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Packaging Printing Today

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Abstract:

Printing packaging covers today about 50% of all the printing products. Among the printing products there are printing on labels, printing on flexible packaging, printing on folding boxes, printing on the boxes of corrugated board, printing on glass packaging, synthetic and metal ones. The mentioned packaging are printed in flexo printing technique, offset printing technique, intaglio halftone process, silk – screen printing, ink ball printing, digital printing and hybrid printing process. The possibilities of particular printing techniques for optimal production of the determined packaging were studied in the paper. The problem was viewed from the technological and economical aspect. The possible printing quality and the time necessary for the printing realization were taken as key parameters. An important segment of the production and the way of life is allocation value and it had also found its place in this paper. The events in the field of packaging printing in the whole world were analyzed. The trends of technique developments and the printing technology for packaging printing in near future were also discussed.

Keywords:

packaging, offset, flexo, screen printing, digital printing

1. Introduction

Packaging printing covers nearly 50% of all printing today. Due to the fast development of society and competition, marketing constantly requires changes and improvements in packaging printing. This is why in the packaging industry new printing techniques are being introduced to meet new requirements and follow the technology of packaging and the stages the packaging will go through during its life cycle. The focus is on

the necessary investment, time to implement the changes, duration of the technological process, production processes and routes, materials to be used, product pricing, mechanical and chemical stability, possible upgrades, handling factors, climatic conditions, possibility of use on a daily basis, and ecological aspects of the production and products. [1-10]

2. Printed packaging

Today's packaging printing is applied to fibre print substrates, primarily paper, cardboard and board, and to lesser extent textiles. In addition to the mentioned bases, a huge portion of production covers packaging printing on synthetic bases, and the share of metal and glass bases is also considerable. Wooden packaging is also printed on, though rarely directly, but rather by sticking labels. The respective global market shares are shown in Figure 1. [11-16]

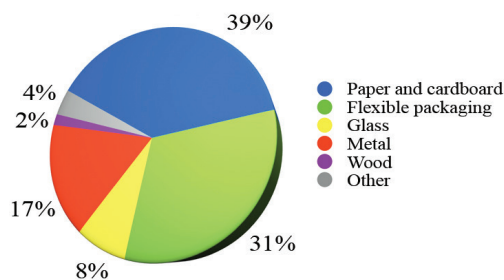


Figure 1. Globally produced packaging by the type of print substrates

2.1. LABELS

The demand for labels, and their production, is great. Today, label is an essential part of the product i.e. packaging. Its effect in marketing is extremely important. In addition to providing information and possibly protection, it serves as a very effective advertising tool. For this reason it is very important which label printing technology is selected. Today, printing houses account for the most of the label market, but it is not uncommon, particularly in case of small circulation, to see labels printed at the same facilities where they are being applied to products. Current production includes labels to which an adhesive layer must be applied subsequently, labels with already applied adhesive layer that is activated with water, and self-adhesive labels. [19]

In medium to large circulations labels can only be printed in the flexographic printing technique at printing houses at medium print quality. Their cost is low. Medium and large circulations may be printed at printing houses in the offset technique as well. The cost is slightly higher, but the print quality is also higher. Top colour prints for labels can, of course, only be achieved in gravure printing. Such printing is conducted at printing houses

for large and possibly medium circulations, and the cost corresponds with quality. [20]

It is not uncommon to see a small circulation of labels screen printed. When this technique is applied, colour prints are rarer. Screen printing is recommended for prints that require a thicker layer of dye. Glow dyes and metallic dyes are also good for screen printing. As a rule, the cost of prints is not high. The highest quality prints can be achieved at a printing house, but printing is also possible at the manufacturer's site. [25]

Labels are being increasingly digitally printed. Inkjet print can provide very high quality prints on appropriately adjusted print bases. The cost is very high. Labels in any quality may be printed in this way as well, at a relatively high cost. The good thing is that the preparation for printing is very simple and in small circulations brings down the price to a competitive level. Due to a simple process, good quality is also possible to achieve outside the printing house. A great advantage of this technology is the possibility of print personalization. Regrettably, printing with metallic ink is not possible yet. Lately, the speed of Inkjet machines has substantially increased which is good for larger circulations and opens the possibility of integration with other machines (hybrid print technologies). [39]

Electrophotography is also a widespread digital printing technique. The most acceptable is the technology with powder toners that can also be used to print labels. Printing with liquid electrophotographic toner is also applied, mostly for the higher print quality. With the simple preparation and possibility of personalization, the area for commercially justified implementation is small edition, as a rule printed at printing houses. However, there is more and more rotary printing applied so as to commercially justify medium edition.

