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# IMPRESSUM

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The papers appearing in this book compose the proceedings of the technical conference cited on the cover and title page of this volume. Papers were selected by the organising committee to be presented in oral or poster format, and were subject to review by the programme committee.

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A MAGYAR TUDOMÁNY ÜNNEPE

MAGYAR TUDOMÁNYOS AKADÉMIA · 1825 ·

# ANALYSIS OF THE MATT LACQUERING STRUCTURE OF FLEXIBLE-WALLED PACKAGING MATERIALS IN THE CASE OF FLEXOGRAPHIC PRINTING TECHNOLOGY

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***Abstract:*** *Flexographic printing is one of the fastest growing sectors in the printing industry. Our related research project examined the potential of matte varnishing as surface finishing process. Various surface finishing processes, such as various safety varnishes, protective varnishes, barrier varnishes, and the types of matt varnish we have chosen, are playing an increasingly important role in the development of today's packaging material trend. In the course of the research, we tested the changes in the surface structure of the varnishing layer in the case of varying amounts of lacquer application, and we measured the gloss values in the case of the use of clichés with different surface patterns. For the tests, we used a type of varnish developed by us, the critical required feature of which was a high degree of heat resistance, and in the development of which the biggest challenge was to achieve fingerprint resistance. Three different cliché types and three differently applied anilox rollers were used for printing. The effectiveness of the varnish application is influenced by a number of factors: the varnish uptake of the printing plate, the printing speed, the printing pressure, the temperature and the properties of the printing plate and the substrate.*

***Keywords:*** *flexographic printing, varnishing, surface structure*

## INTRODUCTION

A number of factors have contributed to the importance of packaging and it is gaining strength nowadays. The most important of these is globalization and the resulting economic changes. Changes in the role of packaging are also affected by consumer and social changes, which are mainly due to demographic changes. Globally, the growing population is a challenge, which, in addition to the expanding supply of goods, is leading to an increase in the use of packaging. This process leads to a narrowing of packaging raw materials and, in parallel, an increase in their price, which often forces developers to innovate technologically.[1]

In the last few years, many product demands have transformed. The main requirement for the production of packaging materials has become a constant supply, constant quality and simple workmanship, one of the basic pillars of which is varnishing.[2] Varnishes have always played a protective role, from which they developed into individual solutions. Today, most varnishes still play a significant role in mechanical protection, but processes have emerged that open up new opportunities for printers and also increase demand for their products. If the consumer sees a surface that seems interesting during a purchase, they will involuntarily step in to feel it. Just because the consumer grabs the products, he already evaluates them better they are more likely to buy them.[3]

One of the leading trends today is the solution of highlighting logos or other important elements on products by treating the surface around them with matt lacquer, so that the brightly left area becomes dominant.

It is no coincidence that this technique has become popular, as the optical experience it provides has a really significant effect, directing the gaze to the right place the result will be clear but dynamic and special. In our opinion, the use of matt lacquer still has many possibilities. We have built our present research to explore these and apply innovative application techniques.

## METHOD OF RESEARCH

### Stain resistance

The requirements for matte varnish are high heat resistance and fingerprint resistance, so that no traces remain on the surface treated with matt lacquer after touch. We launched developments for the latter, during which we developed and tested a special matte varnish. To achieve the desired effects, a mineral filler was used as the matting agent, the proportion of which was increased to 15% and thus the desired opacity and opacity value was achieved. The success of the development is indicated by the positive feedback from our partners, which was followed by a successful introduction in several areas.

### Pattern design

The visual effect of segmental varnishing is becoming an increasingly desirable feature in the graphic industry. The initial usage of varnishing was to protect products. Today, almost every product, from commercial to personalized items, includes some type of varnishing. [4] In terms of design, varnish is applied to the majority of products to increase their value by enhancing their visibility or to personalize the product for a customer. Varnishing could be, to some extent, conducted with most printing techniques, including screen printing, flexography, standard offset printing, drip-off offset systems and inkjet digital printing. [5]

An important aspect is the level of gloss achieved on the matt lacquered surface after the matte varnish. One of the main elements of our research is to examine the range in which we can modify the gloss value of matte varnish even within a given print. This technique can allow different patterns to be displayed by changing the structure of the matte finish. In order to map the possibilities of matte varnishing, we need to examine the factors that can be used to influence the quality and quality of varnish application. 3 types of clichés and 3 different sizes of anilox rollers were used for the tests. For the test print, we used the test chart we compiled in Figure 1, which contained the 19 different surface patterns shown in Table 1.

