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it Sumar

Contents

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Scientific reviewers for the papers published in this number:

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Visibility of graphic elements on textiles

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REZUMAT – ABSTRACT

Vizibilitatea elementelor grafice de pe materialele textile

Scopul acestui studiu este acela de a stabili factorii ce trebuie luați în considerare pentru asigurarea vizibilității logourilor și etichetelor de întreținere de pe materialele textile. De obicei, acestea sunt imprimate direct pe produsul final și, mai rar, sunt cusute. În scopul cercetării, imprimeurile au fost realizate pe un suport textil natural, cu unul, două sau trei straturi de cerneală, prin tehnologia cu jet. Au fost experimentate trei tipuri diferite de caractere, în patru dimensiuni, pentru 16 simboluri de întreținere a textilelor cu 11 dimensiuni diferite, în câmpuri de intensitate a culorii negre de 100% și 40%. Imprimeurile au fost supuse unui număr variat de cicluri de spălare și uscare rapidă. Cea mai bună rezistență a culorii imprimeurilor s-a obținut atunci când cerneala a fost imprimată în două sau chiar trei straturi. Diferențele de rezistență a culorii textului imprimat au fost măsurate pentru cele mai mici dimensiuni ale caracterelor (6 și 8 pt). Dimensiunea minimă acceptabilă pentru simbolurile simple ale etichetelor de întreținere a textilelor este de 4.50 · 4.50 mm, iar pentru cele mai complexe dimensiunile sunt mai mari.

Cuvinte-cheie: simboluri de codificare, etichete de întreținere, element grafic, imprimare, jet de cerneală, vizibilitate

Visibility of graphic elements on textiles

The aim of the research was to ascertain what factors need to be taken into consideration to be able to give recommendations on ensuring the visibility of symbols and typographic elements on logos and textile care labels. From being sewn-in, these are nowadays more frequently printed directly on the final product. For the research purpose, the prints were made on a natural material in one, two and three layers of ink with the inkjet printing technology. Three different typefaces were tested in four sizes, complemented by 16 different textile care symbols in 11 different sizes, and by 100% and 40% intensity fields of black colour. The prints were exposed to a different number of wash and tumble drying cycles (1–5). The fastness of prints was better when the ink was printed in two or even three layers. The most substantial difference in the fastness of printed text was measured at smaller type sizes (6 and 8 pt). The smallest acceptable size of simple textile care symbols is 4.50 · 4.50 mm, while more complex symbols have to be larger in size.

Key-words: care labelling, code symbols, graphic element, printing, inkjet, visibility

In fashion design, the role of products we use on a daily basis with various patterns printed on them for different purposes is gaining recognition. For several years now, the importance of information graphics is on the increase, i.e., logos and marking symbols which prolong the lifecycle of final products by making the information on proper care more visible.

The influence of technology and the increasing number of available materials are efficiently changing our habits. Not only the material composition but also the quality of what is printed is important, not forgetting the brand logo and the desire to take proper care of a product to use it for as long and as easy as possible. The latter presented the focus of our research on the visibility of different textile care symbols, of typographic elements and achromatic surfaces printed on a textile material, where an important part of the quality assessment also lies on the printing technology. At the use of textile care symbols, which are nowadays more commonly printed directly onto the textile product instead of onto a sewn-in label, the problem of symbol sizes arises. The size has to ensure their visibility and recognition.

Printing on textiles is a widespread technology which has been changing through years. The printers and materials which enable simple printing on textiles are nowadays available to almost anyone; however, they are practically unsuitable for a more professional work and producing larger quantities [1]. In consequence, the question on the quality and long-term print fastness has to be dealt with. Print fastness is influenced by several factors, e.g., material composition, printing technology, amount of applied ink [2], and most of all the size of printed graphic and typographic elements. This field has either been rarely studied with corresponding recommendations [3] or without available standards to define the minimal or optimal size, respectively, of textile care symbols. The ISO 3758 standard only mentions that symbols have to be large enough to be legible, whereas the exact size is not determined.

A similar situation is in the field of typography, where it is neither strictly defined which typeface family should be used nor in what size; there is only a recommendation [3] on the most suitable typeface family. Moreover, several other typographic characteristics which make a text more legible need to be taken into consideration. Such characteristics are distinctive character features (counter shape), x-height, ascenders, descenders, serifs, contrast (stroke weight), set width, type size, leading (i.e., space between lines) etc. [4]. A precise type size depends on the x-height of a typeface – typefaces with large yet moderate x-heights are generally more legible at smaller sizes [5] – [7]. In case of textile care instructions, the size is usually between 6 and 8 pt. In the visualization of information, typographic tonal density (or typographic tonality) has a significant influence. The typographic tonal density refers to the relative blackness or shades of grey of type on a page. It can be expressed as the relative amount of ink per square centimetre, pica or inch [8]. The changes in various type features can create variations in the typographic tonal density [4], [5], [8]. Typefaces with larger counters trap a larger amount of white space in the enclosed spaces of letters. The cumulative effect decreases the typographic tonal density. A thicker stroke width creates more ink per area [8] – [11].

The visibility of a typeface and recognition of symbols is also influenced by the type and amount of applied ink. These two factors are extremely important in the today's world of ecological awareness [12], and production and material cost-cutting. Our research was conducted in this respect, and its goal was to find the smallest type and symbol size for textile care labels printed with a modern digital printing technology, i.e., piezo inkjet [13] – [14], ensuring suitable visibility even after several washes. The quality of direct printing onto a natural material was evaluated in the research.