A frequent form of digitally printing labels is direct thermal printing and indirect thermal printing. These techniques are mostly employed to print prices and bar codes at the companies that sell commodities. Labels are printed in several other print techniques, but their quantities are so small that they do not represent a relevant production segment.

2.2. FLEXIBLE PACKAGING

The scope of the materials for producing printed flexible packaging is very broad and includes papers, plastic films, metal foils and all their combinations. It is common to all these materials that they enable quality use of packaging. According to some authors, flexible packaging includes bags, lids, glued packaging, endless packaging, shaped bags, transport bags, multipackaging and wrapping foils. In addition, flexible packaging also includes the already mentioned labels. Flexible packaging is printed in many techniques depending on the circulation, quality, print base and available machinery. [24]

The circulation of flexible packaging is usually large, whereas the required quality greatly varies. The most widely used printing technique is flexographic printing. Flexographic printing is only possible at printing houses. The quality of prints ranges from low to medium to high. Flexographic printing is not adequate for top quality prints, though. That is why some flexographic printing machines are designed similarly to the ones for gravure print. It is not uncommon for the machines to be built so as to have particular flexographic printing units that are interchangeable with the one's for gravure printing and vice versa. This way, the print base may in one pass be enhanced by a top quality colour print from gravure with coarser sections printed in cheaper flexographic printing.

Flexible packaging that requires top quality may also be printed in offset. The cost of such prints is somewhere between flexographic printing and gravure printing. Digital printing is possible but only commercially justified in very small edition. [23]

2.3. FOLDABLE BOXES

Foldable boxes printing is particularly important in packaging printing. This includes small boxes (for medicines, cigarettes, toothpaste etc.) and bigger boxes (for detergents or liquor bottles etc.). The material for producing foldable boxes is cardboard, or sometimes board. Cardboard may be uncoated, coated or one-side coated (uncoated on the side to be printed on, whereas the other side is enhanced with a layer to achieve the required characteristics for packaging specific types of products). [9]

According to some authors foldable boxes

include simple boxes, protection/transport boxes, decorative boxes and advertising/commercial boxes. The bases for making foldable boxes are printed at printing houses and mostly in offset, followed by gravure, much less flexographic printing, digital printing and even letterpress printing. Digital printing, however, has the highest growth rate, but only for grammage up to 300 gm⁻² and copy up to 500 prints, because in higher number of copies its commercial justifiability is lost. [17]

The quality of print in foldable boxes ranges from very low for some simple boxes to very high e.g. in boxes of chocolates where high quality raster print may be applied. To raise the quality even higher prints may be enhanced by applying varnish or coating. Varnish and coatings may serve to increase the attractiveness of the products, as well as provide mechanical or chemical protection against gases or liquids and some chemical agents. Varnish is applied in-line in the printing press or off-line in a separate machine. Enhancing normal prints often includes printing with metallic or glowing dyes. Just like in the before-mentioned label printing, the best quality is achieved in gravure printing, followed by offset printing. However, even screen printing and foil printing may be used for special quality requirements. [18]

2.4. CORRUGATED BOARD BOXES

Corrugated board is a material made of flat sheets of paper with one or more layers of corrugated paper between them. The composition of the material usually includes groundwood, recycled paper fibre and cellulose. Corrugated board is a very sturdy material. It does not break at folds and is, therefore, mostly used in making transport boxes. Of all the bases for graphic printing, board is the most widely used one.

On the outer side of the board there is flat paper called liner. Inside, there are corrugated layers separated by a flat sheet. With different combinations of corrugated layers different degrees of board toughness are achieved, varying in printing possibilities. Today, more than 90% of board boxes are printed. There are different technological processes for printing on the packaging made of corrugated board. The best prints come from printing on the print base that is to be applied as a label to the entire box made of corrugated board. Such a flat print base may successfully be printed in any print technique. The technology for making such a box is relatively expensive, but the

results can be superb. Similarly, the print may be applied to linen paper that is then integrated as the front sheet of board. Linen paper is uncoated and does not enable top quality prints. However, paper to print is flat and this allows for flexible printing and offset techniques when absolute top quality is not expected. Due to poor smoothness of the upper surface, gravure printing and letterpress printing are not employed. [25]

The technological process for printing corrugated board also employs direct printing on ready-made board. The printing techniques used exert lower pressure on the printing form. In flexographic printing it is desirable for board to be structured so that the print layer may sustain pressure of 150 Ncm². Screen printing can also be applied directly to board, because the pressure is so low that it poses no problem. Board can also be printed in inkjet printing or possibly in pad printing. Board i.e. ready-made boxes are frequently marked by using a rubber seal. Smaller labels can also be glued on ready-made board boxes. Labels can be printed in any label printing technique, but as a rule no high quality printing is involved. [26]

