Technological advances in LED development have been achieved during the past 10 years as Phoseon Technology discusses

Market adoption of UV LED curing technology

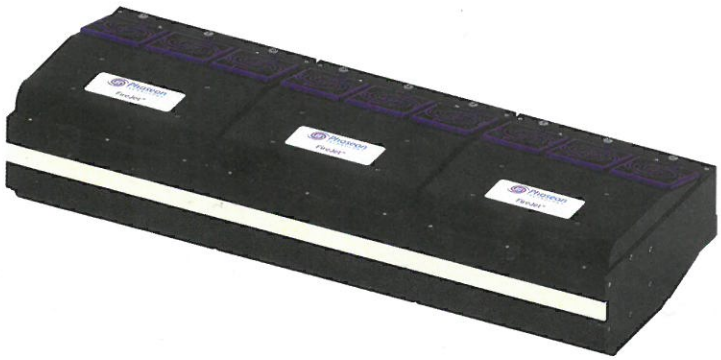
Phoseon optics options

UV LED curing refers to the unique way in which adhesives, coatings and inks are dried using 'energy' from UV LED light sources rather than using heat or evaporation. In the approximately 10 years since UV LED curing light sources appeared in the market, there have been significant technological advances in LED efficiency and curing lamp performance. The initial challenges have been met and overcome allowing rapid technology adoption across a broad array of industries.

TECHNOLOGY ADVANCEMENTS

As UV LED curing technology continues to gain worldwide adoption, it is important to keep in mind some of the important key features that build a robust product optimised for high performance and long lifetime. There are many product options on the market for UV LED but not all of them are built to support rugged and industrial environments. LEDs, arrays, optics and cooling are the four components that are used to maximise UV LED curing performance. Keep these in mind when selecting a UV LED supplier.

Phoseon FireJet UV light source designed for scalability



Light Emitting Diodes

Not all LEDs are built the same nor do they exhibit the same characteristics. UV LED lamp suppliers have critical choices to make as to the quality, type, material and shape of LED for their systems. Key LED characteristics considered by each UV LED lamp supplier include wavelength and UV output.

Arrays

Most applications require UV LED curing systems that consist of more than one LED or LED array in order to achieve not only the desired throughput but to meet the demands for curing applications where the media can be 1-2m wide. Therefore, a key question is if the LED array can be uniformly scaled. UV LED curing lamps can have a continuous scalable array that provides for better uniformity or a discrete array package that can be scaled but doesn't provide the same uniformity of output.

Some LED manufacturers only sell their LEDs pre-packaged into arrays or assemblies that they feel maximise the UV output. UV LED lamp system suppliers that purchase pre-packaged arrays have typically made a trade-off between faster time-to-market and less differentiated lamps vs a slightly longer time-to-market and maximising UV power. This is an area where UV LED lamp suppliers can differentiate themselves based on the suppliers' architecture and engineering capability where two suppliers can take the same batch of LEDs and achieve very different performance in the end product.

Optics

UV LED optics is one of the most important differentiators in UV light sources. The science of optically improving the LEDs to maximise their UV output is key to the lamp's final capability. Based on the end application the optical engineer has to decide what shape, form and material best utilises the LED's unique characteristics. Next they have to balance the fact the LEDs are a 'flood' type of light, unlike a focused mercury lamp where the light is captured by a reflector and directed to a specific point, focal length.

The optical engineer is challenged to use methods to ensure the maximum amount of light 'escapes' at the desired irradiance through the window/glass towards the material. LED lamp suppliers have used various, confidential methods to maximise the UV LED light.

While an end-user or OEM should not necessarily be concerned with how the optics are provided in the UV LED lamp, they should understand if the supplier has the ability to improve their design for their specific application needs.

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Touch screen applications

Cooling

LED cooling is very important for UV light sources. As any reader knows after using a notebook PC on their lap for a length of time, the by-product of solid-state devices is heat. UV LEDs transfer about 15-25% of the received electrical energy into light. The remaining 75-85% is transferred as heat; thus, the need to cool the LED arrays.

Currently, UV LED arrays are cooled with either air or liquid. It is important to note that as the LEDs emit higher output power, the more heat is generated. Thus in the race to build ever higher irradiance products, the ability of suppliers to control and remove heat has become more crucial to building reliable systems. As the quality of LEDs improves and the irradiance increases, so does the need to remove the heat. OEMs and end-users do not want to spend more on the LED cooling of the light sources.

APPLICATIONS

Wood

UV LED curing technology is utilised in the wood coatings industry for applications, such as edge coating, roller coating and digital printing. UV LED technology drastically reduces energy consumption and significantly reduces workpiece surface temperature.

Automotive

UV curing has been used for years in several areas of the automotive production process. UV provides near-instant curing of functional and decorative coatings. And the lightweight materials used in today's automotives benefit from the low temperatures enabled by UV LED technology.

Industrial

Countless manufacturing processes make use of the benefits of UV LED curing. Applications range from manual curing of the adhesives used during sub-component assembly, to high speed curing of coatings and colourings of the finished products. Many electronic product manufacturers are already reaping the benefits of using UV LED curing to improve their manufacturing processes. Touch screens, mobile phones, micro speakers and hard disc drives provide just a few examples of commercial applications.

Printing

UV LED curing technology is rapidly becoming the new standard for UV printing for both full cure and pinning applications. Most ink manufacturers include a UV LED option today, making integration and use of LED even easier. The narrow

Phoseon's FireLine FL200 for direct printing applications

UVA output provides the highest curing efficiency, while also providing a cooler, safer and more stable output, allowing end users to print on a wider variety of materials with increased yield and reduced operating costs. Printing applications vary from small and wide format digital printers, digital and flexographic label printers, direct printing on cylindrical objects, screen printers, 3D printing and many others.

UV LED is ideal for curing inks directly printed on to cylindrical objects. The small size of the light sources makes them ideal for machines with limited space. It also allows for printing directly on heat-sensitive materials. Direct printing technology eliminates the need for label substrates, offering a new solution for innovative bottle and other cylindrical designs and consumer engagement.

UV LED INKS

Ink formulation for LED technology has evolved significantly, and today, there are a growing number of suppliers developing inks that work well with LED technology. As the technology has become more powerful and more compatible inks are available, this has resulted in substantial advanced capabilities for UV printing. Ink companies are taking it to the next level and are now developing inks to support UV LED for low migration packaging. The term 'low migration' packaging is commonly used to designate materials used in the packaging structure whose components will not migrate or move, from the packaging into the product. Package printing is the next big opportunity for UV LED technology.

UV LED technology benefits, in conjunction with low migration printing processes, makes for an ideal application. LED offers excellent through cure due to the narrow LED wavelength (UVA). It offers more than 20,000hr of operation with only minimal power drop over time. This process stability is very important to product manufacturers as they can ensure their products are cured consistently, run after run, without having to worry about bulb degradation. Additionally, UV LED technology provides a uniform output across the print width, which again ensures fully cured product.

CONCLUSION

UV LED-based curing is now an accepted user-friendly tool in adhesive, coating and printing markets. These industries continue to challenge and drive the formulation/chemical material suppliers with UV LED wavelength optimised materials. At the same time, UV LED curing units have become more efficient in delivering higher energy to the media, thus driving, not only environmentally clean, energy efficient and compact size units but also increased throughput and process flexibility.