

NEW TRENDS IN MAP PRINTING

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1. Introduction

The development of computer hardware and software enables in the latest decade introducing of new forms of map presentations. The compilation and production of electronic maps and atlases distributed on CD-ROMs began and the digitized map products appear on the Internet as well in classical as in multimedia form. In spite of this reality remain maps and atlases printed on paper the necessary products of cartographers works. This fact is reflected in the international book fairs, where the interest of booksellers in printed map products is in the last few years increasing. It is usual, that a part of the printed product can be its digital version on CD-ROM, as this brings to the map user many other useful picture and text information as the classical product can do.

2. Pre-press map preparation

For maps prepared in analogue form consists the pre-press preparation in reproduction of s of the line map elements fair draughts and in lithographical elaboration of areas patterns. The goal of these works is to gain printing masters for all printing colours, which serve as well for colour proofs for the final revision as for copying of printing plates.

Digitally produced maps are either derived from the analogue made printing masters or created on basic map source materials in chosen map signs using a suitable software.

The transformation of the analogue elaborated map in its digital view will be usually done by raster scanning of printing masters. The scanned picture is converted into the vector form, where some further arrangements (e.g. electronic retouching, mounting, editing etc.) can be done.

3. Map printing

For maps prepared in analogue form mostly offset sheet printing is used. It enables to print maps except of common 4-colour printing as well in more colours with direct inks. This technology is used e.g. by printing of topographic maps, where the transformation of some map elements into 4 colours (e.g. contour lines in brown) is economically not suitable.

The printing masters serve direct for copying of pressplates, which after processing are put into the offset press.

At digitally prepared maps are printing masters (films) usually gained from the files, elaborated on computers, using an exposure unit. These serve - analogously as by analogue prepared maps - for copying of pressplates. This technology is named CtF-technology (Computer-to-Film). Its advantage is, that the map image for the map reedition can be updated direct in the digital form and can be eventually used for other map products, as e.g. for edition of the map in an electronic version on CD-ROM, etc.

The printing of analogue prepared maps as well as of digital processed maps using CtF-technology requires no special demands on printing plates and on printing presses. These technologies are just now fluently used by production of most maps and atlases. For copying of pressplates usual pre-sensitized printing plates are available.

4. Digital printing

By this term are understood such technologies, when the digital form of the map, created by the computer, is directly imaged on the pressplate. These technologies basically increase and reduce the price of the pre-press preparation.

In principle following technologies can be used :

- „Computer-to-Plate“ technology, where the off-press imaging of pressplates is made in a laser copying unit is used,
- „Computer-to-Press“ technology, where the pressplates are imaged from the digital data direct in the offset press, or
- „Computer-to-Print“ (named also „Computer-to-Paper“) technology, where the map image will be newly created direct on press cylinders of the printing machine after its each rotation. This technology is very similar to the function of the PC printers.

5. Printing plates for digital printing

The Computer-to-Plate technology uses the off-press imaging of digital data. In comparison with the Computer-to-Film technology requires this technology using of special printing plates with extremely high sensitivity in the region of the laser radiation. E.g. the argon-ion laser has usable wave lengths 364 and 488 nm, the YAG-laser 532 nm and the helium-neon laser 543 and 633 nm. The speed of moving of the laser beam in individual lines is by the exposure 180m/s, i.e. for one pixel allots the time only 167 ns.

The main demand of the printing plate coating sensitivity for the Computer-to-Plate or Computer-to-Press technology can be estimated from the formula

$$E = p \cdot e \cdot t / x$$

where

- E is the energy necessary for the exposure of the area unit in mJ/sq.cm,
- p is the power output of the laser in mW,
- e is the coefficient of the efficiency of used radiation and contains the quantum yield of the photoprocess and absorptive factor of the light-sensitive compound of the wave length of the laser radiation
- t is the total time of the plate exposure and
- x is the exposed area of the plate.

Thus e.g. for the argon-ion laser with the power output $p=5$ mW by $e = 0,1$ and the total exposure time 5 till 6 minutes for the plate in format $x = 1030 \times 770$ mm is the necessary energy $E = 0,02$ mJ/sq.cm.