2.5. GRAPHIC TECHNOLOGY PRINTING PROCESSES FOR ENHANCING PACKAGING

Packaging enhanced by employing graphic printing technologies covers about one half of all graphic production with a constant upwards trend. This includes offset printing, flexographic printing, gravure printing, screen printing, pad printing, digital printing and hybrid printing. In different parts of the world different printing technologies prevail. In Europe and in Croatia as well, offset printing is the most used, and flexographic printing is also on the rise. In the U.S.A. the most frequently used technique is the relatively inexpensive flexographic printing, but this process does not provide for high print quality. Japanese market is very keen on quality and mostly uses gravure printing, followed by offset printing, whereas flexographic printing that does not allow for high quality is poorly represented. [44]

2.6. DEVELOPMENT OF THE TECHNOLOGY FOR PACKAGING PRINTING

In the last few years, flexographic printing has been the technique with the highest growth. The main focus of development is on creating conditions for increasing raster linature to enable the print quality to approach the quality of offset

printing as closely as possible. It is also necessary to keep lower machine cost (lower printing pressure, no blanket cylinder, no big ink distribution unit, no dampening unit). These requirements have been successfully met by introducing compressible elastic layer between the printing plate and the plate cylinder (Figure 2). [6]

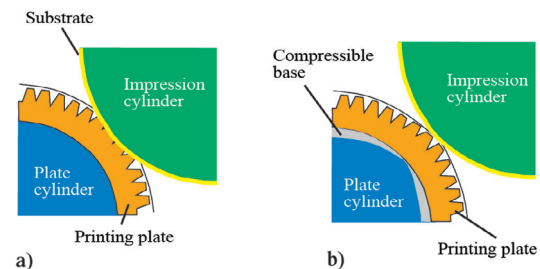


Figure 2. Flexographic printing with and without compressible layer on plate cylinder

The compressible layer also enables greater hardness of printing elements. Harder printing elements can be lower in height. This reduces their enlargement under pressure and increase ink layer on prints, which also improves quality, particularly in colour printing. [7]

In offset printing improvement comes with faster preparation of the machine and the printing form, and with eliminating the dampening solution from the printing process. Such modifications are to speed up and simplify printing and increase the already high quality of prints. Printing forms can be made by using Computer to Plate machine (CTP), as well as in the machine, and this, in addition to the speed of preparation, also contributes to excellent printing registration. Figure 3 shows a commonly used Heidelberg Speedmaster 46 DI. [39]



Figure 3. DI offset printing machine with built-in printing form generator

In addition to the wet offset, there has been an increase in the use of the waterless offset that enables sharper print edges and thicker layer of ink. The result is an increase in the colour gamut in offset printing i.e. extending the limits of objective reproduction. In addition to applying waterless printing, the print drying speed is also improving. [29]

Gravure printing is also being constantly improved so that it manages to retain approximately the same global share in packaging printing. This includes the introduction of less expensive printing forms made of synthetic materials using laser and electron beams.

The printing production has seen some finishing processes introduced such as plasticisation or e.g. lamination. Such processes are used to enhance the surface, or to use the best of the characteristics of two materials combined together. For instance, laminating aluminium on cardboard makes it possible to obtain quality print on cardboard and top-rate protection of the packaged material towards which aluminium faces. Figure 4 shows the method of lamination the two packaging materials directly in the printing machine from rolls. [31]

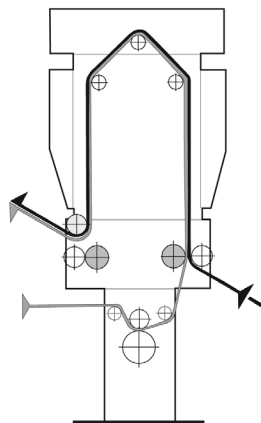


Figure 4. Schematic view of lamination integrated in rotary gravure press

With the arrival of digital printing, screen printing lost some of its share. However, when rotary screen printing technology was introduced, screen printing came back, and, today, occupies a prominent place in packaging printing. Screen printing is used on ready-made packaging, primarily bottles, but screen printing also on different types of products. It is used on flat print substrates made of synthetic materials, metal, fabric, paper and cardboard. Figure 5 shows one way

of printing to screen printing (on flat and rigid printing substrate). [31]

