PrintPromotion

No 92 • April 2013

PRINTERS' GUIDE

Training Information & News in Printing and Paper Converting Technology

Flexographic printing

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1. Printing method (see No 91, December 2012)

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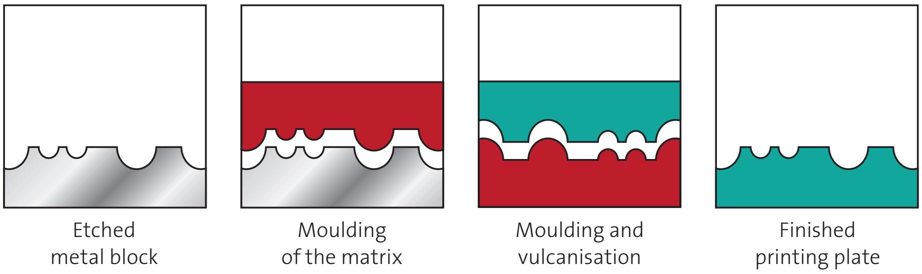
2. Printing forme production

For flexographic printing, an elastic printing forme with a relief of the printed areas is required. As far as printing forme production is concerned, various methods and materials have been widely used which as of late have also become competitors. Depending on the purpose of application, the printing formes are either produced as printing plates or printing rolls made of photopolymers or elastomers.

Until the 1970s, the elastomer printing formes (rubber printing plates) were dominant. Their production required much time and material. Before the rubber printing plate could be produced, a reverse-reading block (matrix) was needed for moulding. For the matrix, on the other hand, first of all an etched metal block was required as the master. Then an untreated rubber plate made of caoutchuk was placed on that matrix and subsequently vulcanised in a strong press for approx. 10 to 15 minutes at a temperature of 140 to 150 °C. Pressure and temperature caused the natural rubber to flow into the moulds of the matrix where it interlinked and became a permanent elastic printing forme. Then the dimensions of the rubber printing form were corrected by grinding; afterwards it could be mounted. The printing properties of the rubber printing plates only enabled to produce rather simple and coarse halftone images.

Significant progress was made with the launch of photopolymer materials. The

Figure 2: Production of a rubber printing plate



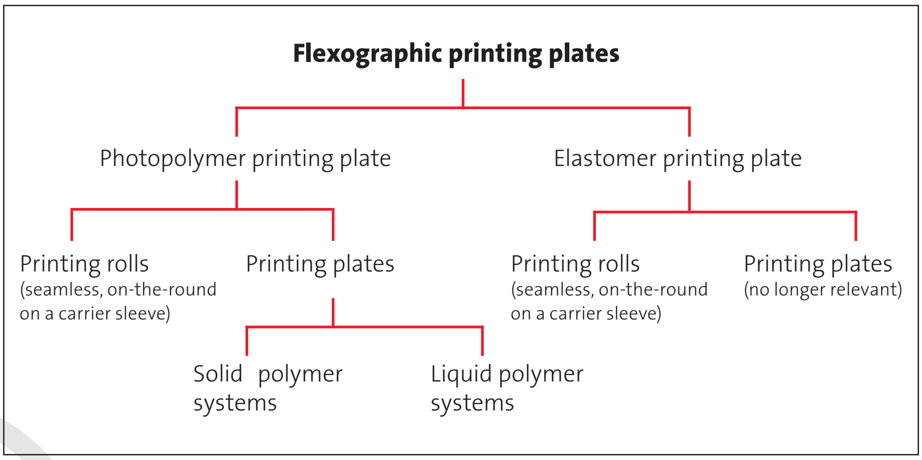


Figure 1: Overview of printing formes in flexographic printing

time and material consuming production of matrixes was no longer required and replaced with a photochemical process in which the printing plate could be made directly from a repro film. As a result, the time needed for the process chain was much shorter, and it was, for the very first time, possible to produce acceptable halftone prints. The initial incompatibility of the new plate materials with the printing inks and solvents commonly used in flexographic printing at that time were soon overcome. Compared to the previously used elastomers, the photopolymers rapidly convinced due to the significantly lower thickness tolerances of the raw