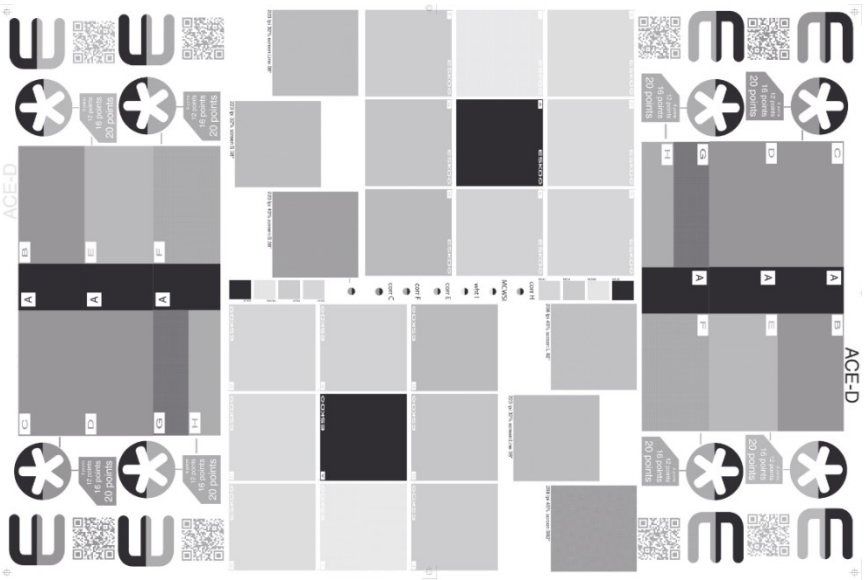
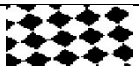
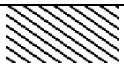
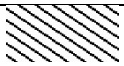
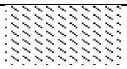
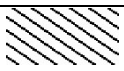
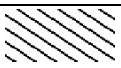
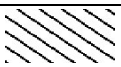
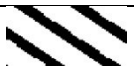



*Figure 1: The applied test chart*

*Table 1: Applied surface pattern*

| | | | |
|---|---|---|---|
| 1 |  | 11 |  |
| 2 |  | 12 |  |
| 3 |  | 13 |  |
| 4 |  | 14 |  |
| 5 |  | 15 |  |
| 6 |  | 16 |  |
| 7 |  | 17 |  |
| 8 |  | 18 |  |
| 9 |  | 19 |  |
| 10 |  | | |

Three types of anilox rollers with different ink volumes and screen line densities were used for printing:

- Anilox 1: 360 L / cm screen line density and 5.5 $cm^3$ / $m^2$ ink volume
- Anilox 2: 260 L / cm screen line density and 7 $cm^3$ / $m^2$ ink volume
- Anilox 3: 200 L / cm screen line density and 10 $cm^3$ / $m^2$ ink volume

The tests were performed using the following cliché types:

Flint ACE-D

- Standard digital cliché
- FLAT TOP: nitrogen chamber with UV-A illumination, surface pattern formation: during lasering
- Shore A hardness: 78 Sh A

Flint ACT-D

- Standard digital cliché.
- FLAT TOP: nitrogen chamber with UV-A illumination, surface pattern formation: during lasering.
- Shore A hardness: 74 Sh A.

MacDermid LUX ITP-60

- FLAT TOP cliché and surface pattern can be created during lasering.
- Shore A hardness: 78 Sh A.

After selecting the appropriate cliché and anilox rollers, the testing process began. Test printing was performed on a Soma Midi Flex 2 press on 0.012 mm thick polyester substrate.

Measurements were performed with a Biuged BGD515 / 3 gloss meter. Furthermore, we visually examined cliche surfaces and structural changes of matte varnished surfaces using a high-resolution microscope and Peret Flex Pro instruments.

## RESULTS

We were the first to perform visual examinations using a high-resolution microscope and Peret Flex Pro. It is clear from the samples to what extent the structure of the location of the matting grains within a given varnished surface can be changed. In the second test cycle, the gloss values were measured in 19 different parts of the test chart. The measurement results are shown in Table 2.

*Table 2: Gloss values*

| **Anilox 360/5.5** | | | |
|---|---|---|---|
| Samples | ITP-60 | ACT-D | ACE-D |
| S1 | 32,7 | 40,7 | 36,5 |
| S2 | 21,5 | 24,6 | 29,7 |
| S3 | 32,7 | 27,3 | 32,8 |
| S4 | 32,7 | 34,3 | 43,3 |
| S5 | 28,1 | 33,2 | 46,3 |
| S6 | 33,7 | 32,1 | 37,3 |
| S7 | 33,5 | 35,4 | 38,2 |
| S8 | 35,6 | 30,2 | 36,3 |
| S9 | 57,6 | 54,3 | 71,8 |
| S10 | 62,4 | 66,8 | 62,5 |
| S11 | 33,8 | 35,9 | 38,6 |
| S12 | 23,1 | 23,7 | 29,4 |
| S13 | 32,3 | 29,2 | 38,3 |
| S14 | 35,6 | 33,3 | 34,7 |
| S15 | 39,2 | 35,5 | 49,3 |
| S16 | 28,6 | 27,9 | 27,6 |
| S17 | 34,3 | 41,8 | 49,8 |
| S18 | 45,8 | 41,9 | 60,7 |
| S19 | 63,8 | 46,5 | 68,1 |

