Highlighting LED UV – A survey throughout the label industry

Rosina Obermayer

The whole industry is talking about LED UV, but what is the current market situation for LED UV really like? What about ink migration? Where do companies see the greatest potential in this regard? NarrowWebTech asked a range of companies who are active in the label industry what they think about LED UV and its current status quo in the market.

Read on to discover the answers from a range of companies who have been active in the label industry for years, including raw material suppliers, ink manufacturers and UV curing equipment suppliers.

BASF
Dr Juergen Baro
Technical Marketing Resins & Additives Europe for Printing & Packaging


Source: BASF

❶ LED UV is penetrating all major printing technologies, but at a different pace. LED UV is state-of-the art in inkjet and is also making major inroads into sheet-fed offset with a focus on promotional printing in both cases. In label printing using flexo, LED UV is a late comer, where high press speeds in combination with corresponding food contact compliance requirements were difficult to achieve until now. However, significant technology progress in recent times concerning LED UV radiation sources and LED UV ink chemistry will make LED UV flexo a viable process option in label printing, in the future.

"LED UV is penetrating all major printing technologies, but at a different pace."

– Dr Juergen Baro

❷ Promising LED UV applications in the future will be flexo printing on thin plastic films usually sensitive to dimensional changes, where mercury lamps emit a considerable amount of heat often causing register problems resulting in a loss of print quality. LED UV radiation sources emit heat as well, but not in the direction of the substrate, so that they are categorized as "cool" radiation sources. LED UV flexo is considered to be the process of choice in narrow web growth markets like shrink sleeves, where dimensional stability of the substrate during printing is a prerequisite.

❸ LED UV flexo inks have a different formulation than conventional UV flexo inks mainly reflecting the different emission characteristics of LED UV radiation sources and mercury lamps. Proper surface cure is still a major obstacle for the LED UV process in general; as a consequence, guaranteeing low migration and with that, food contact compliance is still a considerable challenge. The very high reactivity of LED UV flexo inks to overcome these surface cure issues imparts higher daylight sensitivity, so that adequate handling of such LED UV flexo inks on and off press has to be ensured.

❹ Sustainability is a controversial term missing a generally accepted definition. When looking at LED UV from a radiation source perspective, it has ecological advantages over mercury lamps such as lack of ozone formation during printing, savings in electric energy consumption and absence of environmentally critical mercury. However, when considering LED UV as a process, there will be no difference in recyclability for a radiation cured printed product, no matter if that is accomplished with an UV or an LED UV curing process, because the crosslinking mechanisms are very similar in both cases.

Excelitas Technologies Corporation
Pamela Lee
Senior Product Manager


Source: Excelitas

❶ In recent years, LED UVs have gained traction in the marketplace due to a number of contributing factors. These include downward pricing trends, increased performance and efficiency, and wider availability of curing solutions and LED UV compatible materials. The landscape has started to shift from utilizing the technology in only a small handful of applications to broader adoption in a wider range of applications. With the technology enhancements, increased knowledge base, and decreasing costs, further use of LED UVs will be seen in next-generation printers.

❷ LED UVs offer lower-temperature curing compared to traditional lamp solutions. With no output in the infrared range, heat output is sharply reduced and no cooling through chill rolls or shutters is needed. It enables printing and curing on heat-sensitive substrates, films, foils, plastics and thinner materials for increased productivity and a broader application range. While print speeds are important in narrow web production, the ability to offer expanded print capabilities and differentiating features can set printers apart. LED UV can help with this whilst providing faster speeds and more consistent yields.

"LED UVs offer a number of environmental benefits, including lower power consumption, no ozone emissions, and longer lifetime."

– Pamela Lee

❸ Compatibility of ink/formation with the LED system is critical for customers integrating LED UVs into their process. Unlike the broad-spectrum irradiation of traditional lamp solutions, LEDs are monochromatic and emit radiation in a narrow spectrum. As such, curing with LED UV systems requires wavelengths which match

the photo-initiator package in inks. Not only is there a minimum irradiance (peak power) to trigger the cure, but there is also an energy dosage required to ensure the cure is complete. Applications testing should be thoroughly conducted to truly understand the quality and to validate the cure.

