Phoseon™ TECHNOLOGY

Rapid UV Inactivation Enables Faster Disinfection Processes for Manufacturing

Breakthrough UV LED Performance Delivers New Capabilities

A Phoseon Technology White Paper

September 2018

Introduction

UV LED technology deserves serious consideration by manufacturing entities in the food, medical or other industrial processes.

UV LED technology offers significant process improvements and new capabilities in many manufacturing processes. The intense UV output has already proven itself in certain industries with reduced maintenance, consistent reliable results, and perhaps most importantly increased manufacturing speeds. UV LED technology improves dramatically year over year, and as a result it is finding its way into broader applications from online chemical stream monitoring to photochemistry to disinfection.

This white paper focuses on disinfection and makes the case for why UV LED technology deserves serious consideration by manufacturing entities such as food, medical or other industrial processes where disinfection and decontamination is required. It describes Phoseon's findings related to LED light engines for the inactivation of microorganisms in a manufacturing setting.

High-irradiance Ultraviolet Disinfection System

Breakthrough UV LED Performance Brings New Capability for Disinfection

Not only has the general technology of LEDs improved, but Phoseon Technology has a track record of getting the most out of LED systems. Our patented Semiconductor Light Matrix (SLM)™ technology offers unmatched levels of deep UV irradiance and is key to achieving the performance benefits. High irradiance, combined with appropriate wavelengths as researched and tested by our research team, targets specific bonds within the biomolecules of microorganisms. This allows reduced inactivation times while improving the overall efficacy of disinfection.

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Phoseon Technology is the first to develop a UV LED system that surpasses 5 W/cm² at 275nm, significantly higher than the levels reached previously by other LED systems, and surpassing many other technologies in the market including the legacy technology used in industrial disinfection (1). This milestone development enables manufacturers to install UV LED systems where they were prohibited in the past. Phoseon is trailblazing a new path based on our capabilities and technology to allow our customers to build high-performance UV LED disinfection systems to bring the long-lasting, lower operating cost and improved disinfection capability benefits to their factory processes.

In addition, our research has proven wavelength selection is essential to getting the most from UV LED disinfection systems. We have discovered utilizing both 275nm and 365nm wavelengths provides a synergistic effect allowing even faster, stable reactions. Both nucleotides and proteins can be modified using this light combination. Therefore, both microorganisms and biological material can be inactivated with the right dose from Phoseon SLM-based systems. This allows for integration into many different industries including medical, food, semiconductor, and others. Our systems are well-suited to disinfect sensitive surfaces due to their low heat emission, high intensity, precise control, and long operating life.

Faster Analysis and Operations

UV LED technology enables complete inactivation of contaminants in minutes compared to traditional methods.

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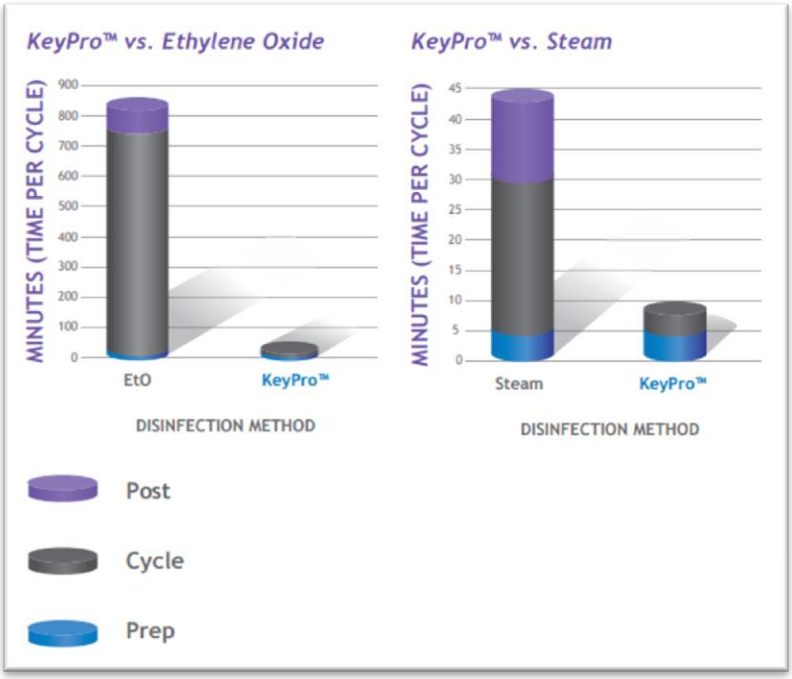

UV-C light has long been known for its disinfection effectiveness in and is often referred to as germicidal UV. When UV light is incident upon a contaminated surface, particular wavelengths in the light affect different bonds within biological molecules. In 1877, by a chance observation, Downes and Blunt (2), two English scientists, discovered that sunlight could kill bacteria. They observed that sugar water placed near a window turned cloudy in the shade but remained clear while in the sun. With microscopic analysis they found the cloudiness was caused by bacteria. Subsequently in 1892 Marshall Ward discovered it was the UV component of the light that killed the bacteria. Early in the 20th century mercury lamps started to be built and shown to have UV output.

