Enhancement of a ProPhotonix UVC LED Product

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Project Background and Motivation

Abstract

A design of an existing UVC LED product was obtained from ProPhotonix. The product was modelled using optical ray tracing and the product was characterized. Options for improving the irradiance from the product at larger working distances were investigated.
A reflector was designed to accomplish this goal of enhancement.
The performance of the product with the new reflector incorporated was assessed and compared to the original product. The results are presented and show the improvement the reflector made.

UVC Disinfection

UVC disinfection is used to kill bacteria off different surfaces or to purify air and water. It is most used in food processing, laboratory work and for sterilizing medical equipment.

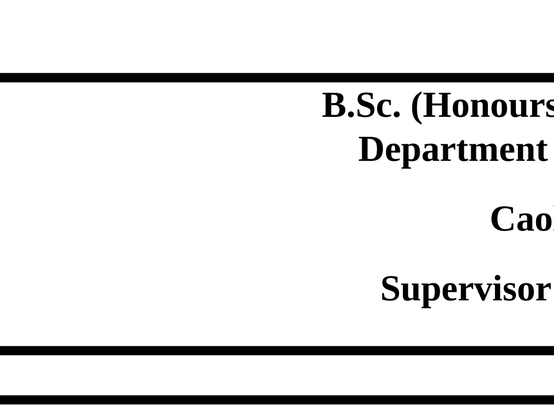


Fig 1: Applications of UVC Disinfection technology.

Existing ProPhotonix Product

The products designs, properties and goals were given by ProPhotonix.

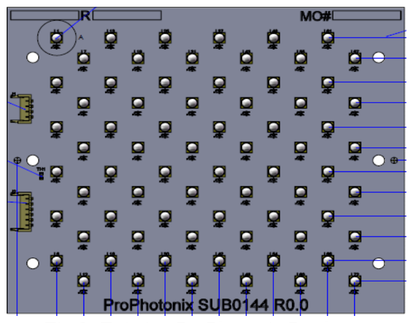


Fig 2: Existing ProPhotonix Product

This image shows the product design given by ProPhotonix, the LEDs are in 2 sets of arrays on a insulated metal substrate board. The LED is purchased from Klaran and is shown in the circle labelled A.

Project Goals

- The first goal of the project is to characterise the product and find the values of the beamwidth and the max intensity the light produces at different distances. This will allow the customers to understand what they are buying. This will assist ProPhotonix in the marketing and sale of the product.
- The second goal is to enhance the product so that the max intensity is increased at larger working distances and the beam width is reduced at larger working distances. This is so that the product can improve its performance.

Methodology

Characterisation

The characterisation was done by modelling the product on Zemax and recording the results.

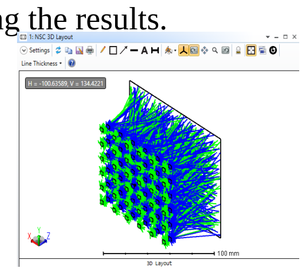


Fig 3: Zemax Model of ProPhotonix Product

This image shows the product when the product is modelled onto Zemax. Source Radials are used to mimic the LEDs. The blue and green lines are the rays of light and the square is the detector measuring the result.

Reflector Design

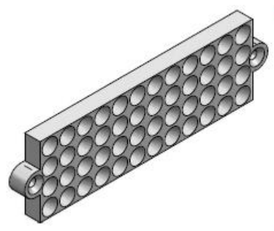


Fig 4:ProPhotonix Reflector for Sister Product

This image is of a reflector used for a different product in ProPhotonix. This is a cone shape reflector. The straight edge reflectors are simpler to machine and cheaper. A lensed solution was considered but was discounted due to difficulty and expense of suitable materials. The reflector for the current product will be based off this reflector.

