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METHODS OF CALCULATING THE DISTORTION FACTOR FOR VARNISHING PLATES CUTTING PROCESS

В статті розглянуто математичні методи розрахунку фактору дисторсії для сучасних формних матеріалів для лакування, зокрема — лакувальних пластин на поліестеровій основі. Процес підготовки лакувальних пластин до друку є одним із найбільш критичних в технологічному ланцюжку, особливо під час виробництва картонних паковань. Помилка у підготовці форми може призвести до зменшення терміну служби у 8–10 разів та збільшити виробничий брак на 50–90 % по даному процесу. Коректна підготовка та розрахунки фактору дисторсії гарантують можливість повторного використання форм та підвищення загальної ефективності виробництва.

Ключові слова: лакувальна пластина, фактор дисторсії, виробництво картонних паковань, зношування.

Introduction and background

Wide adoption of coating units at the end of offset printing presses has meant a rethink in the best process technology to use. In offset printing the image transfer is made from the printing plate via a soft compressible rubber blanket on to the substrate. Today's coating units require a different approach since the image is applied directly just like in the flexo process. This means that compressible components need to be used to enable a smooth precise transfer of varnish. In the same time varnishing plates should have enough stability for continuous usage and hard pressure contact between anilox roller and plate cylinder [1].

Quality requirements for coating high-quality packaging are increasing constantly. Wide range of coatings is used in offset printing presses, including two-layer coating like drip-effect. Every job became more attractive and more complicated. One of the most controlled parameters became register of coating. To reach highest results (1,0 mm and less) preparation of varnishing plate should be made correctly.

There are two basic ways of preparation: by hand and with CAD system. It doesn't matter what technology is used, if basic recommendations for cutting are used during the process [2–5]. In the same time these recommendations doesn't allow to reach good register due to huge variety of thicknesses of plates and underlays. When changing the thickness of one material, difference in a cutting depth and relief is increasing. This brings a new problem to printers — to calculate a distortion factor for every new type of material on a plate cylinder [6].

Main task

The main task of the present research is to find the most accurate way of calculating the distortion factor and preparing the recommendations for using mathematical results in standard production processes. In addition the numbers should be shown for all common modern offset presses to cut the time of preparation the varnishing plates.

Results and discussion

Every press model has different plate cylinder. All varnishing plates are prepared or exposed on a flat surface and thereafter placed on a plate cylinder. As a result an elongated print length is occurs because of the stretch of the polymer surface. This stretch just occurs in circumferential direction and depends on the thickness of the polymer. In order to balance out this stretch, a compensation of the print length is necessary. This means that the information about the print length of the film or the scale data in the plotter's software has to be reduced. It is possible to show the effect as presented on a fig.

It is possible to customize the results for different sizes of presses, but it will not suite absolutely to every model due to different underlays and plates. Therefore it is highly recommended to make calculation for every press model and sheet size. Two main ways of calculation are offered. The main formula in first variant can be shown as [7]:

$$D = \frac{L_1}{L_2} \times 100\,\%, \qquad (1)$$

where D — distortion factor, L_1 — print length, L_2 — cylinder circumference.

To find L_1:

$$L_1 = 2 \times h \times \pi, \qquad (2)$$

where h — thickness of surface layer of varnishing plate (cutting depth).

To find L_2:

$$L_2 = d \times \pi, \qquad (3)$$

where d — cylinder diameter.

For example, distortion factor for Heidelberg Speedmaster CD 102 could be calculated. According to the recommendations of manufacturer, there are 1,15 mm varnishing plates used. Cutting depth of such plate is typically 0,80 mm. Cylinder diameter is 300 mm, so general calculation can be shown:

$$D = \frac{L_1}{L_2} \times 100\,\% = \frac{2 \times 0{,}80 \times 3{,}14}{300 \times 3{,}14} \times 100\,\% = \frac{5{,}024}{942} \times 100\,\% = 0{,}533\%. \qquad (4)$$

This means that length of the image should be decreased on 0,533 %.

