Light-emitting diode or lamp

What are the opportunities for LED UV technology in the graphic arts industry? The basics of LED UV technology (Part 3)

The first two articles in this series delved into the question of what future LED UV technology could have in the graphic arts industry. The first part of the series explained the technical basics of the Light-Emitting Diode (LED), while the second part discussed what the opportunities for LED UV technology are in general and how it could be developed for specific application in the graphic arts industry. While the first two articles were primarily involved with the technology and applications, this third instalment deals with the current status in the development of suitable ink systems. To this aim, various printing ink manufacturers were surveyed.

In our contact with printing ink manufacturers, it became clear that almost all of them were preoccupied with the subject of LED UV technology, but that their companies make use of this technology to a greater or lesser extent. To generalise, we can say that the more special the application, the more development has flourished. Although the technology has been used in isolated instances in large format inkjet printing systems using multipass processing, in the screen printing of three-dimensional objects and in marking applications using inkjet solutions, its commercial use is as yet insignificant. Narrow-web printing was also mentioned as a future area of application. But if we are talking about typical applications in the printing industry such as sheet-fed offset, then the relevant suppliers display rather a “wait-and-see” attitude. Both Sun Chemical and their parent company Dainippon Ink have developed suitable inks that can be cured using currently available LED UV units, Dr. Nick Ivory, European Technical Director at Sun Chemical, tells us. They are waiting, above all, for demand to emerge from printing firms.

Because the Flint Group does not see any demand in the field of offset printing in the near future, they have not developed any LED UV inks as yet, explains Dr. Hans-Peter Seyer, who is responsible for UV offset printing in Applications Engineering at the Flint Group. However, the company is watching the technology with interest, in order to quickly develop suitable printing inks when - as anticipated - the use of LED UV systems in offset printing becomes more widespread.
The Siegwerk company is also unable as yet to forecast when LED UV technology will reach market maturity in the graphic arts industry. However, the company has been conducting laboratory tests for several months. And according to Dr. Heinz Schweiger, Manager of Research & Development, the printing ink manufacturer Zeller+Gmelin from Eislingen took its first steps in LED UV technology in the beginning of 2007. Moreover, the Ruco company is examining the issue of LED UV from the viewpoint of varnish systems and screen printing inks, with a view to developing products for various applications.

The Marabu company, which primarily produces printing inks for screen printing, inkjet and pad printing, is relatively far ahead in this area. As Friedrich Goldner, Manager of Marketing & Communications, explains, this Tamm-based firm is already working on projects in which LED UV curing is to be used, above all, for industrial

applications. Besides the possibility of pinning - or partial curing of inks - in the inkjet printing process, they are also involved in the final curing of printing inks. At the Drupa 2008, the UV supplier IST Metz presented a study of LED UV technology, which was already described in Part 2. The opaque white that was printed on a PP film at the trade fair using the screen printing method originated from Marabu. This company currently has an array of inks in its product range that are suitable for tests of LED UV curing. They are based on conventional UV inks that have been modified for use with LED UV.

Waiting for indicators from the market

Marabu intends to incorporate a range of standard inks specially developed for LED UV curing in its commercial product range once indicators from the market signal the end of the test phase and an actual requirement profile exists. In the opinion of Dipl.-Ing. (FH) Martin Hauck, who works in Development at Marabu, the Drupa 2008 acted as a kind of wake-up call, which triggered numerous initial practical tests. He is convinced that the first special projects will come to fruition in industrial applications during the course of 2009. Where the graphic arts industry is concerned, however, he envisages the dawn of market-ready solutions only in years to come.

Impediments to development are the limited choice of raw materials due to the narrow range of usable wavelengths, for example, and the as yet comparatively low efficiency of LED UV lamps, Dr. Heinz Schweiger from Zeller+Gmelin points out. The principal wavelength ranges for the use of LED UV technology in the graphic arts industry are between 365 nm and 405 nm, with current development focusing primarily on 395 nm. If it were simply a matter of formulating the inks, however, manufacturers would prefer the lower wavelength range of 365 nm, because here there is a larger choice of available raw material components, and the inks could be produced more cheaply. But here they are faced with a range of disadvantages. For example, LED UV systems with 365 nm have a much lower efficiency, a shorter service life and considerably higher purchasing costs. For this reason, most ink manufacturers are, like Marabu, currently concentrating their development on the 395 nm range for reasons of cost efficiency.

