It's the surface, that matters ...

Ecoturn is the new, high precision combined measuring and turning machine for surface preparation of gravure cylinders.

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Swiss company *Ecograph AG* which was founded in 1993 designs, manufactures and sells systems for the preparation of gravure cylinders. Their products include the *Ecoplater P* which is a range of adapterless galvanic machines with a patented centre sleeve construction. The line consists of equipment for degreasing, de-chroming, Nickel plating, Copper plating and Chrome plating. Due to its compact construction and low height, the *Ecotrans* crane system for automated cylinder preparation can be installed independently of the size of the building. In addition to these self-developed systems the company also offers equipment and consumables for the production of rotogravure cylinders such as doctor blades, measuring devices and analysing instruments. The latest innovation is a high precision measuring and turning lathe machine for the preparation of rotogravure cylinders for package printing.

During a visit to the production plant the editor of FLEXO & GRAVURE INTERNATIONAL's sister publication not only got an impression of the practical use of this system but also of the *Ecopolisher Copper*: a high speed grinding and polishing machine for Copper cylinders. It is worth mentioning that *Ecograph* offers its potential customers the opportunity of making a sample cylinder using the company's systems. Because of it's extensive portfolio, the company is one of the leading manufacturers of equipment for the preparation of gravure cylinders.

Measuring the roughness of the Copper surface.

Some fundamentals relating to the cylinder surface

The designers of gravure printing presses specify cylinders with precise, concentric running, and tight tolerances on rotation and high bending strength. In addition to these basics, the surface characteristics of a cylinder are also important factors for the electroplating, engraving and printing processes. These characteristics are determined by the hardness and roughness of the Copper.

The engraving and processing of a gravure cylinder requires a Copper hardness of 210-230 HV (hardness Vickers). If the Copper is too soft after electroplating it is impossible to engrave a cell with sharp edges and precise wall structure. However, if the Copper is too hard, the stylus can be damaged or wear out faster. This is caused by the Copper crystals as they create chains along the lines of force during electroplating, resulting in a soft and rough surface.

This effect can be prevented by adding organic hardening additives to the Copper bath which stops the growth of the crystal chains by interrupting them. The single crystals fill the depressions in the surface resulting in a smooth and fine surface structure, which provides better conditions for after-treatment (grinding and polishing) and engraving.

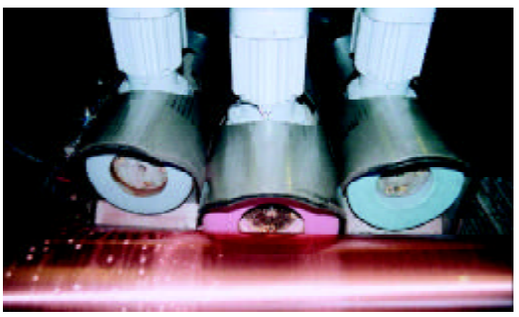
The surface of the gravure cylinders must exhibit a certain roughness. If the surface is too smooth, no ink will stay on the cylinder as it is completely removed by the doctor blade, therefore no ink film sticks to the surface, which acts like a lubrication between the doctor blade and the surface of the cylinder. This results in increased wear of the doctor blade and the cylinder surface, as well as causing blade streaks and damage to the doctor blade. If the roughness is too great a tonal change of the ink on the substrate occurs. Therefore it is important to create an exact, defined roughness of the cylinder with the help of the grinding and polishing machine. The *Ecoturn* measuring and turning machine and the *Ecopolisher Copper* high speed grinding and polishing machine should be regarded as a complete operation.

Separating turning and grinding

The *Ecoturn* system was intentionally not designed as a combination of turning and polishing as such combination systems require different cooling and lubrication for the respective processing steps. Moreover, the demands on the turning and polishing processes are very different.

Requirements of the cylinder take-up system for the concentric running of the turning process is technically more demanding than polishing. The separation of turning and grinding significantly reduces the wear of the turning machine caused by polishing residues, and so ensures a longer lifespan of the machine.

Instead of a highly complex combination system, *Ecograph* offers different systems for polishing (*Ecopolisher*) and turning (*Ecoturn*) at almost the same cost. Furthermore this offers additional doubled capacity. With the *Ecotrans* crane system both systems can be integrated into a fully automated processing line.



Left:
Ecoturn – turning of the Copper layer of a gravure cylinder.

Right:
Ecoplisher polishing heads.

Measuring and turning

The *Ecoturn* is a highly precise and capable measuring and turning machine especially designed for processing gravure cylinders and it can be integrated into a electroplating processing line. The anti-vibration steel-polymer machine bed of the *Ecoturn* requires no special base. The system accepts hollow cylinders with tapers as well as shaft cylinders with take-up spindles. Changing the systems is very simple as it uses symmetrical spindle sleeves for automatic clamping of the cylinders.

