Three decades of gravure form manufacture – enduring and innovative

Ansgar Wessendorf

What is the verdict following 30 years of gravure form manufacture? And what does the future hold? Gravure form manufacture is based on standardized, automated technologies. In terms of competing with other printing methods, the driving force behind developments is cutting unit costs. Direct laser engraving is becoming far more important in gravure printing and this trend is continuing.

Some 85-90 percent of all gravure cylinders are now produced using electromechanical engraving. Digilas and Think are two other laser/etching methods also used. Direct laser processes are becoming increasingly popular. The longest standing of these is the Direct Laser System (DLS) from Daetwyler Graphics, which engraves directly into a zinc surface. However, further development of this process technology has now stopped. The Digilas from Schepers, with its various laser sources, and the Cellaxy from HELL Gravure Systems are currently the two main platforms for the direct laser engraving of gravure cylinders.

Fully automatic production

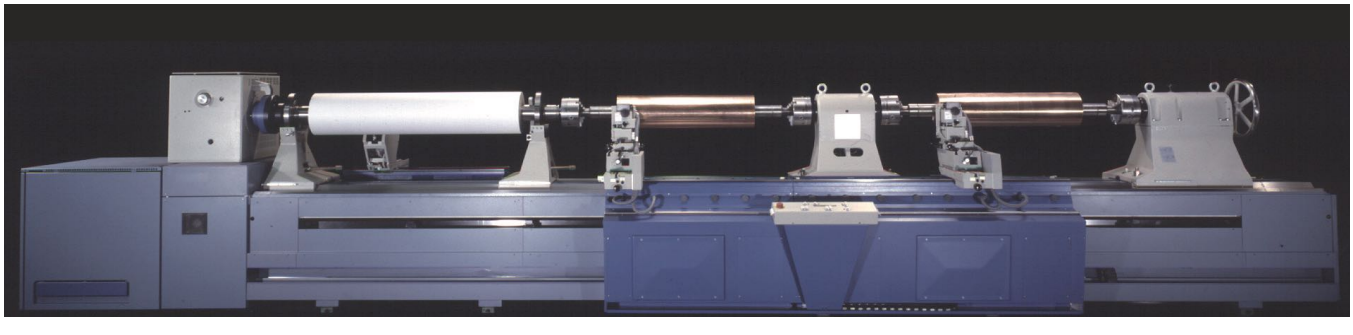
Publication printing was the source of gravure's development in the 1990s, but things looked completely different from the way they do now. Magazines and catalogs with numerous pages were printed in lengthy runs. The success criterion was printing large quantities in a short space of time. Cylinder manufacture already benefited from adapterless, fully automated electroplating, but lengthy proofing processes were the norm because ribbon deviations were unavoidable at the engraving stage. The width of the machines used for production runs steadily increased, but printing presses were still not fully automated – possibly due to the long-standing staffing regulations applying to this particular equipment.

At the start of the new millennium, gravure then also became fully automated. Ribbon differences were a thing of the past thanks to new measuring technology that enabled volume-oriented cell measurement followed by automatic calibration of the engraving heads. The reproducibility resulting from this new gravure quality was so good that many printers no longer needed to use proof printing machines. Form manufacture had finally made the transition from trade to industry. Standardized processes led to consistently high quality and lower unit costs.

In the years that followed, however, the growth of illustration gravure slowed significantly and the driving force behind the development of form manufacture increasingly came from the packaging printing industry. Here, too, automated lines became established – especially in the high-wage countries of Europe and Asia. Knowledge and experience from publishing operations led to the creation of process-optimized workflows and lines. Increases in engraving frequency to 8 kHz and then to 12 kHz, electroplating systems that had a smaller footprint and represented a lower investment, and fully automatic logistics – from trolley to high-bay store – all cut gravure cylinder manufacturing costs. Automated lines went on to become established around the world. Companies across the globe are now benefiting from minimal manpower requirements, stable production and low unit costs.

Electromechanical engraving

The basic architecture of electromechanical engraving remained the same until around the late 1980s – optical capture of the original physical copy, conversion into electronic format, electronic conversion into control signals, and electronic engraving. The starting point was always the actual artwork, the original. By the early 1990s, scissors and glue had been replaced by desktop publishing – the virtual on-screen typesetting of complete pages, which were then available in file format. In principle, anything that has already been digitized can be put to direct use for control purposes. Originals do not need to be scanned. Helioklischograph models K304 to K306 from HELL Gravure Systems were the first engraving machines to be controlled directly from the data sto-



The Helioklischograph K304 engraving machine from the 1990s could be controlled directly from the data storage medium without capturing originals.

Quelle: Hell Gravure Systems

rage medium without first capturing the original. When it comes to electromechanical engraving, solutions from HELL Gravure Systems continue to dominate the global market.

