Gravure printing

Printing plate prodution

The way from the original to the complete printing plate ready for printing requires a large amount of material and time. The challenge is to produce a motif that can be printed, based on a regular screen consisting of cells and walls. The cells are needed for the transportation of ink. The walls are necessary in order to guide the doctor-blade over the printing plate. This means that all printing elements must be rasterised and that the necessary wall structure must be considered in the production of screens for multi-colour printing.

No matter which gravure printing method is used, the printing formes are always distinguished by the cell geometry in three differen variants:

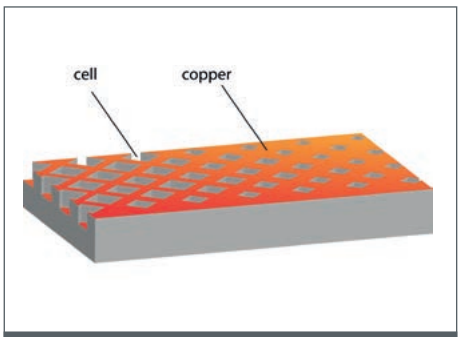
- with variable depth (conventional),
- with variable areas (autotypical/halftone screening), and
- with variable depth and areas (half-autotypical).

The cell structure

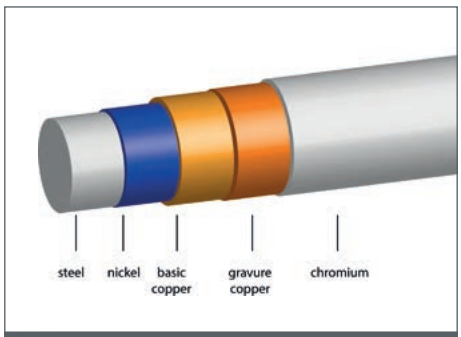
The figure (bottom left) shows the connection between the cell geometry and ink application. In contrast to the other conventional printing methods, gravure printing enables to vary not only the surface of the raster elements (cell width), but also the cell depth. In this way, extremely fine brightness gradations can be produced in the printed image, which enable to achieve a large colour space and nearly realistic continuous tones in gravure printing. The methods that can be used for the production of a printing plate differ tremendously depending on whether the printing method used is doctor-blade based gravure printing,tampon/pad printing or intaglio printing. For doctor-blade based gravure printing and intaglio printing, engraved or now less often etched printing plates are used. In tampon printing and in some cases in sheetfed gravure printing engraved steel plates or photopolymer printing plates are used.

Conventional printing plates for doctor-blade based gravure printing

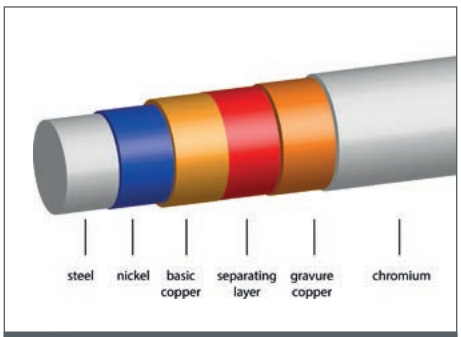
The conventional printing plate cylinder for doctor-blade based gravure printing is the most stable conventional printing plate. If handled properly, printing runs with millions of copies are possible without plate changing being required. In order to produce a printing plate cylinder, first of all a cylinder blank is needed. This blank is either produced using an old plate cylinder and turning off the engraved layer or by producing a new one. For a new one, a steel tube is cut to size and rough-turned. In order to ensure concentricity in the printing machine, the steel tube is balanced with welded weights at the inside. Then the cylinder ends are heated and the cylinder journals, which have also been pre-turned, are inserted. Through shrink adjustment, the steel tube and the cylinder journals are connected in a force-fitting manner. A welded seam fixes the cylinder journals additionally. Then the cylinder blank is turned to its final size and the cylinder journals are equipped with bearing rings for installation in the printing machine. Once the blank is finished, the copper layer is applied to the surface in galvanic baths. First, the cylinder blank is degreased in an acid bath, followed by pre-copperplating with copper cyanide; as an alternative, a nickel layer may be used. Copper cyanide and nickel, respectively, ensure that the basic copper layer is strongly anchored on the steel cylinder. In the next step, the basic copper layer is applied by means of copper sulphate with a thickness of approx. 2 mm. On the basic copper layer, the engraving copper is applied with a thickness of approx. 0.2 to 0.4 mm. In preparation of the engraving process, the blank with the copper layer is exactly turned to size and given a surface with a customer-specific structure. After that, the surface is engraved. This is mostly done with an electro-mechanical process with a diamond stylus. The cylinder is clamped into the engraving machine and processed with a stylus with rapid rotational movements. The engraving speed is between 4000 and 8000 Hz and/or cells per second. In illustration gravure printing, several styluses can be used in order to shorten the engraving time. As soon as the gravure is completed, the surface is cleaned again and degreased as well as hard-chromed in another galvanic bath.