With this demand corresponds e.g. a light-sensitive photopolymer coating used on printing plates Presstek PEARLdry (Presstek, Inc., USA) or Ozasol N 90 (Hoechst, A.G., Germany) with the sensitivity 0,02 - 0,1 mJ/sq.cm or coatings based on silver-halides (sensitivity 0,001 - 0,1 mJ/sq.cm) or on principle of electrophotography (sensitivity 0,001 - 0,05 mJ/sq.cm).

6. Digital offset presses

The digital workflow wins inexorably through the printing technologies and it shows a definite trend for digital data imaging direct on the pressplate placed in the offset machine. It shortens the time for makeready, is more cost-effective and reduces the possibilities of errors. Therefore the up-to-date trend is to leave the Computer-to-Film technology.

a) *Offset presses for the Computer-to-Press technology*

The company Heidelberg, AG. (Germany) developed an offset press Speedmaster 74 DI, which can print on paper-sheets till the size 530 x 740 mm. As a printing medium are used no-processing thermal printing plates. Data imaging is realized using Delta technology from files in formats Adobe PostScript 3 or PDF. The image is copied by a 40W laser. Using resolution 2400 dpi, the imaging of all four pressplates takes about 3,5 minutes.

For the waterless offset was developed a four-colour Karat Digital Offset Press by Scitex & KBA Joint Venture companies. The press enables to print on paper sheets till the size 520 x 740 mm with the basis weight 60 - 350 g/m² with a maximum printing speed 10 000 iph (impressions per hour). Aluminium printing plates Presstek PEARLdry are used. The imaging produce 40 laser diodes on each printing unit. The resolution can be chosen in range 1524 - 3556 dpi. Using the resolution 2540 dpi, the imaging will be done in 6 minutes for all four pressplates. The datas are transferred from formats Scitex, PostScript or PDF. Into the hopper of every printing unit is possible to place 30 printing plates. Their exchange is executed automatically. The makeready of fluent orders will not exceed the time of 15 minutes. After the first 20 prints is reached the automatic aligning of colours and after 100 prints it is possible to use the full speed of the press. Optimal impressions for this machine are 1000 till 10 000 prints.

In cooperation of the American firm Presstek, Inc. and the Czech producer ADAST, Inc. was developed a digital four- and five-colour press ADAST 507 DI (in U.S.A. called PAX DI). The press (Fig.1) enables the print on paper sheets till the size 381 x 520 mm (15 x 20,5 in) with the maximum basis weight 350 g/m² and a maximum printing speed 12 000 iph. There are used pressplates PEARLdry PLUS roll format, which are unrolled from a storage reel containing 37 full sizes of plates. The rewinding and stretching of the pressplates for all four printing units lasts ca 2 minutes. Imaging units consist of 32 infrared laser diodes. The imaging using 1270 dpi resolution is finished in ca 3 minutes. The standard equipment of the press includes a temperation of inking system, remote control of inking units and registers Adacontrol, washing device for offset blankets, dry sprayer and pressplates cleaning device. On demand can be the press completed by tumble device (by the five-colour press for printing of 4/1 or 3/2 colours), by ionizer device, infra-red ink drying device, by a JUST FEED equipment for printing of covers, etc. The datas transfer is secured by PEARL Server with processor Pentium III./256 MB RAM, operation system Windows NT and hard disk 54 GB RAID. It is possible to use resolutions 1270, 1905 or 2540 dpi. Used softwares are PEARLmerge, PEARLview, PEARLwrite, event. PEARLrip.

b) Press systems „Computer-to-Print“

These systems enable the direct print of maps from digital elaborated datas on the paper (without special pressplates). For this technology as well terms „Digital Printing“ , „Computer-to-Print“ or „Computer-to-Paper“ are used. The principle of this technology is similar to the print on paper in the fluently used laser printers of the computers. These press systems are up to now constructed mostly for small size prints.

In these systems serves for printing an electrostatic cylinder with semi-conducted coating. The printing ink is substituted by a pulver toner, which is transferred from the cylinder direct on the paper or transferred on it through an offset cylinder. The toner is fixed on the paper by heating.