The Helioklischograph was originally developed for publishing houses. For a long time, this meant all the machines were dimensioned to suit the requirements of magazine and catalog printing. They could naturally also be used to print packaging, labels, etc., but who buys a truck if they only really need a spacious car? The K500, the first Helioklischograph designed and dimensioned specifically for packaging printing, was launched in 1999.

The latest generation – and the most cutting-edge machine for the electromechanical engraving of gravure cylinders – is the K500 Twain, which should preferably be used in fully automatic production lines. The Twain system is based on the principle of the two 12 kHz engraving heads moving independently of each other, with the linear drive enabling fast and highly precise positioning. The system automatically divides the packaging motif for cylinder engraving between the two engraving channels. Maximum efficiency is achieved when engraving is split as close as possible to the middle, almost halving the engraving time.

Quelle: Hell Gravure Systems

The K500 Twain is the latest generation of engraving machines for the electromechanical engraving of gravure cylinders and is designed for use in fully automated production lines. The system automatically divides the packaging motif for cylinder engraving between the two engraving channels for more efficient gravure form manufacture.

Fundamental weaknesses eliminated

Gravure's advantages over other printing methods include its outstanding color brilliance and exceptional run stability. Smooth vignettes down to zero percent and high screen resolutions are no problem. The technology also has its downsides, though. Its main weak point used to be the limited ability to reproduce line elements with sharp edges and the details of fine graphic elements – a shortcoming that makes smaller text harder to read. Furthermore, the proof printing normally required when using gravure cylinders is associated with high costs. However, developments in recent years have eliminated these weaknesses.

Edge sharpness

The reason why traditional engraving is characterized by a sawtooth effect is that screen definition and write resolution cannot be selected independently of each other. With the usual screen definitions of 60 or 70 l/cm, gradations are visible to the naked eye – even at a normal viewing distance. Higher screen definitions such as 100 l/cm are achieved at the expense of lower printing density and longer engraving times – limitations that do not apply to digital, offset or flexographic printing. Etching used to be the only solution to this "gravure dilemma", but only for line engraving. Direct laser engraving is now the method of choice for achieving offset-quality edge sharpness, but the latest developments have also improved the results obtained with electromechanical engraving. Good to very good edge sharpness is achieved with the new MultiTune adjustment process, and also with the HybridEngraving and XtremeEn-

Quelle: Ansgar Wessendorf

A fully automatic gravure cylinder production line in the early 1990s, integrating the systems for the electroplating process and surface treatment. Back then, cylinder engraving took place away from the line.

The dawn of Industry 4.0 – the state-of-the-art Autocon line produces gravure forms fully automatically.

Quelle: Hell Gravure Systems

graving high-resolution engraving methods from HELL Gravure Systems.

Detail reproduction

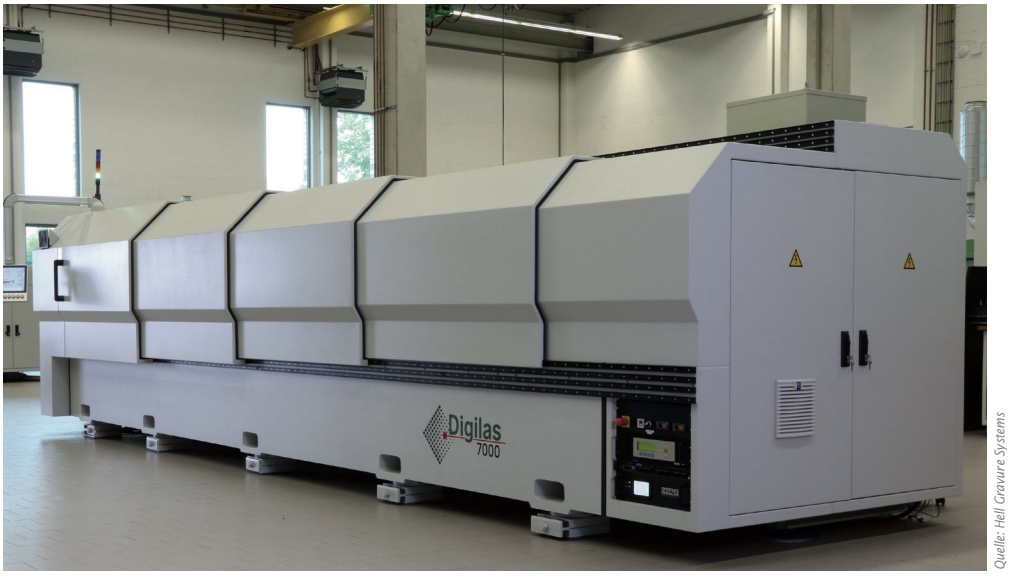
Fine lines and text always pose a challenge in gravure printing. This is not simply due to the above-mentioned problem with edge sharpness. Another issue in gravure printing is that fine elements are normally reproduced more thinly than in the original. This applies equally to positive and negative elements. Repro data normally has to be corrected manually in line with specific engraving requirements to combat this effect. Quite apart from the time this takes and the susceptibility to errors, manual correction has another shortcoming – making very fine text thicker can cause open elements to close or individual letters to run into each other. In both cases, this has a highly negative effect on legibility. The High Quality Hinting process developed by HELL automatically optimizes engraving data, which ensures precise detail reproduction and optimum legibility of even the smallest text.

