SELECTING PHOTOEMULSIONS FOR DIGITAL UV EXPOSURE IN SCREENPRINTING

Roland Studenroth examines the current technology and development of products for the digital UV exposure of screen printing emulsions

FOR SEVERAL YEARS, DIGITAL UV EXPOSURE FOR THE PRODUCTION OF SCREEN PRINTING STENCILS HAS ESTABLISHED ITSELF ON A BROAD FRONT AND CAN NOW BE REGARDED AS AN ESTABLISHED PROCESS. THE DIGITAL PRODUCTION OF SCREEN PRINTING STENCILS CAME ABOUT BECAUSE THE MARKET AVAILABILITY OF REPRO-FILM HAS DRAMATICALLY RECEDED, AND IN A FEW YEARS IT WILL BE INCREASINGLY DIFFICULT TO OBTAIN HIGH QUALITY SILVER-BASED FILM FOR IMAGE COPYING.

The rapid advance of digital UV exposure is particularly due to the fact that there are savings in the costs for film and in other consumable materials such as ink or wax, which these rival systems require. Although wax and ink systems are cheaper as an initial investment, their inherent weaknesses lie in their additional running costs due to the consumption of wax or ink, and the resolution quality is not as high as for digital exposure.

SYSTEMS FOR DIGITAL EXPOSURE

There are currently two different types of technology for digital exposure available:

- Exposure via micro-mirrors (Digital Mirror Device, DMD)
- Exposure via LED UV laser at approximately 405 nm (blue laser).

With DMD technology, the whole spectrum of a metal halide lamp is projected via micro-mirrors (approximately 10-20 µm edge length, depending on type) onto the coated and dried printing screen and with digital guidance of the micro-mirrors, the UV light is accurately transmitted onto the screen as required, thereby creating the image. Systems vary from manufacturer to manufacturer, mainly in UV sources and optical devices. The principle of the light path of a DMD system is shown in Figure 1.

For digital exposure using LED UV lasers at approximately 405 nm, up to 128 laser beams are arrayed on a disk and bundled through an optical device to create the image on a screen. Figure 2 illustrates a typical array. Single laser beams have a diameter of approximately 40 µm and by overlapping or interpolation, they enable very good straight lines to be imaged.

Figure 1: The principle of the light path of a DMD system using the KiWo ScreenSetter as an example

FORMULATION OF SCREENPRINTING PHOTOEMULSIONS

Primarily, diazos and / or SBQ-endowed polyvinyl alcohol (where SBQ is stilbenium quarternised) are responsible for the actual imaging. When diazo-sensitised photoemulsions are used, the UV exposure cross-links the water-soluble polyvinyl alcohol, which then becomes insoluble (see Figure 3).

If other UV-reactive components are included, they are referred to as diazo UV-polymers or 'dual-cure' products. With the appropriate selection of components, different UV reactivity can be achieved; the main influencing factors are the chain lengths of the polyvinyl alcohol, the ratio of hydrophilic and hydrophobic components and the concentration of diazo. Simple diazo photoemulsions without UV reactive resins are not generally as reactive, whereas diazo UV-polymers could be classified as medium-reactive within the general spectrum of photoemulsions.

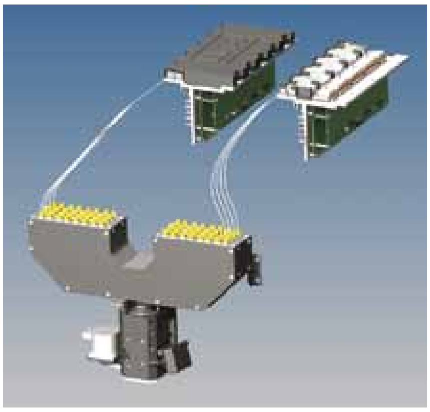

Figure 2: LED UV laser unit using the Lüscher JetScreen DX as an example

In SBQ sensitised products, neighbouring SBQ groups are linked by UV reactivity via a quadrinomial ring; the SBQ polyvinyl alcohol then also becomes water-insoluble (see Figure 4).

The reactivity of SBQ sensitised products can be adjusted by the chain lengths of the polyvinyl alcohol, the amount of SBQ groups and the ratio of hydrophilic to hydrophobic polymers. 'Dual-cure' versions are also included here. As a rule, the reactivity of SBQ photoemulsions is significantly higher than that of diazo-sensitised products. These can be classified as highly to very highly reactive (e.g. projection emulsions).