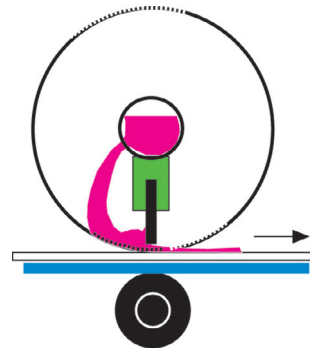


Figure 5. Schematic view of rotary screen printing press

One great area that has been developing lately is hybrid machine printing. Rotary screen printing is quite prominent here, too, because of its characteristics and adequate printing speed. There is also a pad printing version where ink is transferred by rotary elements. It is currently the fastest pad printing available (Figure 6). [36]

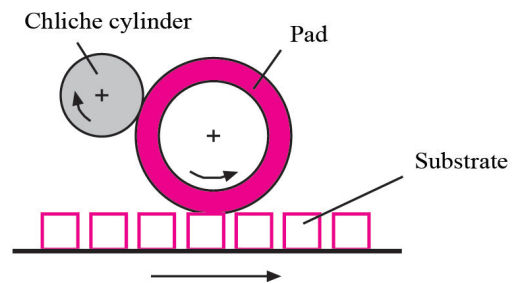


Figure 6. Sketch of rotary pad printing press

To be able to keep abreast in the packaging printing business, digital printing developed faster machines, including rotary press (Figure 7). [37]

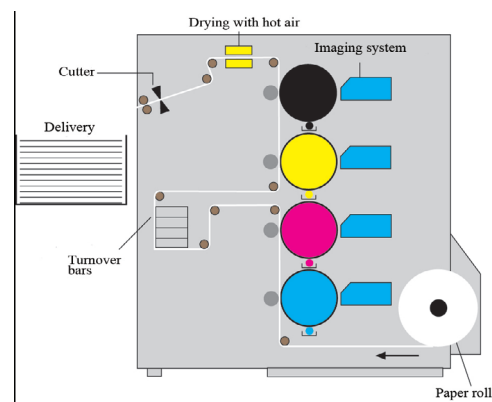


Figure 7. Sketch of digital rotary printing press (electrophotography)

Hybrid printing is a technological process that is the best in dealing with complicated and complex graphic printing tasks. It provides for top quality and cost of prints. The secret is to have a number of different printing techniques incorporated within the same machine, so that every technique may print what it does best in a single pass. Figure 8 shows one hybrid printing method on roll to roll which combines the three conventional printing techniques (offset lithographic, flexographic printing, cold foil printing). [29]



Figure 8. Hybrid printing press with flexographic printing, offset printing and foil printing techniques

Due to smaller volume of continuous work for such machines, their design provides for easily changing the order of printing. This way one printing unit may be used to apply other printing techniques as well. [43]

3. Conclusion

The branch of graphic production that is growing unstoppably is packaging printing. Throughout the world the quantity of packaging is growing. To meet the market demand, attempts are being made at raising the quality of prints, and even more at increasing the speed of production. Today, more than 90% of packaging is printed, with particularly noticeable colour printing trend.

There is a notable increase in packaging printing on rotary printing presses. However, due to the higher quality of prints and a broader selection of print bases, sheet printing is not decreasing, either. Only larger number of copy cost less when printed from a roll. Of course, small edition are the most common domain of digital printing. Digitalization and computer-controlled processes have entered the mainstream of modern competitive production, though.

4. Literature

- [1] Bolanča Z; Influence of Paper and Bord Packaging on the Environment, Annual of Engineering 1, 2000, 71-75
- [2] Casatelli M. Linda; Digital Print Technologies for Packaging, PIRA International LTD, 2011.
- [3] Cooper A.; Developments in specialist process – securiti and reponsive packaging intelligent inks, Package Printing Technologies, Pira International, Leatherhead, UD, 1997.
- [4] Legierse E. J. Peter; Decoration of Packaging, Pira International, Surrey, 1999.
- [5] Anon; Advensis in plastics – materials and processing technology for packaging, Cobham, UK, 1998.
- [6] Anyadike Nandi; Fleksibile Packaging, Pira International, Surrey, 2003.
- [7] Denis Amato and Denis E. Young; Packaging for e – Commerce, ISTACON 2000, Annual Conference, Orlando, 2000, 25 – 28
- [8] Harris A.; Flexibile packaging fikus, Flexo Tech, 1997.
- [9] Macinić D., Golubović K., Majnarić I.; Utjecaj efekta lakiranja na optička svojstva ofsetnih otisaka, 15th International Conference on Printing, Design and Graphic Communication Blaž Baromić 2011, Senj, 372-384
- [10] Soroka W; Fundamentals of Packaging Technology, Institute of packaging professional, Herndar, Virginia, 1998.
- [11] <http://www.tcinne.com/coating.html>, 11. 2005.
- [12] Eldred R. Nelson; Package Priting, Jelmar Publishing Co., Inc., Plainview, New York, 1993.
- [13] Schilstra D.; Flexo, the alternative in karton printing, ECMA, Brussel, 1997.
- [14] Fuch Boris; 200 Jahre Lithographie – 100 Jahre Offsetdruck, Tagung, 2004.
- [15] Potočnik Eduard; Kovinska Embalaža, Saturnus, Ljubljana 2004.
- [16] The Can Makes, UK Market Report 2008.
- [17] Anon; Foeus an bottle filling, capping, labelling, coding and marking, Int. Bottler Packer, 70, 8, 1996, 25 – 48