More nitrogen, better performance

In order to offset the weaknesses of LED technology, ink manufacturers are examining the possibility of combining LED UV units with different emission spectra, for example, or of using LED UV units for intermediate curing, with end-of-press drying performed by conventional UV lamps. Moreover, curing in a nitrogen atmosphere is another method mentioned by several manufacturers for improving performance. According to Marabu, it is no longer necessarily the case that the nitrogen has to be conveyed from tank systems. Rather, it is now possible to divert the nitrogen from compressed air, so to speak. Tests have shown that this method brings about a considerable improvement in curing conditions. Only one single investment has to be made in the technology to achieve inertisation with nitrogen. Costs for the procurement of additional nitrogen can be dispensed with.

First a niche, then a broad market

When we take a look at the most probable areas of application, it becomes clear why the ink manufacturers in particular, who tend to focus on specialities in their product range, are working especially intensively on the development of LED UV inks. Most LED UV units are currently employed for inkjet printing, where their principal task is pinning the droplets to prevent them from running. Another major advantage of LED UV lamps is their light and compact design, which enables them to be integrated easily in existing systems, and also means that they do not contribute greatly to the mass to be moved - an especially important point for multipass systems. At the same time, Friedrich Goldner observes that customers of Marabu who express an interest in LED UV technology increasingly also include firms that have not worked with UV curing inks before, because they lacked the space to install conventional UV units, for example. Here, certain advantages of LED UV systems could also open up new market segments for UV curing.
Industrial screen printing is another important focus of LED UV development. Marabu has received several requests for quotes for projects involving the printing of three-dimensional objects.

Most printing ink manufacturers envisage realistic opportunities for the entry of LED UV technology in traditional market segments of the printing industry when the achievable lamp power is sufficiently high to manage the printing speeds usual in the industry, and when investment in LED units becomes affordable for printing firms. Narrow-web printing is an application with especially promising prospects. Since many label printing firms combine different printing methods (from relief printing and flexographic printing through offset methods to screen printing and photogravure) and processing steps in one production line, the printing speeds are in a range that could be covered by currently available LED technology. The irradiated zone can also be flushed with nitrogen if necessary to improve performance.

Performance is influenced by many factors

To the question as to what performance can currently be achieved in practice using LED UV technology, only a few ink manufacturers could name concrete figures. The achievable printing speed is influenced by too many different factors. The two companies Marabu and Zeller+Gmelin expressed figures based on their own experience, of production speeds of up to approx. 100 m/min in both cases, when certain preconditions are met. In addition to inertisation with nitrogen, these also include the possible combination of LED UV and conventional UV curing processes. In tests with LED UV inks conducted by Marabu in the laboratory of UV supplier IST Metz, speeds of up to 100 m/min were achieved in a nitrogen atmosphere. In a normal atmosphere, around 25 m/min was possible. In the screen printing of three-dimensional objects, test machines achieved speeds of up to 70 and 100 cycles per minute using LED UV lamps with 4 W/cm².

Empirical values are still lacking

One ostensibly important advantage of LED UV technology is its potential to save energy. However, most ink manufacturers were cautious in expressing the extent of this energy-saving potential, firstly because no empirical values are available and secondly, because comparative figures are vague. Experience shows that figures

obtained under laboratory conditions are not necessarily replicated without compromise in a production environment. This applies both to energy figures and to the service life of the lamps, for which the figures mentioned vary considerably from one manufacturer to another. It is the view of Martin Hauck of Marabu that genuinely reliable statements can only be expected once the first LED UV units have been working on production lines for a longer period.

The question concerning the future pricing of LED UV inks is even more difficult to answer. As Dr. Nick Ivory of Sun Chemical explains, the technical parameters of the lamp technology, such as wavelength and UV output, have a decisive impact on the formulation of the inks. Both these aspects also have a major effect on the price of inks. At Marabu, the cost estimates for the raw materials required to produce LED UV colours fluctuate at levels from 30 to 300 % more than conventional UV inks, depending on the application. These figures do not include development costs or higher production costs, as the volumes produced will be smaller during the initial phase of the market launch.

Reaching the goal via compromises

Hopes for the future are roused by a comment from Friedrich Goldner of Marabu, who has this to say: "Inks for LED UV technology must not be more expensive." However, to this statement he adds the prerequisite that LED UV units with a power of at least 4 W/cm² in the 365 nm wavelength range must be available and production must take place in a nitrogen atmosphere. It is still not foreseeable when these preconditions can be fulfilled. In the meantime, compromises will have to be made in terms of technology, inks and cost efficiency in order to reach the aspired-to goal. Today we are faced with three principal obstacles. Firstly, the purchase price of LED UV units is still relatively high. Secondly, the same applies to suitable inks, particularly in the currently most common wavelength range of 395 nm. Thirdly, achieving the smallest possible distance between the LED lamp and the surface of the substrate - necessary for efficient use - involves great difficulty in certain applications.

When and if LED UV technology will prevail in the graphic arts industry remains to be seen.