PHOTOEMULSIONS FOR CTS SYSTEMS

CTS systems based on micro-mirror technology are more common, but there is – depending upon the manufacturer – a certain bandwidth of effective exposure energy. Powerful systems harmonise best with medium reactive diazo UV-polymer emulsion (e.g. Azocol Poly-Plus S) and weaker systems need the so-called standard SBQ emulsions (e.g. Polycol Supra Plus); in general, highly reactive projection emulsions are not really necessary.

As the UV-light source of DMD systems (metal halide lamps) emits a similar light spectrum as in conventional screen exposure, there are no special requirements regarding the choice of photoemulsion. However CTS systems based on LED UV lasers emit light at around 405 nm, so there were initial reservations as to whether the photoemulsion had been fully cured. It has been convincingly proved otherwise and just as with DMD exposure, the first choice is either medium reactive diazo polymer or standard SBQ emulsions.

Incidentally, it has been discovered that colouring the emulsion violet harmonises particularly well with the wave-length of 405 nm. LED UV laser systems offer the possibility for the interpolation (overlapping) of the laser dots; this effectively gives a significant

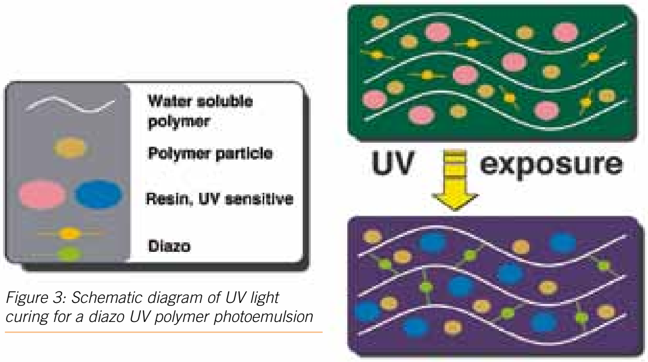

Figure 3: Schematic diagram of UV light curing for a diazo UV polymer photoemulsion

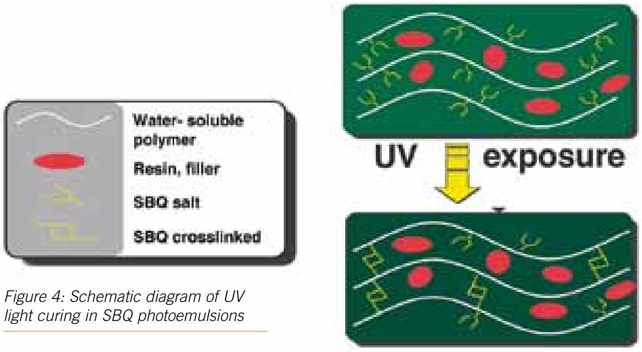

Figure 4: Schematic diagram of UV light curing in SBQ photoemulsions

increase in exposure energy, so you have to fall back on to photoemulsions with a higher exposure tolerance (Diazo UV polymers such as, for instance, Azocol Poly-Plus S).

SPECIAL CTS PHOTOEMULSIONS

With due regard to what has already been stated, it should actually be possible to find a suitable product from the wide range of photoemulsions for each type of system and for each application. Where 'off the shelf' solutions are inadequate, special CTS photoemulsions have to be developed. The main reasons for the emergence of special CTS photoemulsions are that several central influencing factors may deviate from the conventional work process, such as:

- the effective delivery of UV energy (exposure time)
- the image quality (pixel structures)
- the number of screens per day (workflow).

With the help of special CTS emulsions, you can attempt to re-attain, approach or even optimise the previous rate of workflow. In several cases, SBQ-based CTS emulsions were developed to (practically) compensate for longer exposure times.

IN SUMMARY

Whether it's DMD or LED UV laser technology, digital UV exposure of screen printing emulsions is firmly established with a multitude of systems on the market, and is currently a recognised technology for the production of screen printing stencils.

Systems technology continues to be further developed towards achieving even finer resolution and making the units themselves easier to operate. KIWO keeps a watchful eye on technological developments, adapting its photoemulsions to new technology and supporting customers with the development of special CTS emulsions to create optimum workflow. sp

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