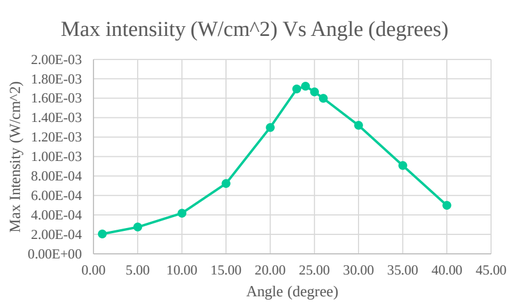


Fig 5: Graph of Angle vs Max Intensity

The variables that had to be determined for the reflector was mainly the thickness and the Angle of the cone. Both were found using trial and error of using various values and checking which had the highest intensity. The graph shows that the ideal angle is 24 degrees, the ideal thickness was found the same way.

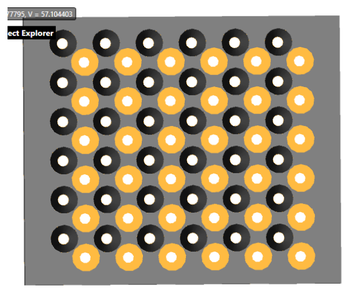
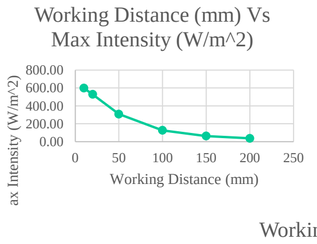


Fig 6: Model of Reflector on Zemax

The diagram above shows the reflector created for the product using Zemax. The reflector holes are designed to match the LED array in the product. The design's used the ideal thickness and the ideal angle.

Results and Conclusion

Characterisation Results



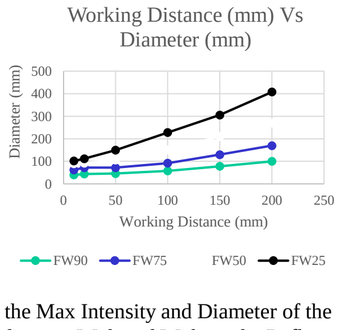


Fig 7 and 8: Graphs of the Max Intensity and Diameter of the Product against working distance With and Without the Reflector.

Reflector Design

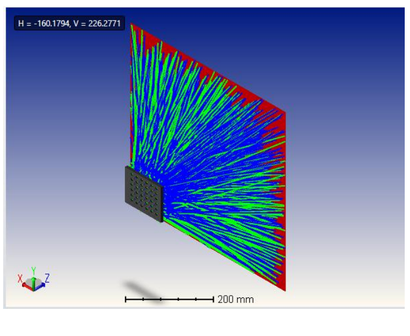


Fig 9: Reflector and Product Model on Zemax

The diagram above shows the final model of the reflector as it is converging the light from the product. As shown each LED from the 2 arrays fits within the reflector and the light is being converged,

Improvements to Product

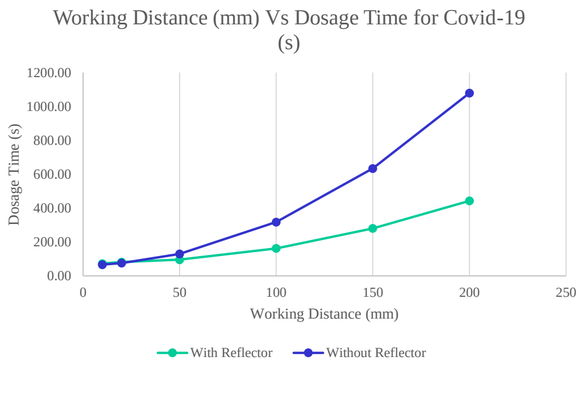


Fig 10: Graph of Dosage time, with and without reflector, needed to kill Bacteria in Covid 19

The graph shows the time taken to kill Covid 19. This graph shows that the product has been improved by adding on the reflector.

Summary of Key Achievements

- An existing ProPhotonix UVC product was optically modelled and characterised
- A reflector which enhances the performance of the product at longer working distances was designed and optimised.
- Characteristics of the product with and without the reflector were compared.

References

[1] Klaran, retrieved on the 31st of January from https://www.klaran.com/products/uvc-leds/wd-series-uvc-leds