❹ LED UVs offer a number of environmental benefits, including lower power consumption, no ozone emissions, and longer lifetime (and thus less waste/consumables). Using LED UV in printing processes has enabled manufacturers to significantly lower their carbon footprint and improve sustainability of the process. UV inks are also essentially solvent and VOC free, and materials coated with these inks have been shown to provide excellent adhesion and consistent cure. Furthermore, with advances in processing technology, UV printed materials can be defibered and recycled.

GEW

Marcus Greenbrook
Director, International Sales


Source: GEW

❶ The market is buoyant and market share for LED UV is rising steadily. Printers and OEMs are increasingly aware of the benefits, whilst the cost of LED UV systems is reducing.

❷ LED UV creates no heat radiation, which is better for many processes where the temperature must be controlled, such as when working with difficult and delicate substrates. Double production speeds can be achieved with thick, heavily pigmented inks. The LEDs' high intensity UV-A rays penetrate thick ink coatings better for more effective curing with improved adhesion, delivering faster speeds with silkscreen and opaque white coatings. When laminating, LED UV penetrates through the top film layer with minimal absorption, making it more efficient than a traditional lamp.

❸ Migration of chemicals from printed ink areas to foodstuffs is a regular concern for printers. They must monitor and control the curing process to ensure compliance with legislation, via stringent GMP practices and the use of low migration inks. On arc systems, products like GEW's multi-point UV monitor ensure the amount of UV light incident on the substrate is monitored and traceable as part of a GMP procedure, giving confidence that regulations are being met.

"The market is buoyant and market share for LED UV is rising steadily."

– Marcus Greenbook

With LED, many ink manufacturers now offer low migration formulations that meet the same criteria as arc inks, so from a process viewpoint there is little change.

❹ The sustainability benefits of LED UV include:

- Over 50% energy savings can be seen when compared to a new arc system, and in the case of an older arc system this saving can increase to over 75%.
- The absence of mercury is good for the environment and eliminates concerns over future legislation on mercury.
- LEDs last much longer, so the impact of spare parts is reduced.
- LEDs do not generate ozone when in operation.
- LEDs use UV inks in the same way as arc systems, so there is little difference in the recyclability of the printed and cured substrates.

Dr. Hönle AG UV Technology

Petra Burger
Process Development


Source: Hönle

❶ LED UV has already entered many fields of the printing and coating industry – as a possible alternative. Whereas in other industrial sectors, e.g. the adhesive industry, LEDs have even replaced conventional UV systems. Here the interaction between chemistry and LEDs was perfectly aligned. This is certainly not yet the same in the printing industry. Though we perceive increasing development activities on the part of the chemical industry. These chemical improvements lead to a larger selection of inks, which is the key to success for the LED technology. In accordance with chemical developments, LED systems have also been improved. Their degree of efficiency could be raised from 5% to 50%!

All in all, the increasing market penetration reveals that the acceptance of LED technology in the printing market is improving.

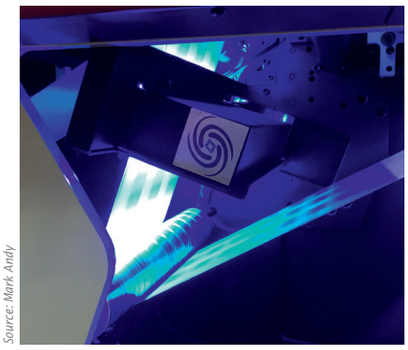
❷ There are very promising applications in the field of label printing. Here LEDs offer the advantage of lower heat input on the substrate. In addition, LED units can be built in very small dimensions and thus are perfectly apt to be integrated into the smallest spaces of the printing machine – benefits which were hitherto especially used by flexo printers but are now more and more discovered for inkjet label printing – certainly a fast-growing trend.

