Phoseon Technology
Labels & Labeling
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UV-LED Technology for UV Curing – Contender or Pretender?

The current economic downturn has been less than kind to most industries and the label and package printing business is not immune. But while such a downturn leaves its mark on printers and print equipment providers, it is also a time of opportunity for new and innovative technology to rise and shine in the market. During positive economic times, introducing a new technology can sometimes be ironically difficult due to the hustle and bustle associated with designing, building and selling equipment. When times are good, companies do not always see the need to adopt a new technology, even if it has significant advantages for them.

One of the technology areas that has gained significant foothold in the market is UV-LED based curing and drying systems for UV inks. These systems are gaining traction as an alternative to traditional mercury vapor lamp systems – and for good reason. At LabelExpo 2009, UV-LED curing systems were displayed by digital printers such as: Atlantic Zeiser, CSAT, Stork Prints and Durst. In addition to digital label printers, the new Gallus ECS 340 flexo press showed that even in traditional press applications that the UV-LED technology certainly has met the technical requirements to meet specific curing and drying requirements.

Yet as with most new technologies attempting to usurp a deeply entrenched and time tested rival, there are barriers that make full scale acceptance more challenging in the short term. In the case of UV-LED technology, these barriers are being eroded and the technology has now made its presence felt in the market.

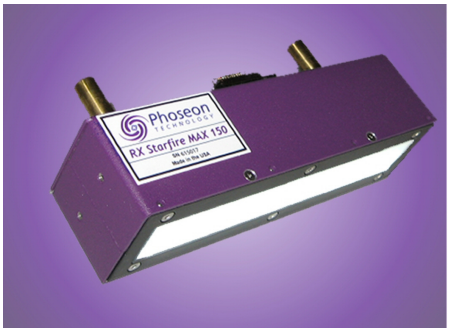
Gallus ESC 340

State of the Art UV-LED Technology

UV-LEDs are a solid-state electronics technology that does not use mercury and does not produce ozone making it a safer and more environmentally friendly than traditional lamp technologies. While the UV-LED as a component is useful the key is producing practical and cost effective UV curing systems for specific applications with the right capabilities to suit customer needs. Phoseon Technology has taken it one step further to offer the most advanced UV LED systems that offer high intensity, scalable, long-life UV-

LED curing systems that have significant advantages over other systems commercially available today.

Phoseon's proprietary Semiconductor Light Matrix (SLM)™ technology is a breakthrough in high power light applications. It uses a tightly-integrated array of high-intensity light-emitting semiconductor devices. Ultraviolet SLM arrays produce significantly higher intensity light than other UV LED technologies. The light produced by standard UV LEDs is limited by the discretely packaged design. Phoseon's SLM approach is to use proprietary packaging, optics, and thermal design to optimize the output in terms of total light produced and cost per watt of light produced.



High Powered UV LED Lamp

Advantages of UV-LED for Curing Compared to Mercury Lamps

Why should UV-LED based systems be even considered? There are some important fundamental differences and advantages for UV-LED lamp systems when compared to traditional mercury-based lamps.

Lifetime

UV-LEDs are inherently long-life with UV diodes typically rated to perform for many tens of thousands of operational hours. When integrated into a practical UV curing system then typically useful lifetimes of 10,000 hours and beyond are possible. In contrast, mercury bulbs are considered a consumable item with replacement typically expected every 1,500 – 2,000 hours of operating use.

Instant on/off

Solid-state UV-LED lamps can be switched on and off instantly (within several milliseconds) which represents a substantial design advantage since shuttering systems are not required. Furthermore, the ability to run the UV-LED system on an "as needed" basis reduces the overall duty cycle of the device and can substantially extend the practical lifetime of the lamp. In contrast, mercury-based lamps typically require a warm-up period and are often required to be kept in a standby mode and/or shuttered when not actually curing ink.

