Aluvis
UV CLEAN TECHNOLOGY

Aluvis UV Dose Analysis & COVID-19 Efficacy Report

Introduction

The Aluvis UV Sanitizing System was tested in-vitro against the following organisms:

- Geobacillus stearothermophilus (spore)
- Methicillin Resistant Staphylococcus aureus (MRSA)
- Vancomycin Resistant Enterococci (VRE)
- Acinetobacter baumannii
- Clostridium Difficile (C.Diff (spore))

99.9%
EFFECTIVE AGAINST

All showed a reduction higher than 99.9% after being passed through the Aluvis UV Sanitizing System.

The following report outlines the delivered UV dose of the Aluvis UV Sanitizing System under worst case scenario circumstances in which a 5% Bovine Serum was used to simulate bioburden that can affect UVC performance and compares such dose with data found in the literature for organisms other than those tested in vitro by Aluvis International Inc by an independent 3rd party lab[1].

UV Terminology

Irradiance: Defined as the power of UV radiation per unit area. Measured in W/m2.

Dose (Fluence): Irradiance over time. Calculated as Irradiance x Exposure Time. Measured in J/m2 with J (Joules), and Exposure time in seconds.

ALUVIS Measured and Calculated Dose

Laboratory performance testing showed that when cycled 45 seconds on and 5 seconds off, the lamps can achieve at least 54000 cycles meeting the pass fail criteria (Intensity > 85% of original value at each given time point).

During this test the average Irradiance after 54000 cycles (per lamp) measured was 1.5mW/cm2. The Exposure time to UV in the ALUVIS system is 12 seconds, hence the achieved UV Dose (Fluence) per lamp is 18mJ/cm2.

Aluvis has a total of 6 lamps, 3 of them to expose the top surface of the device, and 3 for the bottom. The proprietary and patented design of Aluvis allows 360 degree exposure and internal reflection of the UV supplied. The estimated UV Dose (Fluence) delivered (6 lamps accounting internal reflection) by the Aluvis UV Sanitizing System:

>90 mJ/cm2

Aluvis Microbiological Studies Estimated Dose

In Vitro microbiological tests were performed following the EPA recommended Sanitizing Test for Inanimate Surfaces protocol (DIS/TSS 10) with the most commonly found organisms in hospital settings: Methicillin Resistant Staphylococcus aureus (MRSA), Vancomycin Resistant Enterococci (VRE), Acinetobacter baumannii, and Clostridium Difficile (C.Diff (spore)). During these tests, different conveyor speeds were tested while both surfaces of the conveying objects were being sampled. A 5% bovine serum was used to simulate bioburden on surfaces.

Results showed that a 3-log reduction or higher (>99.9%) was achieved with the Aluvis system in travel times as low as 15 seconds.

Required doses to achieve a 3 log reduction of MRSA, range in the literature from 9.6mJ/cm2[2] to 10mJ/cm2[3]. Dosage for similar levels of C.diff spores inactivation range from 18mJ/cm2[3] to 46mJ/cm2[3]. From these findings it can be extrapolated that that Aluvis is delivering a minimum of 46mJ/cm2.

This data supports the Aluvis In Vitro measured and calculated dose of at least 90 mJ/cm2.

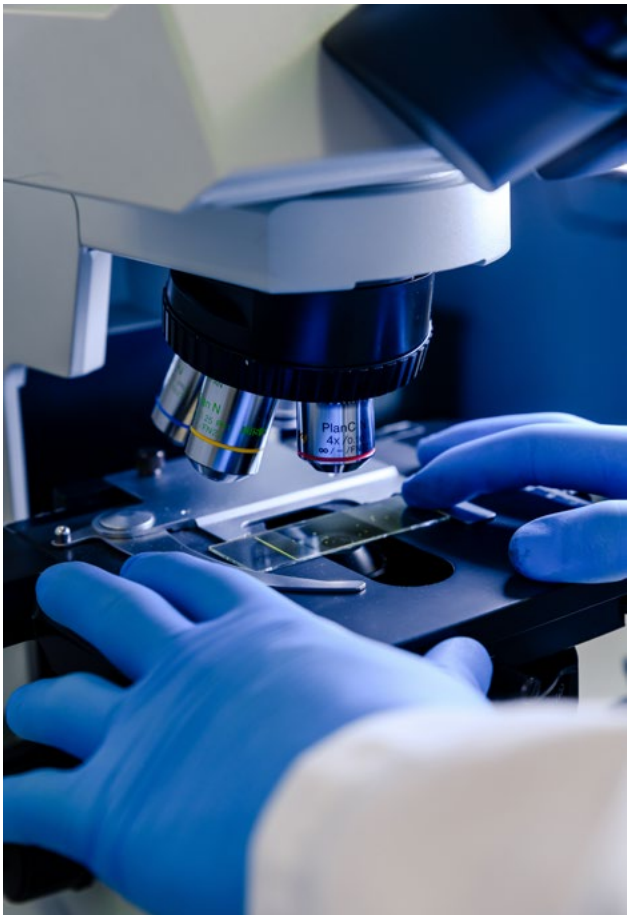
Numerous literature compilations[4,5] show that this dose is sufficient to achieve at least 99.9% reduction in most of the organisms that may be found in hospital settings, being the ones tested by Aluvis International are the most representative.