While mercury lamps are used for disinfection purposes today, Phoseon posits that is due more to a matter of convenience than based on science and UV LED technology is the way to move the industry forward.

DNA's light absorbance peaks at about 270nm. While DNA does absorb light at 254nm, the chief wavelength for the mercury lamp, it is certainly not the best wavelength when concerned about absorbance and subsequent inactivation. In addition, you can see a stark difference in absorbance when comparing a denatured molecule versus a native, helical, molecule. This is where our 2 wavelength system shines…pun intended. Furthermore, we have found that some of the other wavelengths found in the mercury spectrum actually activate repair mechanisms in microorganisms thereby making disinfection more difficult. By selecting two key wavelengths the disinfection/inactivation process is optimized and made faster. This translates into factory benefits of increased line speeds, lower power consumption, and higher yields. Additionally, not only do you gain the inherent increase in efficiency of the LED compared to mercury lamps, but it also reduces the need to remove excess heat or unnecessary by-products with the useless wavelengths that an mercury lamp emits.

By selecting two key wavelengths, the inactivation process is made faster translating into increased line speeds.

Consistent and Reliable Operations

Phoseon's SLM technology delivers industrial-strength targeted wavelength LED-based systems. These system-level products incorporate advanced optics, thermal management, precise electronic control and LED-based arrays to provide a multiple Life Science benefits:

1) **Stability.** Due to Phoseon's patented and proprietary design, the output of each array is calibrated and controlled to provide consistent and stable output. This happens in three phases: first the input current is carefully monitored and adjusted over time so as the diodes maintain a consistent output. Second, upon initial startup controlling the current to each array ensures the no overshoot of the nominal operating output. Last, the units are consistent over a wide ambient operating temperature range so the same energy is produced in various environmental conditions.

2) **Low-temperature**. Phoseon's technology uses custom thermal and optical capabilities to minimize temperature transfer from the array to the working surface. Unlike traditional bulb sources that generate heat in excess of 250°C, solutions typically run below 60°C with the majority of heat being handled by the thermal management system and not at the work surface.

3) **Instant-On/Off.** Being able to quickly turn the array on and off leads to more productive operations. LED arrays are similar to a light switch and can be turned on/off at will. In fact, turning the LED on only when needed is a the recommended practice and extends the LED lifetime. Gone are the days of having to 'warm-up' a system for 45 minutes before it is stable enough to use then leave it in 'standby' mode that wastes energy between uses.

4) **There's no mercury**. Most legacy systems require double containment to reduce the risk of glass and mercury contamination. Cleaning procedures for failed lamps can stop production lines for hours. Our UV LED systems do not require complicated double containment and contain no mercury.

Conclusion

Manufacturing processes have a new tool to improve throughput, yield, and quality. Phoseon's SLM-based LED systems provide a customers with increased capabilities for disinfection and decontamination applications. By leading with science, Phoseon optimizes the disinfection process and brings this new capability to market.

Phoseon started supplying UV LEDs for industrial applications in 2002. With over 270 patents and trademarks and more than 90,000 units shipped, Phoseon has earned a worldwide reputation for innovation, quality and reliability for industrial curing.

Phoseon has seen dramatic improvement over the years in markets where LEDs have replaced mercury lamps. In one example, our customer Constantia Flexibles had this to say: "What really excited us was speed improvement – with LED UV curing, we were able to increase our speeds by 50% of our baseline, and that was just the initial result. Operating temperatures were lower than with mercury curing equivalents. And, there were no cure issues and no discernable performance differences with ink coverage and mileage." This plant ultimately experienced over 50% run speed improvements with the installation of LED systems, and furthermore it used 25% of the power that a conventional mercury system used. The combination of power savings and increased run speed sealed the deal for Constantia Flexibles (4).

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With expertise in UV LED light engines across a wide range of applications and wavelengths, Phoseon Technology is the premier partner to solve new challenges in life sciences instruments, healthcare and advanced imaging. Phoseon works with customers to develop complete solutions for life sciences.

Author

Mark Oesterle, Business Development Manager, Phoseon Technology

For more information about Phoseon Technology products and services, please contact:

Mark Oesterle, mark.oesterle@phoseon.com

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About Phoseon Technology

The world leader since 2002, Phoseon Technology pioneered the use of LED technology for Life Science and Industrial Curing applications. Phoseon delivers innovative, highly engineered, patented LED solutions. The company is focused 100% on LED technology and provides worldwide support.

Contacts

For more information about Phoseon Technology suite of products, visit **http://www.phoseon.com/** or call **(503) 439-6446**