"The increasing market penetration reveals that the acceptance of LED technology in the printing market is improving."

– Petra Burger

❸ The conventional UV curing technology has been offering very good solutions for low-migration inks and coatings for quite a while. Here usually, inert chambers are applied where the oxygen, which disturbs the polymerization, is replaced by an inert gas, usually nitrogen. This technology has been applied and optimized for decades. This is also a possibility for LED UV curing.

❹ The most sustainable aspects of LED UV are the long LED life-time


Source: Mark Andy

The LED UV and printing press manufacturer are already working together - here a Phoseon LED UV unit is installed at a Mark Andy label press

Questions:

❶ What is the current market situation for LED UV and how will this further develop during the upcoming years?

❷ LED UV curing opens up potential for processing difficult substrates. What are the most promising applications with regard to narrow web production?

❸ Ink migration is a hot topic: What are the challenges regarding printing inks and substrates? Compared with other ink systems, what do print shops have to consider if processing LED UV inks?

❹ LED UV is often characterized as being sustainable: What ecological aspects do you identify such as recyclability of the printed and cured substrates?

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2. LED UV curing opens up potential for processing difficult substrates. What are the most promising applications with regard to narrow web production?
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4. LED UV is often characterized as being sustainable: What ecological aspects do you identify such as recyclability of the printed and cured substrates?

and, primarily, the possibility to save energy: LEDs are based on semiconductor electronics which can be switched on or off at any time: standby-functions or starting are not necessary. Energy is saved. In addition, it is possible to switch off single LED segments.

Thus, the irradiation widths of the LED unit can be optimally aligned with substrate and application – and again: energy is saved. The recyclability of printed LED-cured substrates is comparable with that of conventional UV curing.

IST Metz
Volker Selg
Head of Sales Web

1 LED UV is developing very well and has become a standard in some applications, especially in areas where the advantages of LED lamps versus conventional arc lamps lead to technical and/or commercial advantages. A challenge is that too many false promises were provided to the industry, causing wrong expectations.


Source: IST Metz

Technologies have pros and cons and those must be balanced prior to an investment decision. Further growth will be seen for LED – as for all light curing technologies.

2 One of the core advantages is the absence of IR radiation, simply leading to less thermal stress on the substrate. As the range of applicable film materials (especially thinking towards unsupported monofilms) is huge, there is a simple answer: Every application where the additional temperature is not wanted is usually looking into LED, i.e. translative printed label.

3 The challenges are clear: Consumer awareness is growing which simply means that brand owners require products which are fully compliant with the valid specifications as otherwise the brand's name can be harmed. Brand owners understand their responsibility and therefore there is no tolerance at all. LED UV underlays the same requirements as conventional (lamp) UV, due to the small emission band the ink formulation plays an essential role: It must ensure proper polymerization in the available range.

"One of the core advantages is the absence of IR radiation, simply leading to less thermal stress on the substrate."

– Volker Selg

4 LED UV is UV curing which allows printing on nearly every substrate – even on the new substrates like paper manufactured from grass! In addition the need for focusing on the collection of film based packaging (which from a global perspective does not at present exist) prior to the question of recycling, LED UV will not be a problem for recycling.

Jänecke+Schneemann Druckfarben
Philipp Hölzl
Business development manager

1 The current market situation is quite difficult. In the field of raw materials there have been some heavy price increases, some photoinitiators are four times higher than at the beginning of 2018. The second big issue is the availability of some raw materials from Asia. Some are difficult to obtain because a lot of factories has been closed or are not producing anymore. On the other side the printing market is asking for LED inks more and more. We


Source: J+S

have a huge increase of requests for LED inks all over the world.

❷ We would say that the biggest advantage in narrow web (NW) is to print on very thin layer substrates like non-absorbent plastic/films. Because of the reduced heat in the LED process it is easier to print on heat-sensitive substrates.

❸ As we have a big issue with raw material on all UV inks, especially LED inks we have much more difficulties with low migration LED inks. In the field of low migration fewer ink raw materials are available. Especially for LED ink is it is more limiting compared to normal

"The current market situation is quite difficult."