COVID-19 Studies

A study conducted at University of Boston National Emerging Infectious Diseases Laboratories (NEIDL) that exposed materials containing the virus to a UV-C tube lamp from Signify, found that a dose of 5 mJ/cm2 resulted in "a reduction of the SARS-CoV-2 virus of 99%". Based on the data, the study determined that a dose of 22 mJ/cm2 idem will result in a reduction of 99.9999%.

A different study[6] using Human Coronavirus OC43 (HCoV-OC43) as a Surrogate for SARS-CoV-2[4] analyzed the Dose (Fluence) response curve of HCoV-OC43 to UV LEDs with different peak wavelengths was analyzed. The UV LEDs at 267 and 279 nm were very effective at inactivating the Coronavirus (3-log inactivation at irradiation 6–7 mJ/cm2), whereas longer UV-LED wavelengths (i.e., 286 and 297 nm) required higher doses for 3-log inactivation (13 mJ/cm2 and 32 mJ/cm2, respectively). These findings suggest that the dose to achieve 3-log reduction (99.9%) of HCoV-OC43 at 254nm will be approximately 5mJ/cm2.

The same study analyzed the use of HCoV-OC43 as a surrogate of SARS-CoV-2. The Coronaviridae are the largest enveloped RNA viruses, having a positive single-stranded RNA molecule that ranges between 26.2 and 31.7 kb[7,8,9]. Both HCoV-OC43 and SARS-CoV-2 belong to the Betacoronavirus genus, dividing to Embecovirus and Sarbecovirus subgenus respectively[10,11]. HCoV-OC43 and SARS-CoV-2 genomes size are alike, ~30,600 bp (e.g. GI numbers 530,802,586, 530,802,542) vs 29,903 bp respectively (Wuhan-Hu-1 complete reference genome NC_045512.2).



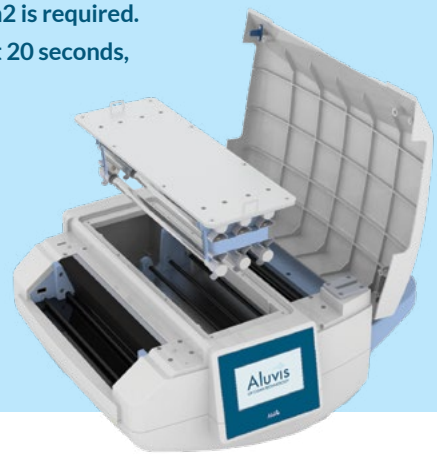
From these studies, it can be inferred that the required dose to inactivate 3 logs of SARS-CoV-2 ranges between 5mJ/cm2 to 10mJ/cm2.

Conclusion

Literature analysis shows that to inactivate 3 logs of MRSA and Cdiff, a minimum of 46mJ/cm2 is required. Aluvis studies showed 3 log reductions of Cdiff spores and MRSA with travel times of at least 20 seconds, indicating that at least 46mJ/cm2 are being delivered.

Based on various studies found in the literature Aluvis delivers the required dose to inactivate at least 3 logs of SARS-CoV-2 (10mJ/cm2).

Peer reviewed publications show that the UV Doses delivered by ALUVIS are comparable to those indicated in the literature to achieve a 99.9% contamination reduction of the most commonly found organisms in hospital settings.



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[2] ClorDiSys, Application Note #12 Ultraviolet Light Disinfection Data Sheet

[3] Ultraviolet-C (UV-C) Monitoring : UV-C Dose Indicators for Convenient Measurement of UV-C Dosing
Jennifer Cadnum, BS, Annette Jencson, MT, CIC, Sarah Redmond, MD, Thriveen Sankar Chittoor Mana, MBA, Curtis Donskey, MD
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