| **Anilox 260/7** | | | |
|---|---|---|---|
| Samples | ITP-60 | ACT-D | ACE-D |
| S1 | 35,3 | 29,6 | 33,5 |
| S2 | 26,7 | 25,6 | 22,1 |
| S3 | 32,9 | 29,4 | 33,8 |
| S4 | 35,7 | 37,8 | 42,1 |
| S5 | 39,8 | 35,1 | 42,4 |
| S6 | 32,0 | 32,1 | 35,1 |
| S7 | 36,2 | 45,2 | 32,7 |
| S8 | 36,1 | 36,2 | 39,5 |
| S9 | 69,3 | 69,5 | 71,1 |
| S10 | 55,4 | 64,9 | 54,1 |
| S11 | 26,1 | 37,8 | 33,4 |
| S12 | 31,1 | 22,1 | 25,3 |
| S13 | 27,7 | 28,3 | 30,1 |
| S14 | 32,2 | 32,8 | 33,7 |
| S15 | 32,5 | 36,6 | 56,2 |
| S16 | 19,8 | 26,6 | 29,0 |
| S17 | 41,2 | 44,5 | 59,8 |
| S18 | 49,8 | 48,8 | 59,9 |
| S19 | 43,8 | 49,3 | 66,0 |

| **Anilox 200/10** | | | |
|---|---|---|---|
| Samples | ITP-60 | ACT-D | ACE-D |
| S1 | 16,3 | 12,8 | 15,1 |
| S2 | 8,6 | 8,4 | 8,4 |
| S3 | 8,9 | 8,6 | 9,8 |
| S4 | 9,6 | 8,2 | 10,6 |
| S5 | 10,5 | 7,3 | 9,2 |
| S6 | 9,7 | 7,5 | 8,6 |
| S7 | 13,7 | 12,4 | 18,7 |
| S8 | 9,0 | 8,1 | 8,1 |
| S9 | 47,4 | 19,8 | 63,1 |
| S10 | 44,8 | 37,1 | 48,5 |
| S11 | 16,1 | 17,1 | 19,8 |
| S12 | 7,8 | 9,1 | 9,2 |
| S13 | 7,7 | 8,2 | 9,4 |
| S14 | 8,3 | 7,6 | 9,8 |
| S15 | 10,6 | 9,5 | 10,5 |
| S16 | 9,3 | 7,6 | 9,0 |
| S17 | 13,1 | 10,4 | 14,0 |
| S18 | 18,1 | 11,5 | 15,7 |
| S19 | 18,2 | 10,6 | 17,3 |

## DISCUSSION

By selecting the appropriate anilox roller, the available gloss range can be well defined as follows:

- gloss range: 8 - 50 200 L / cm screen line density and 10 $cm^3$ / $m^2$ ink volume
- gloss range: 20 - 70 260 L / cm screen line density and 7 $cm^3$ / $m^2$ ink volume
- gloss range: 25 - 70 360 L / cm line density and 5.5 $cm^3$ / $m^2$ ink volume

In all cases, the lowest gloss values were obtained with the Flint ACT-D clichés, from which it can be concluded that the matte appearance of the varnished surface can be increased by using softer clichés.

## CONCLUSIONS

By evaluating the results, we determined the range over which the gloss of the varnished surface can be changed using different cliché surface structures. Within a printed test sheet, the maximum brightness difference from a minimum of 8.4 to a maximum of 63.1 can be achieved using Anilox 3 (200 L / cm screen line density, 10 $cm^3$ / $m^2$ ink volume) and Flint ACE-D cliché.

The most matte surfaces were obtained by the surface patterns with the geometry shown in Figure 2.

