LED-UV Technology

LED-UV coatings in the printing industry

The role of LED-UV technology in printing

LED-UV systems are used in the field of coating. This, among others, refers to the furniture and automobile or to the cosmetics industry. Also in graphic arts, LED-UV becomes more and more important. Printing presses are adapted to this technology. Already, you can find LED-UV curing inks and the first LED-UV coatings in the market. Due to its variety of advantages, LED-UV is valued as a fast growing and profitable business.

However, there is a far more relevant argument for LED-UV technology. Medium to long-term we will face the ban of mercury vapor lamps also in printing presses. Those are applied with regard to traditional UV drying in order to cure inks, coatings, adhesives or other UV-reactive materials. The challenge: Mercury belongs to those substances that are rated as environmentally hazardous. Moreover, the use of mercury is governed and restricted by the RoHS Guideline 2011/65/EU*1. As they do without the use of mercury, LED-UV lamps represent a valid alternative.

LED-UV versus traditional UV technology

Unlike conventional UV lamps whose functionality is based on gas discharge, we refer to light-emitting diodes when talking about LED. These are light emitting semiconductor elements on the basis of semiconductor crystals. While in traditional UV technology a broad UV spectrum between 200 and 400 nm can be emitted, LED-UV systems work with a specific wavelength (monochromatic radiation). Common are 365 nm, 385 nm as well as 395 nm. Shorter wavelengths are currently not available commercially.

In comparison to the traditional UV technology, LED-UV provides many advantages. Nevertheless, there are also disadvantages. Which technology is finally used depends on the corresponding application and the question of investment.

*1 See RoHS Guideline 2011/65/EU (Restriction of certain Hazardous Substances) in order to restrict the use of specific dangerous substances in electrical appliances and electronic devices.

LED-UV technology	UV technology	
no mercury	traditionally, mercury vapor lamps	Advantages LED-UV
no emission of ozone		
energy saving, sustainable		
limited heat generation (works against substrate deformation)	high temperature load of substrate by IR-radiation	
immediately ready for operation	warming-up phase necessary	
long lifespan of lamps, but single diodes not to be replaced easily	shorter lifespan, UV lamps and reflectors to be changed easily	
intensity of lamps does not fall or falls very slowly	UV lamps loose intensity with time	
new technology	well-known technology	Disadvantages LED-UV
high investment costs	limited investment costs	
needs highly reactive inks and coatings	broad availability of inks and coatings	
electromagnetic spectrum in the UV-A sector (difficult surface curing)	very broad emission spectrum	
	also suitable for food packaging (indirect food contact)	

Table: UV-LED is innovative, environmental-friendly and energy-efficient

LED-UV coatings offer an abrasion-resistant color film. Do we still need overprint varnishes in LED-UV printing?

Many responsible persons currently deal with this question within the printing industry. Certainly, it is correct that – due to the immediate drying of inks in LED-UV printing – protective coatings are more or less negligible. Provided, this refers to products that are not taken in hand on a regular basis. Nevertheless, for LED-UV printed products the same applies as to those products printed in traditional UV technology: Overprint varnishes provide a valuable finishing and differentiate the brand from competition. Especially printed products with a high demand on their visual appearance, as for example high-value magazines, premium packaging or labels, will not be able to do without overprint varnishes also in future. Whether stamping, high gloss or matt effects, drip off, partially applied or used full area – finishing offers printers the possibility to "set apart from the crowd".

What are the important features of LED-UV coatings?

Apart from their visual effects, LED-UV coatings offer a good processing. They show a high reactivity and a good flow-out; they are scuff resistant and enable clear and high-contrast printing images. Optimum surfaces without "sand paper effects" are possible, as the LED-UV technology forgoes anti-set-off powders. Due to the immediate curing despite a low radiation energy, LED-UV coatings provide a high energy efficiency.

