Enlisting the Eisco Labs Goggle Sanitizer (GGSN10) against COVID19

Abstract: In the fight against SARS-CoV-2, the virus causing the COVID19 pandemic, many non-traditional tools have been put to use. In this white paper, we show that the Eisco Labs Goggle Sanitizer (GGSN10) is capable of being used as a decontamination aide against the SARS-CoV-2 virus.

Due to the shortage of personal protective equipment (PPE) such as the N95 mask, there has been a great deal of work to devise methods to decontaminate and reuse PPE [1-7 and references therein]. Consequently, the CDC has provided a Crisis Standard of Care Decontamination Recommendation which provides guidelines for decontamination strategies, including the use of ultraviolet germicidal irradiation (UVGI) [1]. UVGI decontamination against the SARS-CoV-2 virus directly is still under investigation [2-3], but extensive studies of UVGI against similar viruses has been performed, including SARS-CoV, MERS-CoV, Influenza A (including H1N1, H7N9, H5N1) and others [1-7 and references therein]. The CDC has summarized these results to indicate that a total radiation dose of 1 J/cm^2 is sufficient to reduce the viral load of SARS-CoV-2 by more than a factor of 1000 on N95 facemasks [1, 4]. Reduction of viral load by a factor of 1000 (a 3-log reduction) is a common standard used in UVGI decontamination literature. Nevertheless, doses as low as 2-5 mJ/cm^2 on stainless steel disks have been shown to reduce the viral load of the SARS-CoV virus by 90% [8] and the University of Nebraska Medical Center has developed a protocol for decontamination of N95 masks based on a dosage of 300 mJ/cm^2 [6].

Devising a protocol to use UVGI requires great care. UVGI radiation is typically absorbed by the first surface it encounters so objects cannot be stacked or shadowed and any decontamination protocol needs to ensure both sides of the object receive a sufficient dose. For example, the University of Nebraska Medical Center protocol illuminates N95 masks on each side to ensure both sides receive a dose of 300 mJ/cm^2 [6]. Additionally, UVGI is a surface decontamination technique; it is not effective at decontaminating wet fabric which has absorbed contaminated sputum. Another complexity is that the dose received depends on the orientation of the surface to the irradiating light. Thus, even if a surface has direct exposure, if it is tilted relative to the incoming light, the dose received will be less than is measured with a detector which is at normal incidence to the incoming radiation. Large ridges or bumps on an object or the presence of soiling agents can reduce the received dosage. Finally, we note that UVC is harmful to both skin and eyes; protective equipment should always be used in the presence of active UVGI bulbs. Because of the above considerations, UVGI experts should be consulted in the design of decontamination protocols that will be used against SARS-CoV-2. If a UVGI protocol is to be used in a health-care setting there are additional regulatory requirements by the FDA that must be met.

In this white paper, we simply provide measurements of the UVC dose delivered in the GGSN10 Eisco Labs Sanitizer. Our purpose is to inform the user whether the cabinet might be considered as a tool in an appropriately designed decontamination protocol to decontaminate objects exposed to the SARS-CoV-2 virus.

Dosage Measurements

The GGSN10 cabinet ships with an internal wire-frame since it is intended to sanitize transparent safety goggles used in scientific laboratories. So that the complexity of shadowing from the wire-frame would not influence our measurements, we first removed the frame. We also chose to use an older, previously used Philips TUV T8 bulb (about 2 years old) rather than a new bulb so that our measurements would provide typical dosage estimates after prolonged use instead of dosage estimates immediately after purchase. A picture of the cabinet is given in Fig. 1(a) along with the coordinate system.