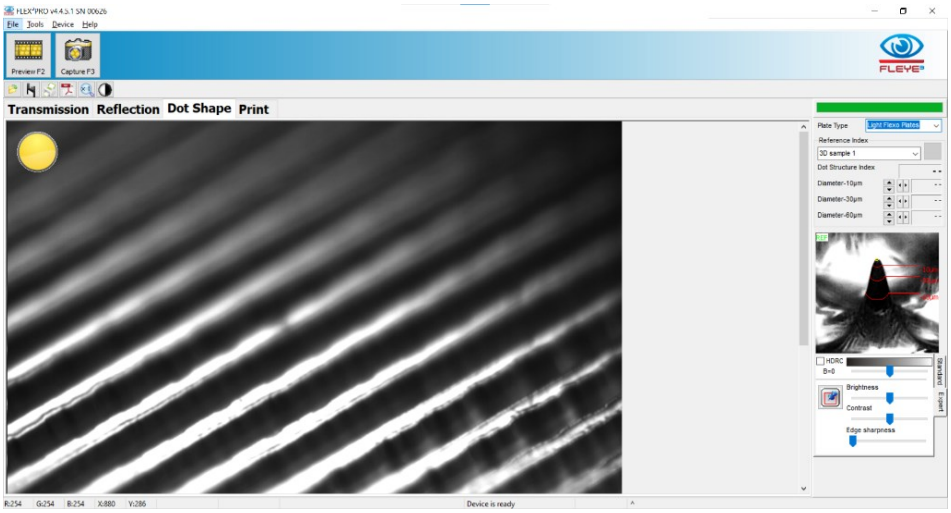



*Figure 2: Surface pattern that formed the most matte surface*

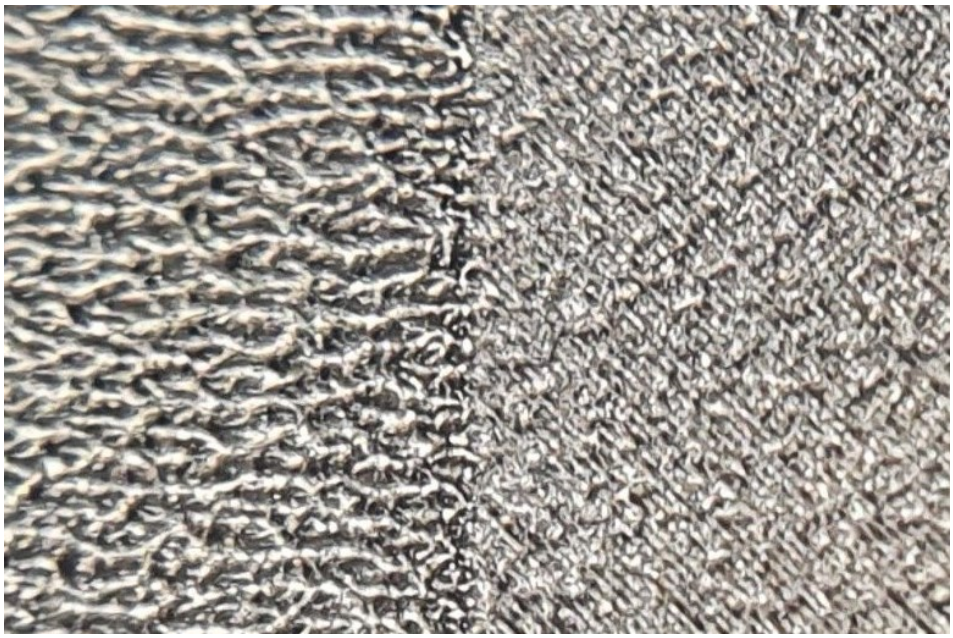


*Figure 3: printed without pattern (left) and with pattern (right)*

It can be seen in Figure 3 that we were able to change the structural surface of the lacquered parts with the microcellular patterns, without printing on the left side, with a line pattern on the right side.

The above test results, as a segment of the potential of flexo printing technology, can have a significant economic impact in terms of efficiency and economy, thus contributing to the protection of our environment. In addition to minimizing the amount of varnish used, production can be optimized with the most suitable surface pattern and the most efficient varnish type to use. With the help of the test results, we got a more

accurate picture of the brightness values of the type of varnish developed by us when using clichés with different surface patterns, thus giving the opportunity to cover the widest possible range of applications. Despite the sudden crisis of the past year, unlike many other sectors, the packaging industry, including the flexo line, has lost momentum surface pattern line density to achieve minimum brightness values.

**REFERENCES**

[1] Dörnyei K. R. : *CSOMAGOLÁS – MENEDZSMENT*, KOSSUTH KIADÓ, ISBN 978-963-09-9307-4 (2019)
[2] JR. Kovács T. CNI Kft.– Lakktrendek a nyomdaiparban; Magyar Grafika 2021/1
[3] Spence, C. & Gallance, A. 2011. Multisensory design: Reaching out to touch the consumer. Psychology & Marketing, 28(3): 267-308.
[4] Hudika T., Majnarić I., Cigula T.: Influence of the Varnishing "Surface" Coverage on Optical Print Characteristics; TECHNICAL JOURNAL 14, 4(2020), 428-433; ISSN 1846-6168 (Print), ISSN 1848-5588 (Online) Original scientific paper https://doi.org/10.31803/tg-20191129104559
[5] Kipphan, H. (2001). *HANDBOOK OF PRINT MEDIA*. Berlin, Germany: Springer-Verlag Berlin, 45-60. https://doi.org/10.1007/978-3-540-29900-4 [2]

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