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Flexographic printing

By Ronald Weidel (azp Chemnitz)

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

Preparation of a printing job begins with the preparation of the printing forme. If press-ready sleeves and premounted printing plates for direct corrugated board printing are used, this work step is not necessary. In this case, the printing formes are checked visually for contaminations and damages, and then make-ready of the printing units is carried out. For all other printing machines, the printing forme must first of all be mounted. Mounting is either done in the machine (for small-format jobs with low requirements as far as register accuracy is concerned) or, what is much more common, in an external mounting unit. Normally, flexograhic printing machines are format-variable. The repeat lengths can be adjusted to the print product by means of different adapters. For printing forme mounting, the printing plates are mounted onto the plate cylinder or an adapter with double-sided adhesive tape in precise register. The majority of the mounting units enable to produce proof prints with the individual printing plates after they have been mounted. This makes it possible to check register accuracy during mounting already. The latest development in this area is measurement of the topography of the printing forme after mounting. The measured values are stored on an integrated chip on the printing forme and later read in the printing machine. The topographic data is used as a basis for the calculation of the dynamic printing pressure. Another important step in the development of printing forme mounting is the use of compressible bases. In this technology, foam tapes with a compressible foam layer are fixed under the mounted plates or adapter sleeves. The purpose of this compressible base is to balance the forces that develop during printing in the printing gap so as to achieve a reduction of the deformation of the printing relief and, as a result, a lower tonal value increase (TVI) in the printed image. With such a compressible base it is possible to use comparatively hard printing plates in order achieve consistent print behaviour with clean results above all in halftone printing.

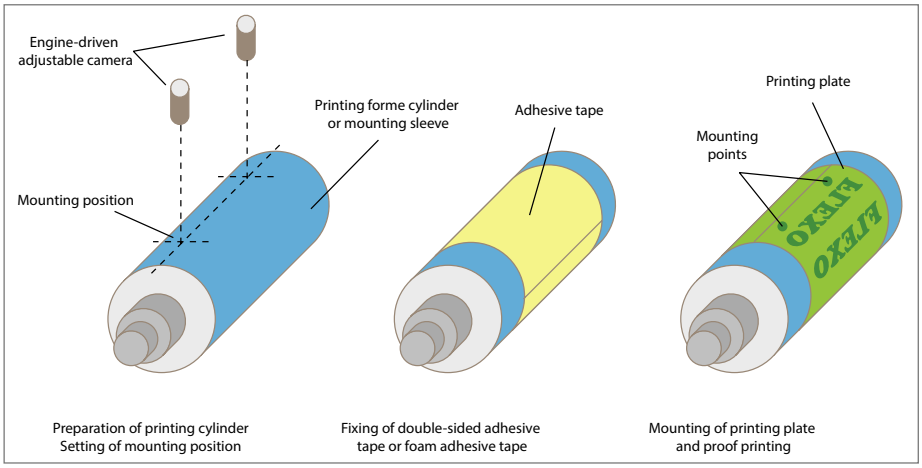

Figure 1: Printing forme mounting

Once mounting has been completed and checked, the printing machine can be made ready. This process is like with other printing methods. There is, however, no clearly defined colour sequence in flexographic printing. Instead, the requirements of the printed motif are taken as an orientation in the selection of the colour sequence. The most important selection criteria are the portions of the printed area, the drying behaviour of the printing ink as well as the absorption behaviour of the printing substrate. In addition, the high amount of special inks used in flexographic printing and the frequently required exchange of anilox rollers cause much make-ready work at the printing machine. In many printing houses, the optimisation of these processes is an essential area of action which requires good job preparation, experienced staff and good documentation of the make-ready processes. The machine manufacturers, too, contribute to a reduction of make-ready times. They have