This method is very simple, but it cannot show influence of underlay to the distortion factor. As a result, it cannot guarantee absolute fitting the plate to printed

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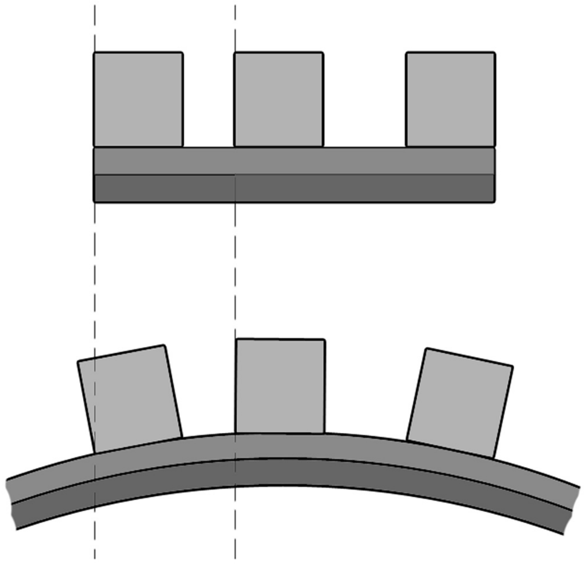

Principle of occurring distortion factor in varnishing plate

elements. Second method [8] is more reliable as depends from more parameters:

$$D = 100\,\% - \frac{R+U+P}{R+U+P+T} \times \times 100\,\%, \quad (5)$$

where D — distortion factor, R — cylinder radius, U — underlay's thickness, P — thickness of base layer of the plate, T — thickness of surface layer of varnishing plate (cutting depth).

To check the accuracy of this method the same example is shown (Heidelberg Speedmaster CD 102):

$$D = 100\,\% - \frac{R+U+P}{R+U+P+T} \times \times 100\,\% = 100\,\% - - \frac{150{,}00+2{,}10+0{,}35}{150{,}00+2{,}10+0{,}35+0{,}80} \times \times 100\,\% = 0{,}52\,\%. \quad (6)$$

General length reduction for this model looking for the underlay's thickness should be 0,52 %.

According to theoretical and experimental research, second method (5) shows more accuracy and higher register. To cut the time of preparation the varnishing plate a list of distortion factors for different models of modern offset presses were developed (table).

On the basis of given and experimentally proved data it becomes possible to develop program complex for calculating the varnishing plate's distortion for preparation. It can prevent mistakes in production process and save up to 5–7 % of time for cutting. In other hand, stability in calculation will bring perfect results and will not cause re-cutting of a plate with correct distortion. This allows decreasing production wastes on 50–90 %.

Distortion factor for different press models

Press model	Recommended plate format, mm	Recommended plate thickness, mm	Recommended underlay thickness, mm	Distortion factor, %
KBA Rapida 74	740×605	1,35	1,95	0,88
KBA Rapida 105	1050×795	1,15	2,10	0,52
KBA Rapida 106	1050×795	1,15	2,10	0,52
KBA Rapida 162	1630×1239	1,35	2,10	0,34
Heidelberg Speedmaster SM 74	745×615	1,15	2,10	0,71
Heidelberg Speedmaster PM 74	745×615	1,15	2,10	0,71
Heidelberg Speedmaster XL75	750×680	1,15	2,10	0,71
Heidelberg Speedmaster CD 102	1030×780	1,15	2,10	0,52
Heidelberg Speedmaster XL 106	1060×819	1,15	2,10	0,52
manroland 500 series	750×670	1,15	1,30	0,68
manroland 700 series	1045×835	1,15	1,30	0,52
manroland 900 series	1630×1280	1,15	1,30	0,27

Conclusions

Different mathematical methods of calculation the distortion factor were analyzed and checked. As present article shows, manufacturers offer different formulas, but results cannot be perfect if underlay thickness is not included to general result. The recommendations for different press models were offered to cut the time for preparation of varnishing plates. It can save up to 5–7 % of time for cutting, decrease production wastes on 50–90 % and increase average production efficiency.

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В статье рассмотрены математические методы расчета фактора дисторсии для современных формных материалов для лакирования, в частности — лакировочных пластин на полиэстеровой основе. Процесс подготовки лакировочных

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пластин к печати является одним из наиболее критических в технологической цепочке, особенно при производстве картонных упаковок. Ошибка в подготовке формы может привести к уменьшению срока службы в 8–10 раз и увеличить производственный брак на 50–90 % по данному процессу. Корректная подготовка и расчеты фактора дисторсии гарантируют возможность повторного использования форм и повышения общей эффективности производства.

Ключевые слова: лакировочная пластина, фактор дисторсии, производство картонных упаковок, износ.

A process of varnishing plates' preparation and cutting is one of the most critical in all technical chain of packaging production. Any mistake can cut the life cycle of varnishing plate in 8–10 times or increase the production wastes on 50–90 %. Correct process guarantee that plate could be re-used in future continuous runs and will increase the average production efficiency.

Keywords: varnishing plate, distortion factor, packaging production, tear and wear.

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