– Philipp Hölzl

UV. Print shops have to understand that the ink manufacturer does not have the full ink system like coatings/varnishes, metallic inks like the normal UV system. From the substrate side we would say that there is no difference in comparison to non-LED systems.

❹ From the ecological perspective the LED system is totally similar to the standard UV system which has been used in the printing industry for more than 35 years. Only from electricity cost side there is a difference. Depending on the machine configuration and what kind of machine you compare (UV to LED or conventional offset to LED or flexo to LED flexo) you may get different cost efficiency calculations.

Phoseon Technology

Marine Faucher

Global Marketing Communications Manager

❶ Between 2010 and 2018, LED UV sources became increasingly more powerful, more efficient, more reliable and less expensive. This trend is expected to continue. Over the next few years, the UV industry will continue to plug away within the technology development network. The LED lamp market continues to grow (+30%) and is converting from mercury systems extremely quickly. Much of this work is actually driven by end users who see the value in converting to LED UV technology. We also see an increase in direct collaboration between LED UV equipment suppliers and formulators to influence where LED UV development efforts need to be focused.

Source: Phoseon Technology

❷ Developers of printing equipment are choosing LED curing technology because its advantages are undeniable. For example, the curing heads are small enough to be used in smaller, more compact machines. Without generating a lot of heat or consuming high levels of electrical power, LED UV curing units can produce deep, thorough curing on a huge range of substrates. LED UV lamps can provide controlled curing intensity on thin plastics, foils, and films that would soften, warp, or discolour under the heat produced by UV arc lamps. This is especially beneficial for

"The industry continues to come up with new ways to use LED UV."

– Marine Faucher

printing flexible materials, shrink sleeves and semi-rigid surfaces.

❸ In 2018, most ink manufacturers and material vendors are formulating for LED. New resins, monomers, oligomers and photo-initiators are under development. Inks, and coatings and adhesives are now widely available specially formulated for LED. Thus, the industry continues to come up with new ways to use LED UV. Braille, bottle, composites, displays, electronics and other segments are showing rapid growth. LED technology has become more powerful as more compatible inks become available, resulting in substantial advanced capabilities for UV printing. Material suppliers are formulating raw materials that absorb energy corresponding to the wavelength of LED UV light sources. Today, a large number of suppliers have developed flexo and narrow web inks that work with LED technology.

❹ Compared to a UV system, LED UV curing technology has no moving or consumable parts which significantly increases the ecological benefits of the curing solution (no mercury bulbs to replace and to discard) and also reduces downtime for maintenance and repairs. LED UV systems last longer and can reduce energy consumption by up to 70% compared with traditional arc lamps. In addition, LED UV curing does not contain mercury, which is used in conventional lamps, making for a safer environment and workplace.

Siegwerk Switzerland

Rolf Montag

Product Manager, business unit narrow web

❶ While in the US 1,200 LED UV units are already installed in narrow web printing, Europe is still l acking behind. Even though, LED UV has already gained importance in EMEA, especially for packaging applications, only ~190 LED UV units are installed until today – only one-sixth compared to the US. So far, the acceptance of LED has generally been limited due to a lack of solutions particularly for low migration. Further growth of LED UV will depend on legislations like RoHS and on the availability of a full range of inks and varnishes enabling the use of LED UV for all kinds of printing applications.

Source: Siegwerk

❷ Because LED UV is generating

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less heat compared to conventional UV lamps, the most promising applications for LED UV curing are in the areas of thin films and other heat-sensitive materials.

❸ The challenge in itself is not the ink it is the process stability. With LED UV the stability is much better than with conventional UV curing. LED UV lamps have a long service life as they do not age and generate zero ozone dispensing with the need for suction removal. The UV power is available as soon as an LED UV system is activated, so that

the process does not require any warm-up phase as is the case with conventional UV emitters that feature mercury vapour lamps.
❹ The main benefits of LED UV technology include its low energy consumption, its low heat generation, long service life of its lamps as well as zero ozone emissions and less waste. LED UV lamps don't contain any mercury like conventional UV lamps, last more than ten times as long, and are ready to operate as soon as they are switched on enabling energy and finally money to be saved.