After each creating of the image on the electrostatic cylinder and transfer of the toner is the imaging process renewed. Therefore it is possible using this technology to print by any turn of the machine another image. From it resumes, that the digital print could be very expedient for printing on demand or for colour-proofs. From the economic view this technology is

advantageous for impressions till 5000 prints, for higher impressions are more favourable technologies „Computer-to-Plate“ or „Computer-to-Press“.

This technology is represented e.g. by machines E-Print 1000, DCP-1 or Chromapress. The same function can be fulfilled by high-powerfull laser printers of computers.

The digital press E-Print 1000 is produced by Indigo, Inc., Israel. It works with a liquid toner ElectroInk using the dimension of the pigment particles 1 - 2 microns. The image is transferred from the electrostatic cylinder on the paper through an offset cylinder. In toner storage are 6 colours for disposal, i.e. can be used four-colour as well as six-colour print. The speed of the press is 500 iph. for four-colour prints in size A 4 using 800 dpi resolution.

The digital press DCP-1 is a product of the firm Xeicon (Mortsel) in Belgium. It uses a dry toner, which is transferred direct from the electrostatic cylinder on the paper. The maximum size of the print is A 3. The machine prints in four colours on reel paper.

The machine Chromapress is the result of cooperation between the firms Agfa and Xeicon. It is a modification of the digital press DCP-1, which is equipped by Open Pre-press Interface and by PostScript output on RIP.

A new development in the press area is the digital press DocuColor 130CSX (a product of Creo-Scitex-Xerox companies), which enables to print on reel paper with roll width 500 mm and is suitable for middle size prints. The machine is based on principles of electrography and prints in four colours. The speed of the press is 16 cm/s. i.e. one map in format 50 x 70 cm can be printed in about 4,4 s. (that represents the printing speed 820 map sheets/h). The used resolution is 600 x 600 dpi with a 4-bits depth for one colour (i.e. 16 levels) and with dot patterns 80 - 170 lpi. The paper web is on the output sewed off into a pre-programmed length. The computer of the press is based on CreoScitex CSX130 (Rumba) and Dual Pentium III. 600 Mhz processors with 256 MB main memory and two 9GB hard disks with operation field 54 GB. The press enables one-sided or simultaneous both-sided printing. The input unit accepts fluently used graphic formats PostScript Level 1,2 or 3 and Acrobat PDF.

7. Practical experiences with digital map printing in the Czech Republic

In the state mapping agency were digitized after 1994 printing masters of the Basic Map of the Czech Republic at a scale of 1:10 000 for the whole state territory. Till 2000 was realized the raster data vectorization. Vector datas are prepared for print using Intergraph MGE Map Finisher program in the output format PDF (Adobe Acrobat 4.0). At the present time are from these datas gained new printing masters on films using the exposure unit EMMA. The colour assignement of individual map symbols is defined by the relation of colour components of the four-colour printing in CMYK-model and for printing of the layout (dark grey) and the altitude (brown) in direct inks. The pressplates are copied from these films on presensitized printing plates Horsell and automatically processed in a developping device.

During the World Printing Fair EMBAX in Brno in 1999 the first check of printing of a part of a Basic Map sheet at scale 1:10 000 using Xeicon DCP 50D was done. A sample of the reached result is introduced in the Fig.2. The result is fully comparable with offset prints and it is possible to assume, that the direct digital print could be successfully used for maps printed in small runs, i.e. from one to some hundreds of prints.

8. Conclusions

The digital map pre-press together with the „Computer-to-Print“ technology will be the future of printing of topographic maps in small runs. It is a practically non-waste and from the ecological view completely pure process, which enables to produce in a short time prints of up-to-date maps.

In the whole process of the cartographic production enables this technology

- in the pre-press phase to produce simply colour-proofs for the final revision,
- printing of offer prints for the market research,
- promptly map printing according to customer's demands, and
- negates the map printing on store.

This technology makes minimum demands on material supply, removes the use of films and their chemical developping, montage and copying of printing plates. Unbeatably accelerates the makeready of the press and completely reduces the costs and increases the productivity of the map production.

For printing of maps in large runs seems to be most suitable the „Computer-to-Press“ technology, which accelerates the makeready of the press and enables to exploit the high printing productivity of the sheet offset presses.

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