- [18] Kamen, M; A.Georges; C. Stoffels; A. J. Schlossman; Envirolgluv – the Perfekt decoration for glass beverage bottels, Bev – Pak Americas 97, Fort Landerdale 1997., 1 – 16
- [19] Kipphan, Helmut; Handbook of Print Media, Springer – Verlag, Berlin, Heidelberg, New York, Barcelona, Hongkong, London, Milan, Paris, Singapore, Tokyo, Springer, 2001.
- [20] Onusseit, H; PET bottle labelling, Adhasion, 41, 9, 1997., 18 – 24
- [21] Bolanča Zdenka; Ekološki aspekt fleksografskog tiska, Zbornik radova, Simpozij Tectus, Brijuni, 2002, 154-162
- [22] Heath S.; Choosing the most suitable ink and varnish system, Fleksographi for castan printing, Pira International, Leatherhead, UK, 1997.
- [23] Horvatić Stjepan; Tiskarske rotacije i rototisk, Adamić, Rijeka, 2004.
- [24] White Antoni ; High Quality Flexography, Pira International, Surrey, 1998.
- [25] Zjakić, Igor; Jamnicki, Sonja; Bertić, Irena; Utjecaj otiranja na kvalitetu tiska ambalaže; 12. Savjetovanje o materijalima, tehnologijama, trenju i trošenju MATRIB 07, 2007.
- [26] Bolanča,Stanislav: Glavne tehnike tiska, Acta Graphica, Zagreb, 1997.
- [27] Bolanča,Stanislav: Suvremeni ofsetni tisak, Školska knjiga, Zagreb, 1991.
- [28] Heidelberg Nachrichten, 261, 2007, 41
- [29] Kumar, Grafičar, Revija slovenskih grafičarjev, 2/2006, 22
- [30] Horvatić Stjepan; Tiskarske rotacije i rototisk, Adamić. Rijeka, 2004
- [31] Roncoroni V.; The future of rotogravure printing in flexible packaging, Converting, 4, 6, 1997, 3 – 40
- [32] Bolanča Zdenka; The influence of the screen printing inks on environment, Acta Graphica, 17, 2005, Zagreb, s 1-4, 12-20
- [33] Bücherer R.; Siebdruck – Digest, Verlag der Siebdruck, Lübeck 1988, 6 -8
- [34] Henning Roni; Watson – Guptill Publikation, New York, 2006, 102
- [35] Ingram Samuel; Screen Printing Primer, GATE, Sewickey, 1999. USA. 55
- [36] Courtesy of Matthews International, Katalog
- [37] Kipphan Helmut ; Handbook of Print Media, Springer, Berlin, Heidelberg, New York, Barcelona, Hongkong, London, Milan, Paris, Singapore, Tokyo, 2001.
- [38] Bolanča Z., Bolanča I., Majnarić I., The Influence of the Digital Printing of Packaging on the Characteristic of the Recycled Fibres, Proceeding of International Conference on Digital Production Printing and Industrial Applications, Amsterdam, 2005, 100
- [39] Heidelberg DI 74 – 6, Heidelberg materijali
- [40] HP Indigo, materijali Indigo
- [41] KBA, Karat 74, KBA materijali
- [42] Majnarić I., Bolanča I., Bolanča Z., Milković M., Conditions in Digital Printing of Packaging on the Print Quality, DPP 2005, Amsterdam, 2005,
- [43] Majnarić, I., Bolanča, S., Bolanča Mirković, I., The Influence of the Toner Structure on the Quality of Black-White Digital Printing, Annals of DAAAM for 2008 @ Proceedings of the 19th International DAAM Symposium, Vienna, 2008, 779
- [44] Farkas J; The market for narrow web printing, Folding Carton Ind, 23,1, 1996., 39 - 41
- [45] Hayes R; The letterpress swansong, Print. World, 225, 3, 1996., 24 -25
- [46] Katalog Heidelberg, studeni, 2002. Priprema – tisak – dorada.