Heat on the substrate

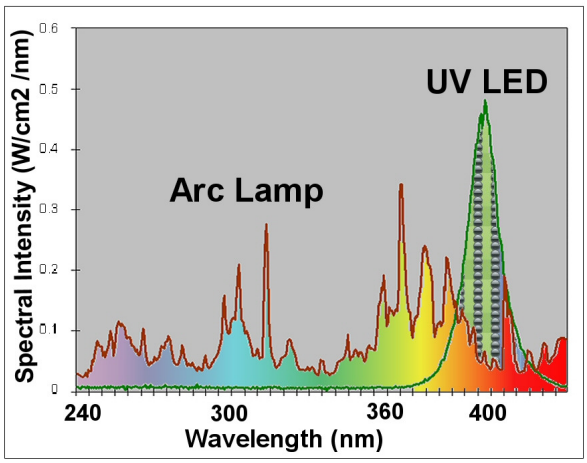
Since more than half of the total energy created by a typical mercury lamp is output in the infrared (IR), managing heat load on the printed media is a reality that manufacturers have had to face on their UV product lines. While filters and other techniques have been used to minimize the heat delivered to the substrate and while media cooling systems, such as water chilled drums have been used, the issue of heat can limit the type of materials than can be printed and can increase the operational system costs due to hot air extraction/treatment, media cooling, etc In contrast, UV-LED based lamps emit a very narrow range of UV energy (typically UV-A) with zero IR energy emitted.

Power consumption

While an argument can be made that the "quantum efficiency" of mercury vapor lamps and UV-LEDs is roughly comparable the general experience is that reductions in total power required to provide comparable curing results is often 50% or more lower with UV-LED systems. To a large degree this is a function of the properly formulated UV curable material to accept more of the energy from a narrow output UV-LED system so that the more of the total light produced is useful for the actual curing process. This power savings will increase when air extraction, media cooling, and energy required to maintain the mercury vapor lamp's non-printing standby mode are considered.

Environmental and Safety

While traditional mercury-based UV lamps have been widely deployed and accepted in a wide variety of industrial and printing applications, the printer manufacturer has to carefully design his system to ensure that no operator or person near the UV curing system is exposed to potentially dangerous UV wavelengths or heat. This fact has an impact on the total size, weight, and portability of a traditional mercury-based UV system that typically has to be fully enclosed and shielded so that no human can see or touch the enclosure while the lamp is operating. In contrast, UV-LED systems emit no UV-B or UV-C wavelengths which are inherently more dangerous to the human eye. Also, most UV-LED designs do not transmit substantial heat to the lamp enclosure itself reducing the design constraints placed on the inkjet system designer. Since mercury is not used within an LED system and because no ozone is created as a byproduct of the narrow-band UV-A energy, LED-based systems are inherently environmentally friendly.



Mercury lamp vs. UV-LED Spectral Output

Application of UV-LED Curing Technology for Label and Package Printing

While in concept UV-LED technology can be applied to all drying and curing process of UV cured materials, but reality has proved to be more challenging. The single biggest hurdle to mass adoption has been the reality that most pre-existing UV curable materials are not optimized for the practical wavelength outputs of commercially available UV-LED systems. The good news is that UV inks curing with high-wavelength UV-A are freely available today for UV-inkjet, and many are becoming available in "analog" printing applications such as screen, flexo and offset printing.

In addition, recent advances in LED technology make high power LED based UV sources a viable solution for the curing inks in printing. UV-LED intensity and power capability is now comparable to traditional mercury vapor lamps. Costs for UV-LED curing systems continue to decline, and confidence in the "new" technology is rising due to customers' positive experiences.

While UV-LED is already becoming more widespread in the digital arena, there are many single pass and wide format UV inkjet systems using the technology today with many more currently in design. The use of the technology in flexo and offset printing applications will likely take more time as the equipment makers and ink providers decide on the best course of action to bring the technology to market.

It's clear that the technical and cost barriers to UV-LED technology are eroding. If the industrial use of mercury continues to be more strictly legislated against, and future changes to the EU ROHS, then UV-LED will quickly gain the traction required to become truly mainstream.

While the jury may still be out on the speed and scale of the acceptance of UV-LED curing technology, there is no doubt that the technical and business hurdles for mainstream acceptance will be eliminated. UV-LED curing systems are a contender. We anxiously await to see if they are to become the long term champion.