plate materials, their homogeneous material structure and the fineness of the relief structures that can be produced.
For the production of analogue photopolymer printing plates, a reverse-reading negative is required as the original copy. Exposure with UV light and development proceeds in 6 work steps. During the first step, the full surface of the reverse side of the plate is exposed to UV-A light without a light scattering film and vacuum. Hardening of the base (polymerisation) takes place during **exposure of the reverse side**. The base is needed in order to provide the printing elements with sufficient stability. At the same time, the relief depth of the plate is set via the base height. If the relief depth were too shallow, the form would get dirty during the printing process too quickly, which would continuously necessitate stops for cleaning. If the relief depth were too deep, there would be the risk that the printing elements are not sufficiently linked with the base and would break off during plate washing or the printing process. The information is transferred onto the plate and the printing relief is produced with the **main exposure**. For that, the original is placed on the plate and covered with a scattering film. In addition, a vacuum is produced in order to remove even the smallest amounts of air trapped between the film and the plate completely. The printing relief emerges in the exposed areas. The main exposure is followed by the washing-off process. During this step, the unpolymerized areas of the photopolymer plate are dissolved under the influence of a solvent and with rotating brushes in the washing unit (processor) leaving the clean printing relief on the exposed base. During the washing-off process, the printing plate takes up a large amount of the solvent and expands so that the plate needs to be dried. After drying, post-exposure of the plate is required. **Post-exposure** ensures that those areas at the relief edges that have only partly polymerized stabilize and the plate is given its final stability. Finally, the plate is exposed to UV-C light during the **finishing** process. This step removes the remaining stickiness of the plate and improves inking of the photopolymer. The necessary exposure times as well as the wash-off and drying times differ strongly and, as a rule, depend on the plate thickness and the concrete formulation of the photopolymer.
In order to reduce the washing and drying times required in this process, a thermal system (FAST) has been developed. In contrast to the washout plate, this plate is heated after reverse-side exposure and main exposure in the processor. The unpolymerized photopolymers evaporate and are taken up by a fibre cloth. This process is repeated until the printing relief is absolutely freed from unpolymerized material. The advantage of this variant is that no drying time is needed. Post-exposure and finishing can be carried out immediately after the processor.

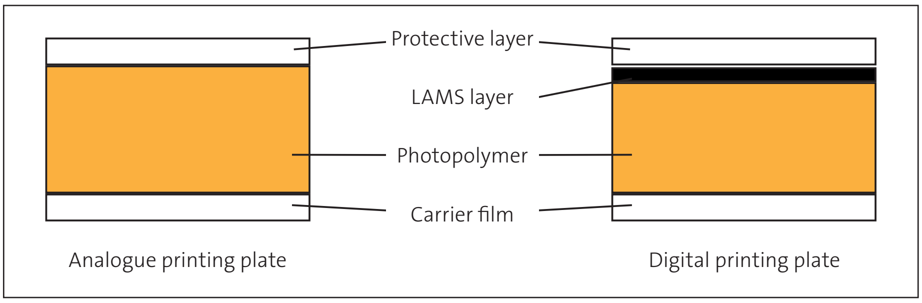


Figure 4: Analogue monolayer printing plate and digital monolayer printing plate

Analogous to the developments in offset printing, work has been done in flexographic printing to develop a variant of the direct imaging of printing plates (ctp - computer to plate) without the use of a separate repro film. In the 1990s, the digital wash-out plate was launched as a supplement to the analogue wash-out plates. As far as their basic structure is concerned, they differ from the older ones by an additional LAMS (laser ablation mask system) layer on the photopolymer. Compared to the ctp application in offset printing, the printing plate is, however, only imaged and no exposure is made. With the ctp laser, the LAMS layer of the digital plate is partly destroyed. On the surface of the plate, a mask of transparent and black areas is produced. Afterwards, the printing plate is processed like in the analogue process.
A third photopolymer application is the liquid photopolymer system. In this process, the printing plate is created above the original. The original is fixed on the copying frame and covered with a transparent protective film. Then a liquid photopolymer layer is applied and covered with a transparent carrier film, followed by the main exposure (from below) and the reverse side exposure (from above). Polymerisation causes the forming of the printing relief and support backing. At the same time, the carrier film crosslinks with the support backing. After the exposure process, the liquid photopolymer can be pulled off and channelled back to the storage container. Washout and drying are not necessary and the plate can be used after a short after-treatment and finishing process.
The manufacturers especially focus on the development of photopolymer sleeve systems. A sleeve consists of a fibre-reinforced plastic sleeve on which a photopolymer layer is applied, optionally with a compressible base. There are two variants: The plate-on-sleeve system for which the plate is mounted with a double-sided adhesive tape and the plate gap is then closed as well as the seamless sleeve (in-the-round) system for which a

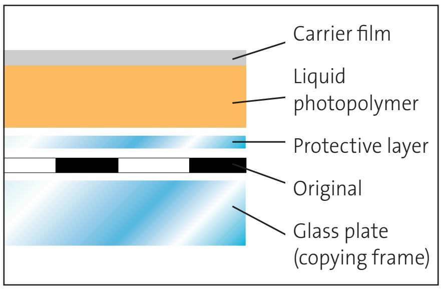
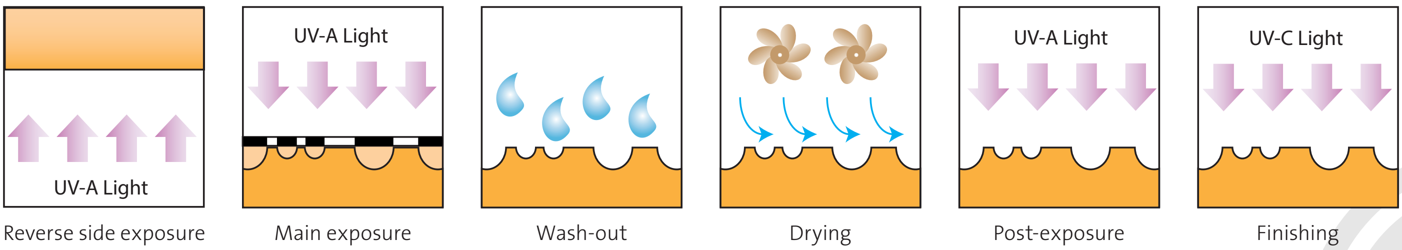