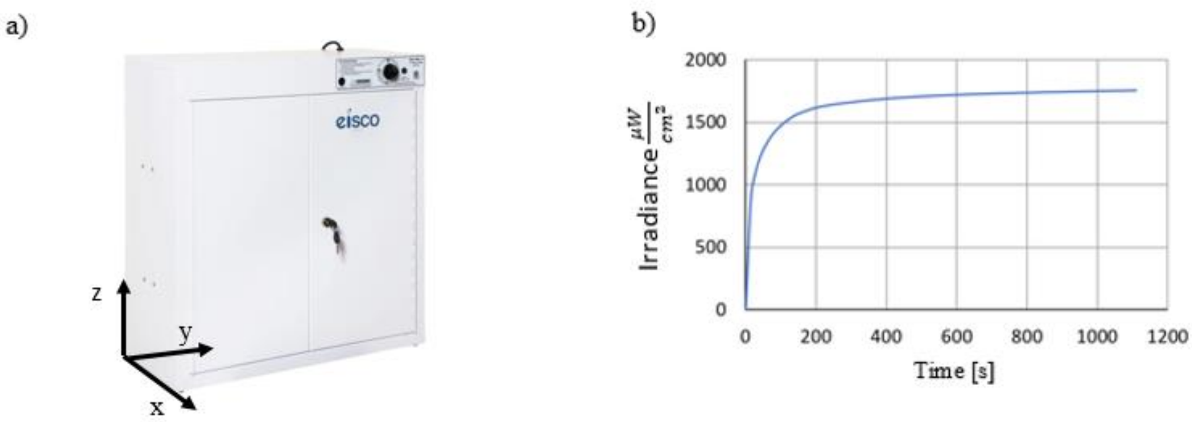

Figure 1. a) Eisco Labs Goggle Sanitizer GGSN10 and measurement coordinate system. b) Irradiance as a function of time in the vertical direction at a distance of 4.5" x 12" from the rear left corner of the cabinet at a distance of 3.5" below the bulb.

All measurements were taken using a General UV512C Digital UVC Meter. Two sets of measurements were taken. The first set of measurements explore the time dependence of the irradiance. The second set of measurements give the spatial dependence of the irradiance on a vertically oriented detector throughout two horizontal planes at the top and bottom of the cabinet.

Time-Dependence

The cabinet comes with a built-in 15 minute timer; we measured the irradiance in 15 second intervals until the timer expired. Measurements are shown in Fig. 1(b) and were taken 3.5 inches below the bulb in the approximate center of the cabinet, 4.5 inches from the back and 12 inches from the left side of the cabinet when facing the doors. Understanding the time-dependence of the bulb is important because the bulb takes about 3 minutes to achieve 90% of the steady-state brightness as it warms up from room-temperature. Consequently, in a given location in the cabinet, the full 15 min dose after starting at room-temperature as determined by integrating the irradiance measurements is only about 92% of the dose calculated using the steady-state irradiance measurement for that location. Additionally, though the timer actually ran for 18.5 min in total, we base our calculations on a 15 min duration to provide a conservative lower bound on the total dose. In typical practice, when the whole timer duration is used, the total dose will increase from the numbers reported here by about 25%.

Spatial-Dependence

Irradiance measurements on the vertically-oriented detector in the horizontal planes and the associated 15 min dose are given in Fig. 2. Measurements were taken every 3 inches along the width of the cabinet and every 1.5 inches along the depth at a height of 3.4 in (87 mm) below the bulb and 24.4 in (620 mm) below the bulb (1.3 inches or 34 mm above the bottom of the cabinet). Positions are measured in inches from the back left corner of the cabinet. The bulb was allowed to warm up, and then measurements were taken throughout the two horizontal planes. The 15 min dose was determined by multiplying the measured irradiance by 900 seconds and multiplying by 92% to take into account reduced radiation from the bulb as it warms up.

It is easy to see in Fig. 2(b) that the 15 minute dose exceeds 1 J/cm^2 over a 6” x 9” region and 500 mJ/cm^2 over a 7.5” x 15” region on the horizontal surface located 3.5” below the bulb. Even on the bottom surface, the 15 min dose delivered exceeds the minimum inactivation dose of 2-5 mJ/cm^2 [8] by a factor of about 20 over the entire region.

Consequently, the GGSN10 is able to supply the UVGI dose required to kill the SARS-CoV-2 virus. Under an appropriately designed and approved decontamination protocol, the sanitizer cabinet is able to provide sufficient radiation to decontaminate N95 masks.