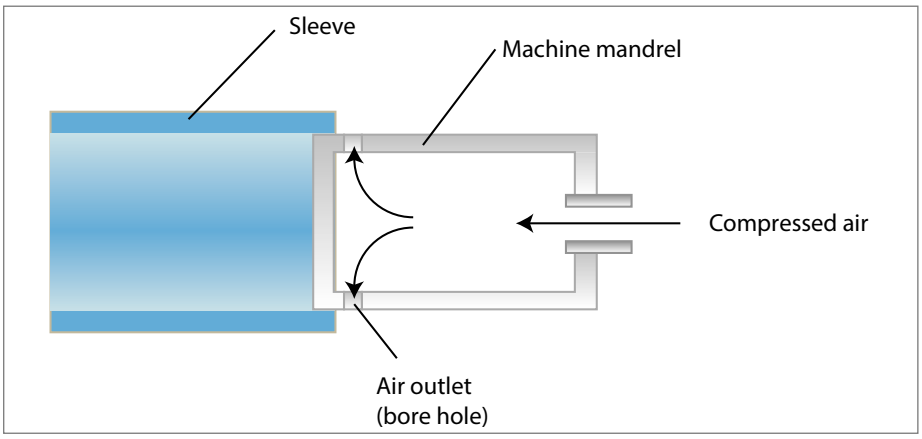

Figure 2: Sleeve and machine mandrel

been offering, e.g., lifting and robot systems for large-format printing machines for more than twenty years. With the launch of single drives, it became possible to carry out the make-ready operations on free printing units and, as a result, flying job change-overs. Especially high hopes are placed in the sleeve technology which is being used more and more. The change from heavy fixed axle cylinders to lightweight sleeves is proceeding not only as far as plate cylinders are concerned, but also for the anilox rollers.

With the exception of UV printing inks, the printing inks used are exclusively low-viscous inks. The ink systems are matched to the requirements of the printing substrate and/or the finished product. The suppliers offer water-based and solvent-based printing inks. Normally, flexograhic printers do not use ink containers from suppliers, but have their own ink kitchen where they mix their own press-ready printing ink. The commonly used ink mixing systems mostly comprise 11 to 15 base inks (concentrates) plus additional blends for the setting of colour brightness and/or pigment concentration. Mixing of the basic components is made and documented by means of computerised recipes. This "independence" of a flexographic printing house as far as ink supply is concerned is partly necessary in order to cover the comprehensive special ink segment and to be able to work economically. The adjustment of the ink recipes to the different anilox rollers and their pick-up volume alone continually increases the number of recipes. Such recipe books quite often comprise several hundred recipes.

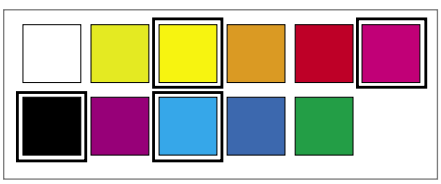

Figure 3: Basic ink preparation system consisting of 11 base inks with process colour inks CMYK

Besides absorptive materials like paper, board, corrugated board or tissue, non-absorptive substrates like plastic films, aluminium foil and composite materials are part of the domain of flexographic printing. The surfaces of many plastic materials are not readily suitable to be printed on. In these cases, pre-treatment is absolutely necessary for the ink film to be able to anchor on the substrate surface. Often the surface treatment applied in film/foil production is not sufficient or no longer active enough for the achievement of satisfactory results in printing. Therefore the printing machines are equipped with pre-treatment units. The pre-treatment method most commonly used is corona pre-treatment. With this method, a high-frequency generator produces strong alternating voltage which is discharged on the substrate by means of an electrode system. The bombarding of the surface with the charge carriers results in an activation of the surface so that printing inks and glues can be applied. The crucial parameter for successful surface activation is the amount of energy transferred per unit of area. As a consequence, the intensity of pre-treatment must be adjusted to the machine speed. If the bombardment with charge carriers is too strong, the film web may break or be destroyed.