Figure 5: Liquid photopolymer system

Figure 3: Production of an analogue washout printing plate



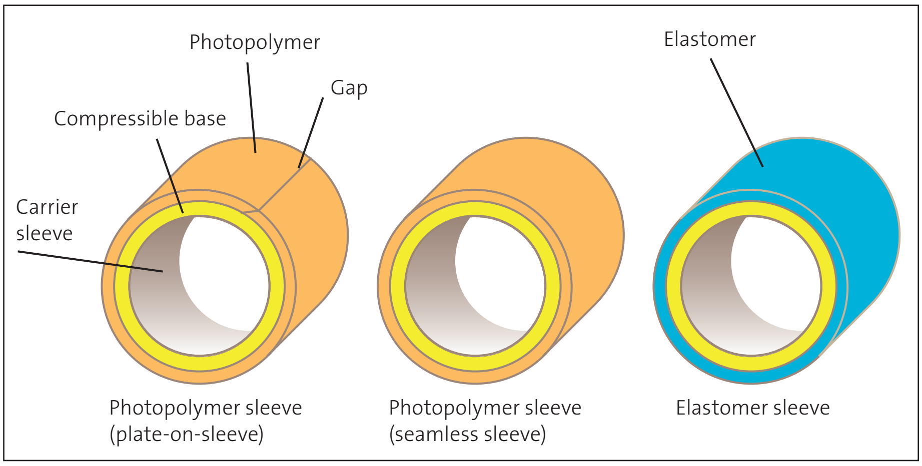


Figure 6: Sleeve variants

polymer layer is applied directly onto the sleeve. Processing is similar to the digital plate materials. Thanks to the finished sleeve, plate mounting is, however, no longer required.

With the launch of the photopolymers, the development of elastomer printing

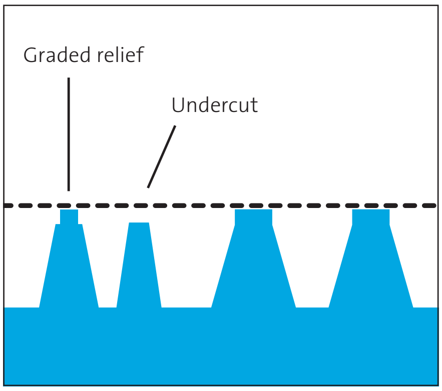


Figure 7: Elastomer printing plate with relief

plates didn`t come to a standstill at all. Elastomer printing plates were still preferred for specific fields of application as, e.g., wallpaper and napkin printing. At the end of the 1980s, the first direct engravings with lasers were carried out. The results were so convincing that this method was refined over the following 20 years so that direct imaging, photopolymer and directly engraved elastomer printing plates now even compete with each other. Direct engraving also requires the use of the elastomer blank in the form of a sleeve. These elastomer sleeves have a multi-layer structure. They are also based on a thin sleeve made of fibre-enforced plastic material. The basic sleeve can additionally be coated with compressible plastic foam and/or a basic elastomer layer with the engraving elastomer being the top layer. After vulcanisation, the blank is ground for the required dimensions and for precise concentricity and can then be engraved. Engraving is carried out in accordance with the external drum principle. The rotating cylinder is guided along the laser. The high energy of the laser burns off the elastomer so that it partly evaporates. The resulting residues are extracted. After the engraving process, it is only necessary to clean the surface from residues of the burning-off process completely. In contrast to the photochemically controlled imaging process of the photopolymers, direct engraving of the elastomers with the laser enables to produce a perfect mould of the printing relief. It is, e.g., possible to produce relief elements in graded conical forms or with undercuts. The large variety of methods in printing plate production will continue to have a strong influence on the development of flexographic printing.

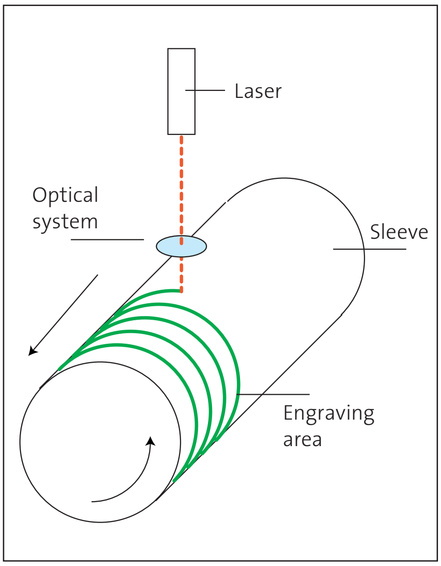


Figure 8: Basic principle of direct engraving