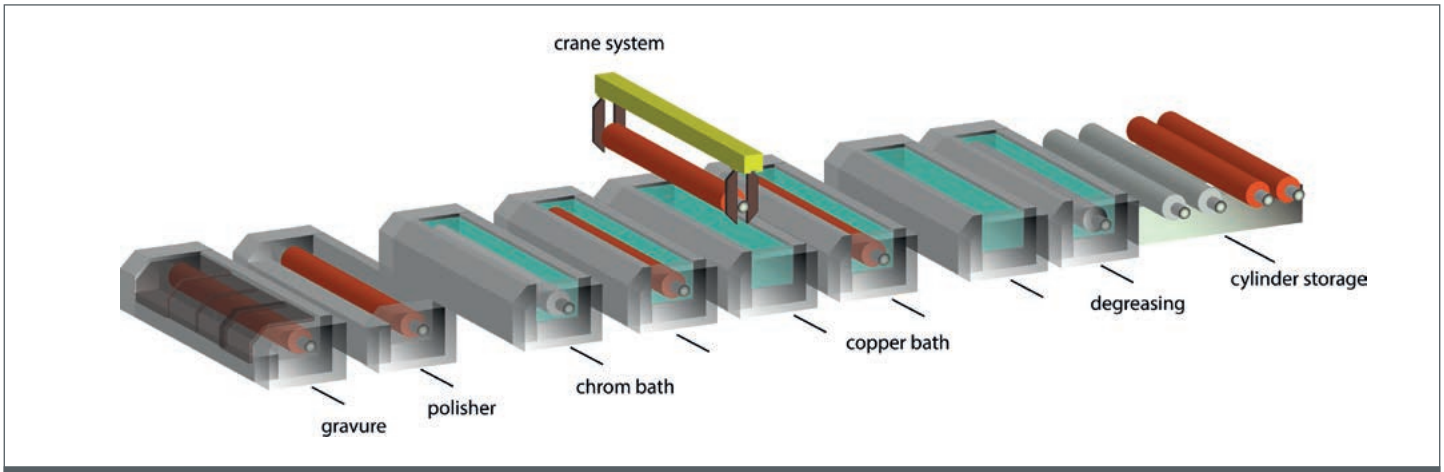
The cell structure



The layer structure of a cylinder blank



The normal layer structure and Ballard skin



An electroplating line

The layer structure of a cylinder blank

A special process is the Ballard shell process. Particularly in illustration gravure printing, the used printing cylinders must be available again quickly. In order to shorten the time needed for the production of the cylinder structure, a separating layer is applied between the basic copper layer and the engraving copper. This separating layer enables to tear off the chrome and engraving copper layer, also called Ballard skin, quickly. Once the separating layer has been removed, the structure of the printing cylinder can be built again galvanically.

The normal layer structure and Ballard skin

The coating and the processing of the plate cylinder are carried out in fully automated electroplating lines. The cylinders are removed from the bearing by means of a crane and then processed in the chemical baths in a fixed order. The electroplating line is completed with engraving, turning and polishing machines.

Electro-mechanical engraving and laser direct engraving

Initially, the gravure printing plate cylinders were etched. In order to produce the necessary structure of the cells, complex copying and masking steps had to be carried out before the etching. A similar approach is used in the electromechanical engraving process developed in the 1960. The cells are cut into the copper surface by means of a vibrating diamond stylus. The basic shape of the cells is defined by the geometry of the stylus. The diamond stylus is moved by a vibration system stimulated by two overlapping signals (basic frequency and image signal). The basic frequency determines the number of engraving movements per second and is normally 4000, 8000 or 12,000 Hz. The image signal contains the brightness stages (highlights, mid-tones and shadows) in the printed image and controls the penetration depth of the stylus. Depending on the penetration depth of the stylus, the cell depth and width vary. The result is a half-autotypical gravure printing plate. Nowadays, the electro-mechanical engraving process is the leading manufacturing method for gravure printing plate cylinders.

A comparatively young process is direct laser engraving. Instead of a diamond laser, a high-performance fibre laser is used. Dome-shaped cells are burnt-in on the surface of the cells. The advantages of direct laser engraving are that the engraving tool is wear-free, furthermore, good reproducibility and the high speed of up to 70,000 Hz that can be achieved. The shaping of the cells is no longer dependent on the stylus, and a combination of depth-variable and area-variable structures is possible. Another possibility for the application of laser is the masking technique in combination with a conventional etching process. In this variant, the copper-plated cylinder is coated with an acid-resistant varnish on the surface. Then the varnish is destroyed at the image areas and the copper is uncovered. After masking, the cylinder is etched in an acid bath with iron(III)chloride. Once etching has been completed, the cylinder is cleaned and hard-chromed like the engraved cylinders.

Printing plates/clichés for tampon printing

In tampon printing, a wide range of different materials are used for the printing plate (cliché). The properties of the cliché depend on the application. Etched steel clichés, water-washable photopolymer clichés as well as aloxide or laser-engraved ceramic clichés are being used. Etched steel clichés are used where the number of print products is high. For the cliché to be durable, a complex etching process is required.

Especially for advertising printing with rather short runs, a photopolymer wash-out system is used. Optionally, water-based or alcohol-based washout system can be used. The printing motif is exposed by means of a positive film under UV light, followed by a second exposure with a halftone film in order to produce the wall structure. Then the exposed cliché is washed. The result is a structure consisting of cells and walls that is typical of gravure printing. The low stability of the printing cliché is no problem due to the short print runs and the low-abrasion doctor-blade scraping process. These two cliché variants are supplemented with laser-engraved aloxide and ceramic clichés. Especially aloxide clichés are becoming more and more popular. The cells are engraved into the surface of the cliché by means of the laser. The necessary wall structure is already producedin the RIP process so that the cliché can be used after engraving and a short cleaning process immediately. Due to the increasing availability of affordable laser systems, cliché production in tampon printing is quicker and the detail precision as well as reproducibility are increased.

As is the case with other printing methods, it is to be expected that laser direct gravure will replace the photomechanical printing plate/cliché materials.