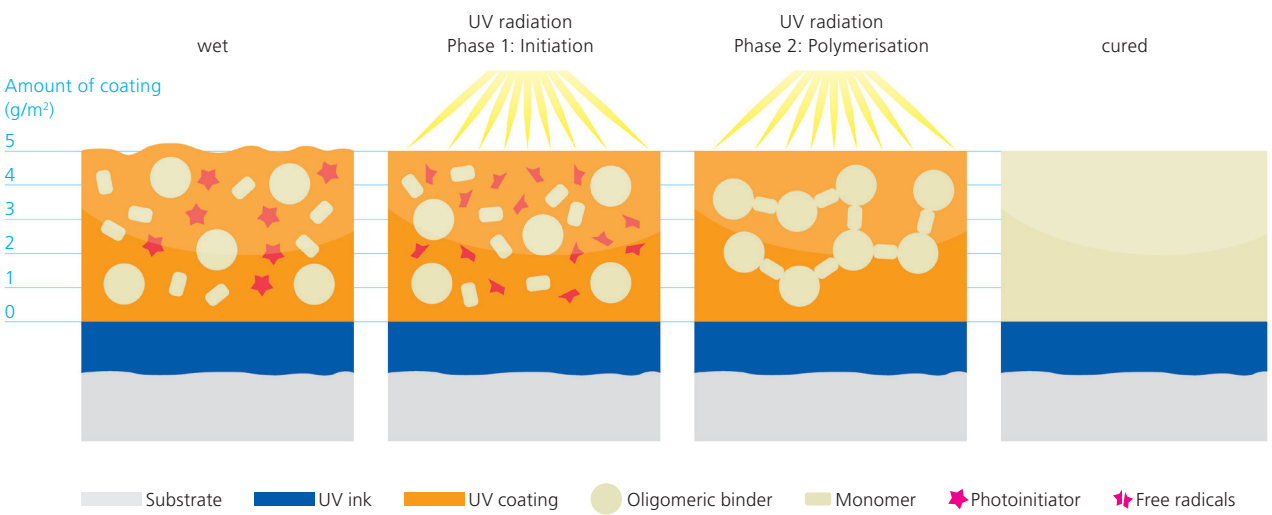
What to consider when using LED-UV coatings?

UV coatings cure under ultraviolet radiation by means of a chemical reaction, a chain polymerization. During the radiation with UV energy, the photoinitiators become highly reactive particles. These highly reactive particles crosslink the acrylates so that a plastic film is formed within milliseconds. Important to know: Photoinitiators are characterized by their absorption spectrum. This refers to the wavelength area that activates the photoinitiators, which is effectively the "starting signal" for the polymerization reaction.

Currently used UV varnishes, however, adjusted to the spectrum of conventional UV lamps, are not suitable to be used in LED-UV printing. New developments and their photoinitiators must consider the narrow wavelength definition of LED-UV technology*2.

For maximum surface curing: By means of DIN 5031, part 7, the UV area of the electromagnetic spectrum is divided into four sub-groups. As the following table shows, LED-UV coatings face a critical surface curing.

*2 At ACTEGA Terra, we have developed LED-UV coatings for wavelengths of 385 nm to 395 nm. As this is close to the visible light spectrum, you must protect liquid coatings against strong and direct artificial light as well as daylight.



UV area	Characteristics	Wavelengths	Impact on coatings and inks	LED-UV vs. UV
Visible light				
UV-A	Long-wave, close to the visible light	380–315 nm	Deep curing/ Curing	LED-UV UV
UV-B	Shorter-wave, more energy intensive	315–280 nm	Curing	UV
UV-C	Short-wave, aggressive	280–200 nm	Surface curing	UV
Vakuum-UV				

Table: UV spectrum & areas of wavelengths for coating and ink layers

OUR TIP: You can achieve maximum surface curing by considering

- Low press speeds
- Small gap between lamp and substrate
- Use of coatings that have been adapted to the LED wavelength
- High lamp performance

Conclusion

LED-UV becomes more and more important. This technology combines all advantages of traditional UV printing; however - compared to conventional lamps - without the emission of ozone or the use of mercury vapor lamps.

Although there is limited need for additional protection due to the immediate curing of LED-UV printing inks, overprint varnishes are indispensable. They finish printed products with valuable visual effects and differentiate the brand from competition. Moreover, LED-UV coatings provide a wide range of advantages, as for example a high reactivity, the very good mechanical resistance or by forgoing anti- set-off powders for optimal surfaces.

LED-UV coatings persuade by means of their simple handling; in their formulation, however, they need to be adapted. Make sure to ask for LED-UV products if you work with this technology. You will also be able to master the challenges of critical surface curing by considering our tips.

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