UV LED Technology Emerges in the Graphic Arts World+

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Abstract

Traditionally mercury lamps have been the standard for UV curing in graphic arts world, but now UV LED technology for curing has emerged. In combination with suitable chemistry, UV LED technology has advanced significantly in the past few years and is now readily available for a wide range of graphic arts applications. There are many benefits driving companies to move toward acceptance of UV LED technology such as higher productivity and a more environmentally friendly solution, which more and more end customers are demanding. As manufacturers are developing UV LED curing systems, knowing how the key sub-components work together will help in creating the optimum solution. UV LED technology reduces the overall environmental impact of the process and at the same time maintaining and improving productivity. Application examples that successfully use LED curing technology include digital inkjet printing, flexographic printing, screen printing, and many others.

UV LED Curing Technology

UV curing technology is utilized for drying inks, coatings, adhesives and other UV sensitive materials through polymerization.

Traditionally, mercury-based UV lamps have been used for curing, but now more energy efficient and environmentally friendly LED-based UV technology has proven a superior solution in the graphic arts industry. LED curing technology uses semiconductor-based devices to project UV light when an electric current is passed through them. When an LED is forward biased, electrons are able to recombine with electron holes within the device, thus releasing energy in the form of photons. The color of the light emitted, or corresponding energy of the photon, is determined by the energy gap of the semiconductor material.

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Figure 1

Benefits of Owning a UV LED Printer

Today UV LED curing technology is in the forefront winning over many users in the graphic arts world replacing traditional methods. To utilize the advances in technology from UV LED light sources, there has also been growth in the high- performance UV LED energy curing materials. Combining energy generation of today's UV LED light sources and the right formulation of UV curable resins, photoinitiators, and additives, it is possible to surpass current process capabilities for a variety of applications.

Advanced Capability

Small and compact UV LED technology allows you to print on a variety of substrates such as plastic, wood, metal, glass and textiles. The cool temperature allows you to print on heat sensitive substrates with new creative possibilities.

Economic Benefits

UV LED technology is energy efficient, has a long lifetime, lower operating temperatures with low maintenance.

Environmentally Friendly

UV LED technology is mercury and ozone free which creates a more pleasant and safer work environment for your staff.

Lower operating costs

UV LED printers which use LED lights for curing requires significantly less energy than other sources resulting in much lower electricity bills.

Reliability

UV LED lamps have a very long lifetime up to 20,000 hours unlike traditional mercury lamps that need to be replaced on a regular basis.

Increased Productivity

UV LED printers have less material fall out, smooth production runs and increased productivity. It has less waste and fewer consumables.

High quality printed material that is resistant to fading, rubbing, moisture and heat because the ink has been converted to a polymer and already exposed to maximum levels of UV light, it's significantly more durable and resistant.

No warm-up and Instant drying time

The small compact UV LED lamps are instant on/off with no warm up time which increases operating speeds. UV inks cure almost instantly, depending on the ink color and intensity of the UV light.

Consistent and better color on substrates

UV inkjets produce consistent images from substrate to substrate even on dark and transparent media.

Key Components for Success

There are three key components of a UV LED curing system when optimized that provide an economically advantageous high throughput solution to the printing industry: 1) UV curable materials (inks) that can absorb energy in the UV region to undergo polymerization process, 2) UV LED curing lamp that provides energy in the UV region of the spectrum, and 3) a printer where the UV LED lamp is integrated to cure material underneath it. These elements together provide a long-term sustainable printing method through green technology, eliminating ozone emissions and lowering energy consumption.

Figure 2: *Air Cooled UV LED Curing Lamp*

Spectral Wavelength

UV LED lights have a narrow spectral output centered on a specific wavelength, +/- 5nm. LEDs are a solid state device that can be built with various wavelength diodes including but not limited to 395nm, 365nm, 385nm, 405nm, 410nm unlike broad spectrum of wavelength range output by Hg-based lamps. This monochromatic distribution (see chart) requires new chemical formulations to ensure proper curing of UV materials (ink). Currently, the most popular wavelength used in LED curing is 395nm, with 365nm being used in specific applications.