Sun Chemical
Jonathan Sexton
Marketing Manager Energy curing products, Europe

❶ LED was introduced to the narrow web market in 2012, since then development has been steady with


Source: Sun Chemical

an estimated 200 narrow web flexo LED presses installed worldwide. There are many more installations that are capable of using LED by way of modular units that can be run with normal UV and LED inserts, but where LEDs have not yet been installed. In sheet fed offset printing, LED technology was introduced earlier but was overtaken by low energy mercury technology. However, in the last two years LED has accelerated again. Today, there are more LED offset presses than narrow web and LED is starting to be used in web offset also. LED use will continue to develop steadily but a step change will be dependent on lower LED wavelengths and government regulation.
❷ Promising applications include applications that involve printing films, particularly unsupported and low weight films for wrap, shrink labels and flexible packaging. In narrow web using in-line presses, the stability of the web is a key factor and anything that reduces heat impact on the web and improves overall stability is an advantage. LED can also be used on central drum common impression presses where they contribute to the temperature stability of the drum.
❸ LED inks contain higher levels of photoinitiators compared with standard inks and as with all inks, require a minimum UV dose to cure the inks adequately and achieve migration-compliant print. Therefore, the requirements for food packaging printing are the same as with normal UV inks, but the risk of insufficient curing needs to be controlled and inks used fit for purpose and designed for food packaging. LED printing offers advantages as the UV dose is highly controlled and stable over time, if adequate ink curing is achieved at the start. Regarding substrates there are no limitations, only the adhesion of the inks needs to be controlled on films, similarly to standard UV inks.
❹ LED is proposed as a sustainable solution due to the lower energy consumption of the lamp units and longer lifetime. These are, however, not the only or main purchase criteria, operational efficiency, system stability and low heat impact on the substrate are all cited advantages. UV inks can be designed to reduce their impact on labelled bottle recycling processes by retention on the label during washing. UV print on paper and board can be recycled by paper mills adapted to this. LED inks are not different in this regard.

"A step change will be dependent on lower LED wavelengths and government regulation."

– Jonathan Sexton

Zeller+Gmelin Corporation USA
Ed Dedman
Flexo Technical Support / Product Manager

❶ Like many new technologies, LED curing for the narrow web market has been somewhat slow to


Source: Zeller+Gmelin

evolve. However, adoption of this technology, at least in North America, has begun to accelerate, with a high level of interest from attendees at the recent Labelexpo Americas. There is a larger number of label and packaging printers looking at LED than ever before, and we expect that the level of interest to continue to grow over the next few years. We do believe that LED will prove to be the curing technology of the future, slowly supplanting traditional mercury-type UV systems.
❷ LED certainly is a good fit for the shrink sleeve and flexible packaging markets, as many of those substrates are very heat-sensitive; with LED offering a much lower level of heat energy as part of the curing process, it's a natural choice.
❸ One of the main production aspects that must be monitored is degree of cure; this remains a key consideration for both LED and conventional UV technologies. LED does offer some benefits over UV in terms of curing heavier ink laydowns, and is very effective for opaque whites, but can sometimes suffer from reduced surface cure. LED also has the benefit of a more consistent energy output over the life of the system, compared to conventional UV which exhibits a slow drop in power, ending with a pretty steep drop-off in power near the end of the bulb's lifespan.
❹ To our knowledge, labels and packaging printed and cured using LED technology are no more/no less recyclable than their UV-cured counterparts. If a product can be recycled today when cured by traditional UV, it can certainly be recycled when cured by LED. The environmental benefits from LED are primarily two-fold; the potential reduction in mercury into the waste stream, and the reduced energy consumption of LED systems when compared to UV.

"We do believe that LED will prove to be the curing technology of the future."

– Ed Dedman

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