.00 | |
| 3 | | 5.17 | 4.57 | 0.60 | |
| 4 | Unit ON; panel present; no filter | 4.74 | 3.81 | 0.93 | 1.55 |
| 5 | | 5.37 | 3.37 | 2.01 | |
| 6 | | 5.28 | 3.57 | 1.72 | |
| 7 | Unit ON; panel present; filter present | 4.98 | ≤1.80 | ≥3.17 | ≥3.37 |
| 8 | | 5.37 | ≤1.80 | ≥3.57 | |
| 9 | | 5.17 | ≤1.80 | ≥3.37 | |

Figure 2. Statistical analysis of viable virus detection. Detection of viable virus was significantly reduced when the air stream passed through the device with the panel on and no pre-filter (p=.0453), sprays 4-6, and through both the device with the panel on and the pre-filter (p=.0195), sprays 7-9. Viable virus detection was not significantly reduced when the air stream passed through the device with the panel off and with no pre-filter (p=.2506), control sprays 1-3, indicating that natural virus inactivation was significantly less than viral inactivation by activated PCO panel alone and by activated PCO panel and MERV 13 pre-filter.




In summary, the Genesis Airs air purification technology is effective at inactivating 95% of SARS-CoV-2 when using only the activated PCO panel without a pre-filter and is effective at inactivating greater than 99.99% of viable virus when used in combination with a MERV 13 pre-filter.

*TCID50/ml of Tissue Culture Infectious Dose per ml is the viral titer that kills 50% of the tissue culture. It is estimated that infected patients expel viable SARS-CoV-2 in concentrations ranging from 6,000 to 74,000 TCID50/ml (14).

**Due to biohazardous nature of the experiments, the airflow speed and amount of air that passed through the test stand were limited by the laboratory set up and capability. Due the extremely fast nature of the photocatalytic reaction there is no reduction in the effectiveness of the Genesis Air technology at typical operating airflow speeds.

## References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## Acknowledgement


We would like to thank Dr. William S. Lawrence, PhD, assistant professor of Microbiology and Immunology and manager of Aerobiology Service Center and his staff, from the Galveston National Laboratory, University of Texas Medical Branch, for conducting the nebulization and detection tests of viable SARS-CoV-2 virus & TCS Global for their contribution