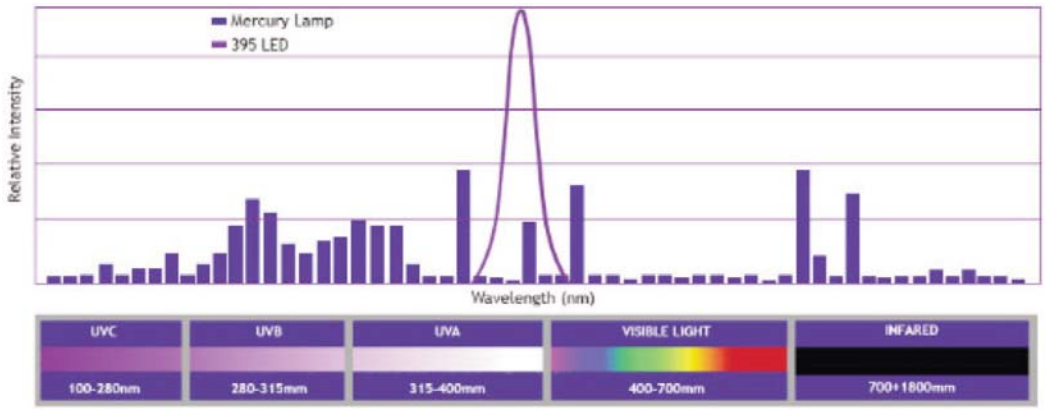

Figure 3

Ink Formulation and Materials

Ink formulation for LED technology has evolved significantly in past years and today there are a growing number of suppliers developing inks that work well with LED technology. Material suppliers have responded to the demand and challenge in the printing world to formulate raw materials that absorb energy corresponding to output wavelength of UV LED curing units.

One of the key ingredients in the chemical formulation is a photo-initiator that serves as a catalyst to initiate the polymerization process when exposed to narrow spectrum UV LED energy. And with the continued wide-spread acceptance of UV LED systems, availability of suitable base materials continues to grow. The driving factors in advancement of chemistry of raw materials is increased capability and cost effectiveness of commercially available UV LED Curing lamps.

Thermal Management

Cooling process is very important for UV LED lamps maximizing photons output. UV LEDs transfer about 15-25% of the received electrical energy into light and the remaining 75-85% is transferred as heat; thus, the need to optimize heat dissipation of 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 and long lasting systems. As the quality of LEDs improves and the irradiance increases, so does the need to dissipate the heat. OEMs and end-users do not want to spend more on the cooling of the lamps.

Digital Inkjet

UV LED curing is now an accepted tool in the printing industry. It allows for advanced capability on challenging applications for industrial printers. Printers can offer media versatility at its peak and can now run thinner materials through the machine without curling or warping. UV LED technology offers the ability to print on substrates that are uncommon. As a side benefit, these thinner substrates also reduce shipping costs, both of the raw materials and the finished product, providing further economic benefit to end-users and their customers.

Flexographic Printing

Flexography is a mechanical printing process widely used in the production of packaging materials and labels due to its high throughput speeds. UV LED technology offers superior performance with intense UV output, while using a fraction of the power required with traditional UV lamps.

Screen Printing

Recent advances in LED lamp technology and UV screen-printing ink formulations have proven LED curing as a viable alternative to medium-pressure mercury lamps. UV LED light sources are ideal for high-speed curing in screen printing applications such as direct glass printing, printing on plastics, CD/DV printing and web printing.

Conclusion

UV LED curing technology continues to emerge and has become widely accepted in the graphic arts sector because it offers new and more advanced capability for printing applications. 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 with increased throughput and process flexibility. UV LED technology offers its users advanced capabilities, economic advantages and environmental benefits.

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