

# MAKING IN-ROADS INTO PRINT TECHNOLOGIES

Rich Dunklee and Laura Maybaum explore the benefits of LED curing

Throughout the past decade, the use of LED (Light Emitting Diode) curing for energy curable inks and coatings has been gaining inroads into the graphic display, label, packaging, industrial, container, and other commercial printing sectors. In the last two years, we have seen a significant increase in the number of commercially available ink-jet printers equipped with some form of LED/UV curing systems, narrow web presses with LED/UV pin and final curing, and screen presses with LED/UV curing systems. Nazdar has developed a wide range of inks for use with LED-curing technology for digital, screen, and narrow web printers.

The benefits of LED curing are well documented and explored later in this article, but one factor that has recently come into play has pushed print equipment manufacturers to accelerate their research into LED curing. On April 13th 2015, an EU ban came into force that prohibits the use of mercury in lighting, causing concern amongst some in the print industry that printers using mercury vapour for ink curing will also be affected. While it seems this is not on the cards just yet, the EU's focus on the metal suggests it may be worthwhile looking at the alternatives when choosing new equipment.

## ALL THE BENEFITS OF LEDS

Luckily, LED curing technology offers more benefits than just escaping the attention of EU regulators. LED curing is less energy intensive than mercury vapour, as lamps not only need less power to run but also need much less warm-up and cool-down time. Therefore the lamps can simply be switched on when needed, rather than left on stand-by throughout working hours. Most machines can be plugged into standard electrical sockets, making installation easier and cheaper, while the cooler LED light source does not produce ozone, a by-product of mercury lamps that require ventilation. LEDs last significantly longer than mercury lamps too – lifetimes can be ten times greater – again saving money, time and maintenance. Additionally, print companies report shorter drying times for LED-cured output compared to prints completed on mercury vapour machines, and many are finding they can use thinner and more heat-sensitive substrates thanks to lower temperatures, thus reducing material costs. To businesses and customers looking for cheaper, more environmentally-friendly products, there are plenty of advantages.



LEDs have a much longer lifespan than a traditional bulb, typically 20,000 hours (courtesy Phoseon Technology)

LED lamps have proven to have tremendous benefits over the mercury arc lamps that have traditionally been used for UV curing. Several ink-jet printer manufacturers are claiming power reductions of their UV curing systems in the 65 to 75% range. Studies done by Nazdar on LED/UV curing system in the screen print industry support the assertions made by inkjet printer manufacturers. Beyond the reductions in power consumption by the curing systems, studies have also shown a reduction in the energy needed to cool the print environment when LED lamps are used in place of mercury arc lamps. While not as significant in the enclosed confines of an ink-jet printer, the reduction in overall heat and ozone produced can lead to additional energy savings in the shop environment.

## FEWER DRAWBACKS

Because LEDs are solid-state devices that use semiconducting technology to produce their output, they do not share some of the drawbacks of traditional mercury lamps. LEDs have a much longer lifespan than a traditional bulb – 20,000 hours for an LED vs 800 to 1000 hours for a mercury arc bulb. The diodes in an LED also provide consistent output throughout the life of the lamp. While a mercury bulb will show a marked decrease in output intensity over its lifespan, a LED will provide the same level of power through its entire life.

LED technology also allows for the lamps to be switched on and off as needed with no warm-up or cool-down periods required,

further enhancing their energy saving properties. Much of the efficiency in LED lamps is due to the fact that 100% of the energy emitted is used for curing. LEDs are monochromatic, which means that all of their energy is emitted in a very narrow spectral band; typically 395 nanometers. We also see LED systems emitting their energy in the 365nm or 405nm range. With mercury arc lamps, a great deal of the energy emitted is lost to the visible spectrum or to heat, neither of which aids in the curing of the deposited material.

While LED lamps do produce heat, the fact that an LED is very similar in its construction to a printed circuit board allows the use of heat syncs, air cooling and even water cooling to help draw heat away from energy emitting components of the LED. This allows for very little of the heat generated by the LED unit to be transmitted to the substrate being printed. For ink-jet printers producing jobs on heat sensitive films or on substrates that tend to buckle under the high heat of mercury arc lamps, LED lamps can greatly improve the efficiency of the print operation.

## PRESENTING THE CHALLENGES

With all the efficiencies we see today, LED/UV curing has not been without its challenges. The high cost when compared to a mercury arc lamp of a similar width was initially a prohibition to adoption for use in ink-jet printers. We have also seen many manufacturers try to enter the market by manufacturing a less expensive LED, with poor results. In order to save on cost, printer



It is important to work closely with printer manufacturers when developing LED/UV curable inks (courtesy Phoseon Technology)

manufacturers experimented with LEDs of lower power and quality only to find that to gain the benefits of LED curing, a high-quality lamp with sufficient power is vitally important for consistent quality out of the printer. What we see today is a limited number of manufacturers producing very high quality lamp systems. This has allowed ink manufacturers like Nazdar to focus on making inks that respond precisely to the monochromatic wavelengths emitted by today's lamp systems.

For ink manufacturers like Nazdar, it is important to work closely with printer manufacturer partners in the development of LED/UV curable inks. While it is true that many inks developed for use with mercury arc lamps can cure with an LED lamp, that cure may not be as efficient or complete as if the ink has been exposed to a multichromatic UV bulb.

#### THE CORRECT PHOTOINITIATORS

Inks designed for mercury arc curing typically have a blend of photoinitiators that respond to many different wavelengths simultaneously, and may (or may not) contain an initiator that will react to the specific wavelength being output by an LED lamp. This situation can lead to two problems. If the ink does not contain a photoinitiator that can react to the LED wavelength, the ink will simply not cure. If the ink does contain a photoinitiator that, for example, will react to a 395nm emission, the question becomes one of having enough initiator in the ink formula to fully cure the ink. The output power of a lamp will also play a role in whether or not the ink will cure. When experimenting with inks designed for mercury curing, we found that an ink may cure completely with an eight Watt LED curing system, top cure with a four Watt system, and remain tacky with a two Watt system.

We also find that a photoinitiator package designed to receive a limited dose of 395nm emissions from a mercury arc bulb will yellow when exposed to the more intense emissions from an LED lamp. This can adversely affect clears, white and light colour inks.

For the LED/UV and mercury arc curing inks being developed today, we are fine-tuning the photoinitiator packages to optimise the very different spectral outputs of the varying lamp technologies.

LED/UV curing is a technology that is here to stay. From the perspective of an ink manufacturer, we see great growth potential in LED curable inks and are focusing a great deal of our research and development efforts on LED curable inks. n

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