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© S. Havenko, Dr. hab., Professor, O. Kotmalova, Ph. D., Associate Professor, M. Labetska, Ph. D., Associate Professor, Ukrainian Academy of Printing, Lviv, Ukraine

SYSTEM-TECHNICAL ANALYSIS OF TECHNOLOGIES OF SHRINK LABELS MANUFACTURE

Shrink label today is one of the leading innovative solutions in the field of packaging labeling. Therefore, it is important to conduct system-technical, economic analysis and determine the most cost-effective and efficient technology for the production of shrink labels.

Keywords: gravure printing; flexographic printing; imprint; shrink label; film material.

Introduction

Shrink label as one of the most modern ways to provide an attractive appearance of products today is widely used in the packaging market, because the range of its possible use is quite wide and diverse: food, cosmetics, household chemicals, pharmacy and more. The main advantages of the shrink label are the ability to cover the surface of a complex shape, protection of printed information from the inside of the label from UV rays (burnout), low temperatures (freezing and cooling), moisture and mechanical damage during transportation. In addition, for the convenience of customers, the heat-shrinkable label can be supplemented with transverse or longitudinal perforation or tear-off tape. The functional versatility of the shrink label encourages specialists in the printing industry to develop new materials and equipment, improve methods of applying printed information.

The range of film materials used in the production of shrink labels is quite large, most commonly used PVC, PET, PETG, OPS, PLA and OPP films, which differ in their shrinkage, thermal sensitivity and environmental friendliness. PET film is used in cases where it is necessary to obtain higher print quality and/or a high degree of shrinkage. In addition, PET film is more environmentally friendly. PVC films are the most popular material for labeling with heat-shrinkable sleeve, as they are better controlled in the process of heat shrinkage, are characterized by high resistance to abrasion, pasteurization at a lower cost compared to competing materials. The maximum level of shrinkage of PVC films is about 65 %. Although PETG films are more expensive than PVC, they have the highest shrinkage coefficient in heat-shrinkable sleeves (up to 80 %) at lower temperatures, which allows for more

careful control of label shrinkage in thermal tunnels. Films are the most common material for heat-shrinkable labeling of bottles of water and carbonated beverages. OPP film labels have a high adhesion to hot melt adhesives, good abrasion and wear resistance, a high degree of gloss and transparency, but the shrinkage coefficient of OPP films varies only from 5 % to 20 %. Therefore, OPP roll film can be a cheaper alternative to heat-shrinkable sleeves in cases where a medium degree of shrinkage is sufficient. Packaging manufacturers interested in biodegradable heat-shrinkable labels are encouraged to use a polylactic acid (PLA) film that decomposes in the environment within two months [1–3].

The printing market for consumables for the production of shrink labels is constantly replenished with new formulas for printing inks, which must meet the requirements of resistance to heat shrinkage, abrasion in dry and wet form, exposure to solvents, low flavor and high gloss, ensure a constant balance of high-speed fixation and the ability of the hose label to compress. Scratch resistance must be combined with high adhesive properties to a wide range of materials. UV polymerization technologies in an inert atmosphere help to significantly increase the adhesion and scratch resistance (when shrinkage is reached at 70 %), prevent the migration of volatile organic compounds and reduce flavor. Therefore, UV inks are currently recognized as the best in this segment: they are environmentally friendly, provide less spreading compared to solvent intaglio inks.

According to researches of known technologies for applying information to the heat-shrinkable label, the method of gravure and flexographic printing is most often used. Since there is a significant difference in these technologies, which are discussed in a number of publications [1–4], and accordingly in their cost-effectiveness, there is a need to compare and formulate practical recommendations for the use of these methods in the manufacture of heat-shrinkable labels.

Methods

Technical and economic analysis of the efficiency of manufacturing shrink labels by two methods of printing was carried out on the basis of known guidelines for performing economic calculations [5–8]. The initial information for the technical and economic analysis are given in table 1. The following indicators were calculated: complexity of the annual production program; labor costs; cost of basic materials; depreciation deductions;cost of production; payback period of investments.

Calculations were made on the basis of relevant regulatory materials, the experience of printing companies and technological instructions for the processes of manufacturing printed products by the above methods [9, 10].

In this paper, an enlarged method of calculating the main technical and economic indicators is used. Direct calculation determined the cost items that depend on the volume and nature of the output: the cost of basic materials, wages, depreciation. All other costs were determined as a percentage of variable items.