The NC-controlled machine is very easy for the user to control via a touch-screen display. All parameters relevant to the process are keyed in via the operator guided self-explanatory interface based on Windows CE. The user mode comprises the selection of automatic, semi-automatic or manual processes. Furthermore the respective processing status can be viewed and the job data keyed in or retrieved with the touch-screen display. The graphic elements of the screen allow clear representation of each parameter.

Cylinder preparation

With *Ecoturn*, not only images and text are removed from a cylinder which is no longer used or worn out but also the side faces and end radius are processed. This results in a cylinder geometry which is reproducible in radius and surface as well as in quality and precision.

After the Copper cylinder is clamped, the face length as well as the desired radius (nominal value) are keyed into the display. The following steps take place fully automatically:

- using an integrated 3D measuring device the true values of the cylinder (face length, radius) are determined.
- with a hard metal tool the left and right sides are processed.
- during the processing of the cylinder, the optimal turning depth is adjusted individually
- a hard metal tool is used for the rough turning of a worn out Chrome-coated cylinder or a strongly oxidised Copper surface. The process speed is up to 300 mm/min.
- the fine turning is carried out with a diamond cutting tool at a lead speed of up to 150 mm/min. If the turning depth is low, for example if a gravure cylinder needs to be turned down to the desired circumference after Copper-plating, rough turning is no longer necessary.

With this fully automatic process, very precise cylinders in terms of parallelism and reproducibility (+/– 0.01 mm) can be manufactured. The high process speed of about 10 min/m^2 guarantees high productivity. Depending on the diamond tool used and the process speed, the depth of surface roughness ranges from 0.5 to 1.5 micron.

The *Ecoturn* is equipped with a quick change system for tools. After inserting a new tool, calibration takes place automatically. Continuous drives for the cylinder and the lead speed of the cutting tool ensure an even and reproducible surface quality independent of the radius as well as even cutting capacity. The developed geometry of the cutting tools as well as the effective removal of the filings by an air extraction system results in an even surface which means less grinding during the after-treatment of the cylinders.

Polishing with the Ecopolisher Copper

With the very compact and low-height Copper polishing unit, which can also be integrated into the automatic processing line, the cylinder has its final and reproducible polishing. With the three polishing heads with grain sizes of 1000, 2000 and 3000, the surface is wet ground. This very precise and fine process eliminates even the smallest unevenness and grinds the cylinder to the required roughness.

As an option this machine can be upgraded to four polishing heads and/or with a band grinder. The symmetric cylinder bearing and the slide guides are made of stainless steel. According to the grain size, the impression pressure of each tool is in-dividually adjustable from zero to 50 kg. The adjustment of the cylinder and tool speeds are performed automatically. The PLC controlled hard- and software facilitates fully automatic processing as well as manual operation of the unit. Production parameters like grinding times, revolution and lead speed of cylinder and grinding stone are individually programmable. The PLC control makes the handling of the machine very simple.

The Copper cylinders are final treated first with a polishing stone of a grain size of 1000 and then with a grain size of 2000. For very high quality requirements on the

cylinder surface, e.g. for film printing, a polishing stone of grain size 3000 is used. Depending on the characteristics of the Copper, the circumferential speed of the cylinder is 250-300 m/min. The whole process takes place at a very low grinding pressure. Attention should be paid that a sufficient amount of water is supplied to the grinding area to remove the grinding residue from the surface. The *Ecopolisher Copper* uses filtered water which does not contain any dirt particles. The whole grinding process takes about ten minutes. The final roughness depth of the surface is about 0.3–0.5 micron. With these reproducible values of roughness the cylinder is passed for further processing like engraving.

Evaluation of the surface roughness

Measuring devices for roughness (*Penthometer, Hommel*) use the tactile principle. With constant speed the micro detector moves along the surface with a vertical mobile diamond head tracing the surface profile. The swing of the detector is transformed into electrical values and then further processed. The results of the measurements as well as the diagram of the surface profile appear on a display or can be printed out. The following roughness depth measurements can be recorded:

The mean roughness value is derived from five consecutive separate roughness measurements. This value is of significant importance for the judging of the required surface quality and its reproducibility. The largest value of the separate measurements characterises the maximum roughness depth.

Summary

As a compact precision tool the *Ecoturn* is characterised by a long lifespan and constant quality. The designer of the machine intentionally rejected a combination turning and polishing process. User-friendly handling as well as fully automated and fast processing results not only in constant, high and reproducible surface

quality but also in very low costs for tools and maintenance.

Simple tool exchange with fully automated calibration of the diamond head as well as fast and simple converting from solid shaft cylinders to hollow cylinders contributes to further increased productivity.

The *Ecopolisher Copper* is a superfinishing device for the precise grinding and polishing of Copper surfaces. Especially for printing on packaging films the Copper surface must match the most demanding requirements. *Ecograph* dedicated itself to supply the most appropriate and conclusive equipment.

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