Reproducibility

In electromechanical engraving, it is essential to calibrate the engraving system prior to each engraving process. This measure – referred to as the "testcut" – ensures the current condition of the engraving copper, system and stylus has no impact on the engraving result. Narrow engraving tolerances deliver high color fidelity during proof printing and production, and also enable rapid color adjustment in the press.

A calibration system for engraving machines consists of a camera and an algorithm that uses appropriate engraving system settings to align target and actual values for the engraved cells. Today's engraving machines have an integrated autofocus measuring camera for this purpose. Ideally, the measuring procedure itself is also automatic.

Traditional 2D calibration is based on measuring longitudinal and transverse diagonals of the cell. This method does not adequately factor in geometric distortions or wear on the engraving diamond. Volume-based 3D calibration produces the most accurate values and results in exceptional repeat accuracy for engraved cylinders.



The Digilas can be equipped with various laser sources, which makes it ideal for the direct engraving of different materials (e.g. ceramic screen rollers, copper surfaces of gravure cylinders or embossing rollers).

Quelle: Hell Gravure Systems

Direct laser engraving

Direct lasers have been available for many years in gravure printing. They have led to the introduction of a completely new, pi-

Quelle: Hell Cravure Systems

The Cellaxy supports direct laser engraving for linework, contone and embossing rollers.

oneering technology that was initially driven by high quality requirements (e.g. text with sharp edges). Improvements in the performance of direct lasers have made them more cost-efficient and also mean they are increasingly gaining a foothold in areas that used to be standard applications for conventional mechanical engraving.

Considerable market interest led to the importance of this new laser technology being recognized back in the early 1990s. Laser technology has been used for autotypical gravure cylinder manufacture since 1992. Advances in YAG laser technology made mask ablation possible for autotypical gravure cylinders. Cylinder development became unnecessary and there was no longer any need to apply a protective coating prior to etching. High-performance laser systems now make it possible to directly engrave both autotypical cylinders and contone cylinders with high resolution and the finest elements.

Alongside "standard" gravure printing, a lucrative market for laser engraving has emerged that is playing an increasingly important role and requires the very highest resolutions for motif elements. The applications in question are printed electronics, security printing, micro-embossing, special coating rollers and embossing rollers.

Some suppliers are currently working on developing gravure cylinders that just have a monolayer. These monolayer systems are intended to replace the conventional structure of copper and chromium layers in the long term. Similar approaches have been taken in the past. The layer is imaged directly using high-resolution laser technology. In principle, the entire form manufacturing process then consists of just three process steps:

- Coating with a polymer or elastomer layer instead of copper and chromium layers
- Grinding/polishing the surface
- Direct engraving using a laser.

The key challenge when developing these monolayer systems is to match chromium's positive effect on ink emptying, its doctor blade compatibility, and its chemical and mechanical resistance.

Problematic proof printing

Manual proof printing for gravure cylinders is very time-consuming and costly, which makes gravure slower and more expensive than other printing methods. This process is still used today, but throughput times would be far shorter without it.

Consequently, digital inspection systems for printing cylinders need to be developed that are freely available on the market. Digital inline control after each production step in cylinder manufacture (copper plating, engraving and chromium plating) would result in further optimization and digitization of processes.

After all, unlike proof printing, almost all upstream processes in cylinder manufacture are partly or fully digitized. The repro is processed entirely digitally – except for the proof – and the cylinder is imaged with the help of relevant engraving data. As described above, even the manufacture of printing cylinders now mainly takes place on fully automatic production lines.

Replacing the manual proof printing process and manual cylinder inspection with a digital solution would be an essential part of digitization and Industry 4.0. This would also provide a competitive advantage over the other printing methods.

Various digital quality control systems are available on the market for proof printing purposes. One such software solution checks the scanned proof against defined comparative data and indicates any deviations.

There are also more advanced approaches from gravure cylinder manufacturers, who are working with scan checking solutions they have developed themselves for engraved cylinders. So far, however, no fully developed scanner and software technology for the quality control of finished print cylinders is freely available on the market.

The verdict – a very straightforward printing method

Gravure printing combines high, reproducible print quality with excellent print run stability. It is a very straightforward method compared with offset and flexographic printing. The technologies used for gravure cylinder manufacture are well engineered, can be controlled precisely and are completely automated. This will lead to direct laser engraving playing a bigger role in the coming years.