We gratefully acknowledge assistance from Steriliz, LLC. in taking the UVC measurements.

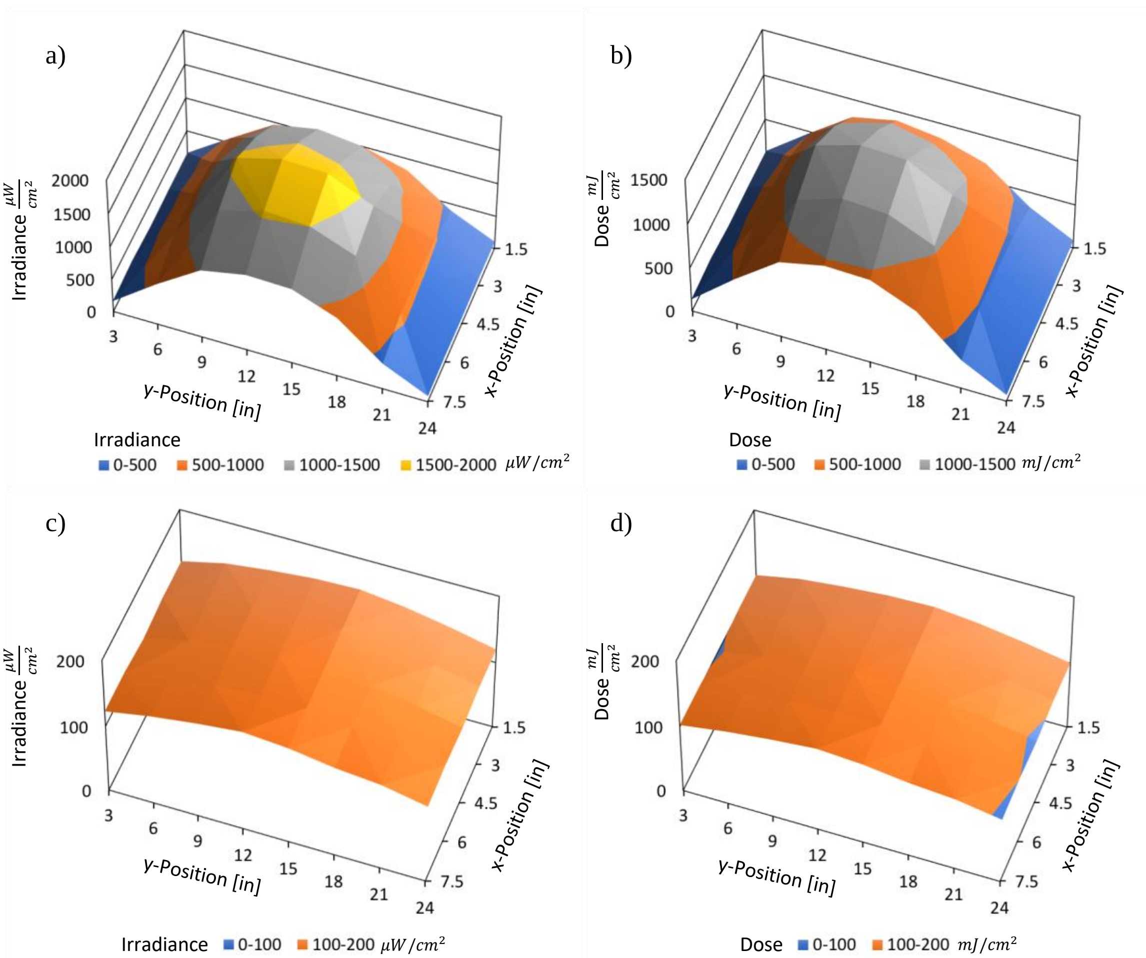

Figure 2. a) Irradiance and b) dose in a horizontal plane 3.4" from bulb. c) Irradiance and d) dose in a horizontal plane 24.4" from bulb. All measurements taken with detector oriented in the vertical direction with positions measured in inches from the rear left corner of the cabinet.

References and Notes:

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