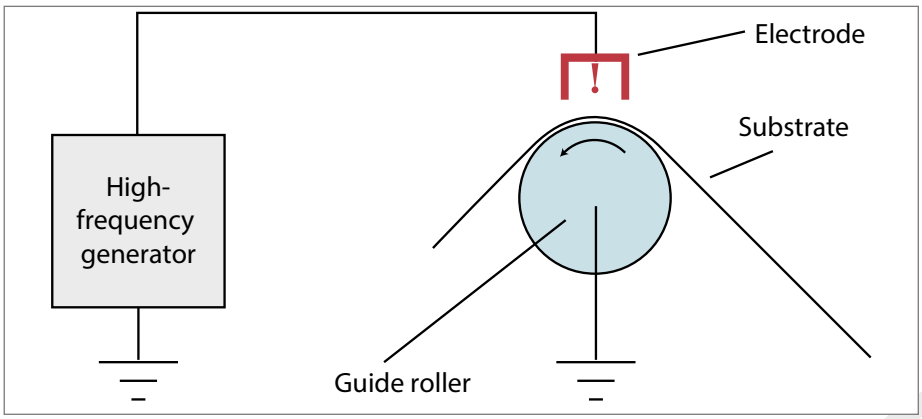

Figure 4: The basic principle of corona treatment

Once the preparation of the printing forme, printing ink, substrate and printing machine has been completed, the printing process proper can be started. Flexographic printing is a direct letterpress printing process with a short inking unit. The heart of every flexograhic printing unit is the anilox roller. It defines the ink volume that is transferred and is responsible for even inking of the printing forme. There are two methods which are normally used for the transfer of ink to the anilox roller: the chambered doctor-blade and the pan roller (squeezing) principle (see PrintPromotion Newsletter No. 91 of December 2012). Both methods have their specific fields of application; the chambered doctor blade method has, however, become the dominating method. Inking is carried out as follows: The chambered doctor blade system is filled from the ink storage containers by means of a pump. The ink volume stream is set so as to fill about half of the chamber with printing ink. The ink circuit is closed via a return stream to the storage container. Many printing machines are equipped with an integrated viscosity control which continuously monitors the viscosity of the ink. Part of the returning ink stream is channelled to the control system via a bypass. The viscosity is measured and, if necessary, solvent is added in order to achieve the preset viscosity. The chambered doctor blade and the anilox roller are a closed system. The chamber is closed in the direction of rotation by means of metering blades and sealing blades as well as sealing elements at the sides. The rotating anilox roller moves through the chamber, and during that time the cells at the surface of the anilox roller are filled from the ink stream. While the sealing blades prevent the chamber from leaking, the metering blade scratches off the surplus ink on the surface of the anilox roller. The ink is only stored in the cells. The low quantities of ink in the cells easily dry. Therefore, the anilox roller also needs to be moved when the machine stands still in order to ensure a consistent exchange of ink. From the cell,

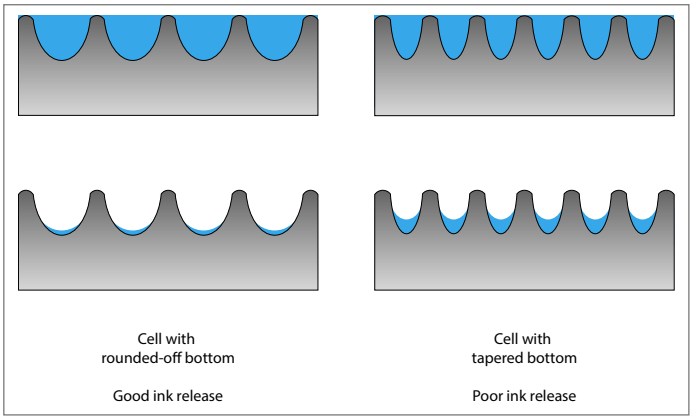

Figure 5: Discharging behaviour in relation to the cell form

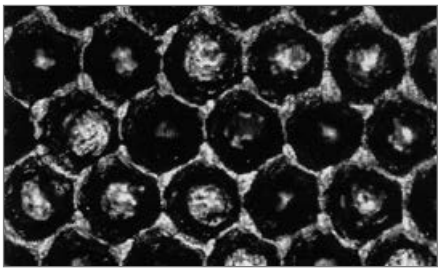

Figure 6: Surface of an anilox roller with 120 L/cm

the ink is transferred onto the printing forme. Like in other printing methods, the ink is split which influences only part of the ink transfer from the cells. The surface of the anilox roller consists mostly of the cell openings and the cell walls in between. The cell wall parts must be as small as possible in order to achieve uniform and extensive inking of the printing elements. Cells with steep flanks and a round bottom have better discharging properties than tapered structures.

After inking of the printing forme, the ink is directly transferred to the substrate. The soft-elasticity of the printing forme results in a strong deformation of the printing elements in the printing nip and, as a consequence, an enlargement of the printing area since printing ink is squeezed out at the sides of the printed image which produces the characteristic squeezed edge effect in the printed image. Besides the squeezed edge, deformation of the printing forme also affects the rotation of the rollers which becomes manifest in the form of tonal value increases in halftones, different print lengths of the individual colours and register differences in the printed image. In this respect, the impression setting has an essential influence. In flexographic printing, printing pressure set slightly above the "kiss print" point is considered to be optimal. "Kiss print" means that the pressure between the plate cylinder and impression cylinder is set to the level at which the printing elements just begin to print. The only slightly higher printing pressure ensures that the ink is reliably transferred onto the printing substrate even if there are some recesses and tolerances. With the launch of the compressible bases and harder printing plates, the unwanted deformation of the printing relief could be compensated so that even fine halftone structures are finely printed even with lower printing pressure.

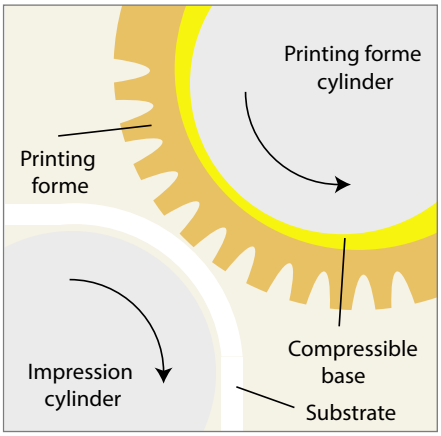

Figure 7: The compressible base and its influence on print rolling.