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Results and discussion

As is known, the main basic indicator for making organizational decisions in the production of printed products (determining the rational technology of production in the required amount; qualitative and quantitative choice of equipment; needs for basic and auxiliary materials; number of employees; energy and water supply; the need for production and auxiliary areas, orientation of cargo flows) is the production capacity, which is determined by the formula:

$$B = \frac{\left(T_{ef} - \sum T_r\right) \times C_{ni}}{\frac{N_{ad} + K_f \times \left(N_w + N_r\right)}{60} + \frac{C \times N_p \times C_c}{60}} \times \times \frac{S_m \times C_m \times C}{1000},$$

where K_f — the number of forms; T_{ef} — effective fund of the machine; T_r — machine repair time; C_{ni} — coefficient of norms implementation; N_{ad} — time norms for adjustment; $N_w + N_r$ — time norms for washing away and replacement of forms; C — circulation; N_p — time norms for printing; C_c — coefficient of complexity; S_m — the number of sheets, that are printed per operating cycle of the machine; C_m — colourful of the machine.

Based on the results of calculations of production capacity is projected cost of production, profit, profitability, payback period. The results of the calculations of the main technical and economic indicators of the production of shrink label by gravure and flexographic printing are shown in table 2.

Based on the obtained numerical results of the calculations, a histogram of the ratio of the main costs of gravure and flexographic

Table 1

Initial data for technical and economic analysis

Technical indicators	Value
Width of the printed material and share of a sheet, mm	850/4
The maximum diameter of unwinding, mm	600
Thickness of PVC film, microns	45
Number of names	1
Average circulation, thousand copies	170
Color of products	4(CMYK) 2(Panton)
Inks for gravure printing for flexographic printing	 SunChemical series Fidelity Siegwerk series NC 110-3
Finished product format, mm	195×230
Equipment: gravure printing machine flexographic printing machine	 Heliostar S Soloflex 8L

Table 2

The results of calculations of the main technical and economic indicators of shrink label production

Indicators	Gravure printing	Flexographic printing
Annual production capacity, mln imprints	21,35	30,24
Cost of production, UAH	0,19	0,15
Payback period, years	1,81	1,15

printing in the manufacture of shrink label (fig.). Analysis of the calculations of the main technical and economic indicators showed that the largest costs require the use of flexographic printing machines, and smaller — gravure. However, the technological calculations of materials and time for the manufacture of heat-shrinkable label in 8 colors with a projected circulation of 170 thousand copies indicate a much lower cost of production and payback period when printing in the flexographic method.

Therefore, the option of manufacturing heat-shrinkable labels by flexographic printing, which significantly exceeds the estimated cost of production, production capacity, payback period, etc. is more efficient from both economic and technological points of view.

Conclusions

In recent years, the shrink labeling industry has undergone significant changes, the reasons for which are the rapid development of the packaging market, the development of new technologies and the ever-growing demand for this type of product. The label from a heat-shrinkable film is widely used for packings of the goods of food, medical, perfumery and cosmetic, household purpose.

Since gravure and flexographic printing methods are most often used to apply a colourful image on the inside of the heat-shrinkable label, these technological options were chosen for technical and economic analysis of the efficiency of such products. As a result of the

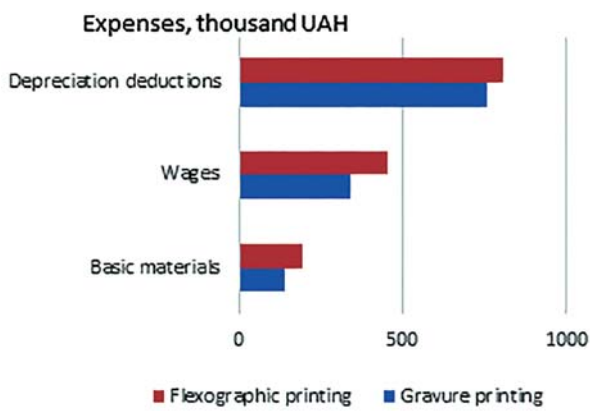

Diagram of comparison of the main costs of printing a shrink label

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calculations revealed higher profitability of flexographic printing in all respects, in addition, in terms of greater ease of use of flexible forms when printing on the same flexible materials, flexography is a more logical way to apply information to the heat-shrinkable label.

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Термозбіжна етикетка на сьогоднішній день є одним із передових інноваційних рішень в галузі маркування паковань.
Тому важливим є проведення системо-технічного, економічного аналізу та визначення найбільш рентабельної і ефективної технології виготовлення термозбіжних етикеток.

Ключові слова: глибокий друк; флексографічний друк; відбиток; термозбіжна етикетка; плівковий матеріал.

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