Getting into it with UV. UV LED Curing Systems.

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By Melissa Donovan

Part 1 of 2

UV LED curing systems are one of the reasons digital printing is gaining traction in manufacturing facilities. The ink curing process is sped up dramatically thanks to LED lights, which also allow for a wider range of substrates or surfaces to be printed to directly.

Ken Reynolds, business and technology manager, ProPhotonix, admits LED technology is still relatively new in the printing industry, but continuous improvements and increased awareness is accelerating adoption. “This is driven by forward-thinking printer manufacturers and end users who see the advantages LED systems offer in terms of increased lifetime and stability, reduced maintenance and energy costs, in addition to the removal of ozone emissions from the system.”

Unfamiliar with implementing UV curing into a production process, there are number of deciding factors to be aware of. Most important is recognizing whether the substrate or surface being decorated is able to be under UV LED light. And if it isn’t—what other options are available?

Need to Know

For manufacturers—in any industry—unfamiliar with digital printing and UV LED curing systems there are certain things that they need to know prior to committing to integrating a system into their facility.

First, UV LED is a versatile technology. As noted the cool curing technique—no heat—allows for its use on a number of different surfaces and substrates, even heat-sensitive substrates like shrink sleeves. UV LED offers other benefits as well. Reynolds suggests looking at it from an economic standpoint.

“Energy consumption is lower on LED based systems—about 40 percent. When you consider LED lamps do not need to cool or heat displaced air as with mercury lamps, the cost savings can be significant over the lifetime of the printer. It is important to consider the capital and lifetime costs of the solution when assessing LED technology in comparison to conventional curing,” he adds.

The versatility of UV LED extends beyond substrates into configuration. Manufacturers can purchase turnkey or bespoke printing devices. If leaning toward a bespoke machine, David Lyus, international sales manager, specialist UV systems, GEW, Inc., recommends working

with an established industry supplier. “Reliable UV digital inkjet printers are the result of extensive engineering and a solid understanding of how the various components—printheads, inks and coatings, UV curing systems, material handling, and the surfaces to be printed—all work together.”

Many intending to use UV LED may already be familiar with—or currently using—mercury lamps. Reynolds cautions that when replacing mercury lamps for UV LED it is not a simple switch. “Due to LEDs’ narrow curing spectrum in comparison to mercury lamps’ broad spectrum it is not a case of selecting a direct LED replacement for a current solution. Ink compatibility is also a consideration. While it is possible for LEDs to cure inks developed for conventional technology, they are often not a match for both technologies due to the peak specific wavelength of UV LED.”

During the exploration process, manufacturers need to consider the items they plan on printing on. “The first step is to identify the range and volume of items that will be printed as well as the desired functional and aesthetic print requirements. Items to be printed can be discrete parts, sheets of direct mail, or product labels and flexible packaging generated on a web. Printing needs span single-color black ink used for marking and coding all the way to extended gamut full-color decoration,” explains Lyus.

The items printed and the ink used determine the specific wavelengths required from the UV LED lights. The right wavelength ensures proper adhesion to the surface. “A UV LED system is wavelength specific so the customer needs to know if they want to go with a 395 or 365 NM system. After they determine that, we can advise how much power at that wavelength is available,” suggests Meredith Stines, president, American Ultraviolet.

Fact gathering is important during the exploration process, but even more essential is the testing phase. “It is important to specifically seek UV LED formulated inks and test the curing configuration in a lab or smaller scale facility first, before then running on a pilot/production trial run. Achieving a successful integration may be an iterative process, with tweaks in working distance, speed, equipment, and pretreatment to formulation thorough testing of cure quality. Depending on the complexity of the process and integration, the development time of a viable solution can range from a few days, weeks, months, or in rare cases, as long as a few years,” advises Pamela Lee, senior product manager, OmniCure UV LED curing solutions, Excelitas Technologies Corp.

Not a Fit

UV LED curing is versatile, but there are scenarios manufacturers should be aware of where the technology may fail. This relates to the product or surface to be printed in conjunction with the ink type, and not so much the failure of the technology itself.

“It is imperative for LED formulated inks to be used in conjunction with UV LED curing systems. In print applications where manufacturers are unwilling to change the formulation, and traditional UV inks are used, LED systems are unlikely to be a suitable fit given the monochromatic spectral output of these solutions,” advises Lee.

Today’s ink manufacturers are rapidly developing new UV LED ink configurations to make sure any and all are available. Reynolds says more options continue to be added to various portfolios. That being said, still-developing areas include varnishes and low-migration inks, primarily due to the need for further field studies and qualification.

The substrate to be printed to needs to have a surface energy that is greater than the surface tension of the ink or coating. “As a result, greasy and contaminated materials as well as materials with low surface energies such as plastic—particularly lower grade or recycled variations—must often be cleaned, primed, or pre-treated with an IPA wipe, flame, corona, or plasma to raise the surface energy and remove dirt and grime before printing and curing. Pretreating does not guarantee adhesion, but it certainly helps,” recommends Lyus.

She also points out that certain surfaces or really in the case of pre-manufactured parts, it may be challenging to achieve the proper cure. “UV curing always requires direct exposure of the cure surface to the UV source for a short but defined time period. Shadow areas, surfaces outside of the exposure window, or surfaces that are too far from the light source will not cure. As a result, parts with drastic part profiles and complicated assemblies can be difficult to both digitally print as well as cure,” continues Lyus.

Alternatives to UV LED

When UV LED curing is not the right solution for the job at hand, conventional methods—mercury arc lamps—are one option. Depending on the application, a combination of UV LED and mercury arc may be a possibility. Finally, if UV LED curing doesn’t work, it doesn’t necessarily have to be ruled out—it may call for additional pre- or post-treatment to ensure the proper adhesion the surface.

Mercury arc lamps are a proven technology used for decades, much longer than UV LED curing has been used. “All early UV digital inkjet printers used mercury arc lamps before embracing UV LED curing about ten to 15 years later. While some UV digital inkjet web applications use UV LED curing for both pinning and full cure, most machines rely on a combination of UV LED pinning and mercury arc lamp final cure. This is because many digital inks used for roll-to-roll UV digital inkjet label printers have not yet been reformulated to cure with UV LED at the required web speeds. As a result, many web-based digital platforms continue to use mercury lamps for the final cure station for the foreseeable future,” says Lyus.

Reynolds agrees, explaining that in certain applications, UV LED technology haven't reached the levels of power required to perform the job. This is when hybrid systems that incorporate both UV LED and conventional technology are used.

"These systems utilize UV LED lamps located next to the printhead and are set at a lower intensity than a full cure system. They cause the UV inks to thicken but not fully cure. This ink thickening or pinning holds the ink droplet pattern in place allowing the end user to control dot gain. This process is repeated for each ink color in the system. All pinned inks then pass through a final cure UV source to be fully cured," he explains.

Growing Stronger

While conventional curing systems are still in use, there is no question that UV LED curing is the way of the future. Its versatility is one of the strongest reasons for its growth.

"UV LED solution suppliers typically have a range of products with varying performance tiers to suit different applications and process speeds. If a lower performing device is not the right fit, the use of a higher performance system as an alternative may prove to be successful. Through trials and evaluations, the right combination can be found," advises Lee.

As ink manufacturers continue to introduce new ink sets, UV LED's presence will only grow stronger. Manufacturers interested in adding UV LED curing capabilities into their production lines should stay abreast of recent introductions and advancements in the space.

The second article in this two-part series looks at curing systems from leading UV LED vendors.

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UV LED Curing

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