EXPERIMENTAL PART

In the research, we wanted to establish how many ink layers printed with a modern digital printing technology for printing onto textiles enable the best quality and long-term fastness. Furthermore, we wanted to find out what typeface family in relation to its size contributes to better legibility and what minimal symbol size enables its recognition.

Textile properties

The prints for the research were made on a natural material, i.e. cotton. The mechanical and colorimetric properties of cotton are shown in table 1. The colorimetric properties (whiteness and hue) were measured with a spectrophotometer DataColor, Spectra Flash 600 Plus-CT (aperture size 6.6 mm).

Test form and printer properties

The prints with one, two and three layers of ink ($L_1 - L_3$) were made with a non-impact printing (NIP) technology and its cartridge: Roland LEC-300; piezo inkjet technology with Roland ECO-UV ink.

For textile care marking, 16 different symbols in accordance with the ISO 3758 standard were printed. The symbols were printed in 11 different sizes – from 2.50 · 2.50 mm to 10 · 10 mm (altogether 166 symbols).

Table 1

FABRIC PROPERTIES	
Fabrics	100% cotton; combed, mercerised
Mass per unit area, g/m^2	144.10
Yarn density, yarns/10 cm	warp density – 253 weft density – 200
Type of weave	plain weave P1/1
Whiteness (CIE)	74.48
Hue, h°	98.21

Different, widely used typefaces were tested, i.e., one sans-serif (Arial), one transitional (Times) and one modern (Blaznic) [15], [16] typeface, each in four different sizes (i.e., 6, 8, 10 and 12 pt). On the test form, also the 100% (K 100) and 40% (K 40) intensity fields of dimensions 10 · 10 mm were printed.

The test form was designed with the program Adobe InDesign CS5 and was used as a PDF file, which ensured a unified appearance of the form on various computers and operation systems, and in consequence, on the print.

Print fastness

The prints were exposed to different temperature and mechanical conditions defined in accordance with the standard on textile washing and drying procedures, i.e., ISO 6330 standard. With a washing machine Gorenje WA 1341S (at temperature 40°C), five repeated washes were performed with a 2458 ECE phosphate reference detergent (B), whereas for drying, a Benz laboratory drier (at temperature 60°C) was used. Print fastness was measured after the first, second, third, fourth and fifth cycle of washing and tumble drying.

A visual evaluation of 166 textile care symbols was conducted, the results defining the minimal size of each symbol which still ensures its recognition before and after a different number of washes.

The differences in the typographic tonal density of the unwashed and washed samples of typefaces were measured with the image analysis (the program Image J). This software gives the opportunity to measure, analyse and provide output values, e.g., area, number of particles and percentage of coverage [17], [18].

The CIE L*a*b* parameters of prints were measured with a spectrophotometer DataColor, Spectra Flash 600 Plus-CT (aperture size 6.6 mm) in accordance with the ISO 105-J01 standard using the D65 standard illumination, 10° standard observer, black backing and instrument geometry 45/0. The colour difference (ΔE) between the unwashed and washed samples was calculated according to the CIEΔE2000 L*a*b* equation for colour differences [19], [20]:

$$\Delta E_{00} = \sqrt{\left(\frac{\Delta L'}{k_L S_L}\right)^2 + \left(\frac{\Delta C'}{k_C S_C}\right)^2 + \left(\frac{\Delta H'}{k_H S_H}\right)^2 + R_T \left(\frac{\Delta C'}{k_C S_C}\right)\left(\frac{\Delta H'}{k_H S_H}\right)} \quad (1)$$

where:
$\Delta L'$ is difference in lightness;
$\Delta C'$ – difference in chroma;
$\Delta H'$ – difference in hue;
R_T – correction of ellipsoid orientation in the blue region;
k_L, k_C, k_H – parameter factors which are under referential conditions set to 1;
S_L, S_C, S_H – factors representing correction of visual disunity of the colour space CIEL*a*b* and defining the ellipsoid half-axes.

RESULTS AND DISCUSSIONS

Visibility of textile care symbols

Figure 1 shows the visual evaluation results on the visibility of textile care symbols. More complex symbols, e.g., those including wash temperature, hand wash, tumble drying, chlorine bleaching, ironing temperature, were not identifiable in their smallest size (2.50 · 2.50 mm) after the fifth wash. As a matter of fact, they were already unidentifiable as soon as being printed. These symbols were recognized in the sizes from 4.50 · 4.50 mm to 6.00 · 6.00 mm. The best results were given by three printed layers of ink (L_3), which was expected, as this was the largest amount of ink applied onto the substrate. Simpler symbols printed with three layers of ink (L_3) can remain in smaller sizes (3.25 · 3.25 mm), while simpler symbols printed with one or two layers should be larger (4.50 · 4.50 mm (L_1) or 3.25 · 3.25 mm (L_2), respectively). More complex symbols have to be larger in size, i.e., 4.50 · 4.50 mm printed with L_3, 5.25 · 5.25 mm printed with L_2 or even 6.00 · 6.00 mm printed with L_1. It is recommended for all the tested layers of ink that the symbol size not be less than 6.00 · 6.00 mm to ensure suitable visibility and recognition of even more complex symbols.

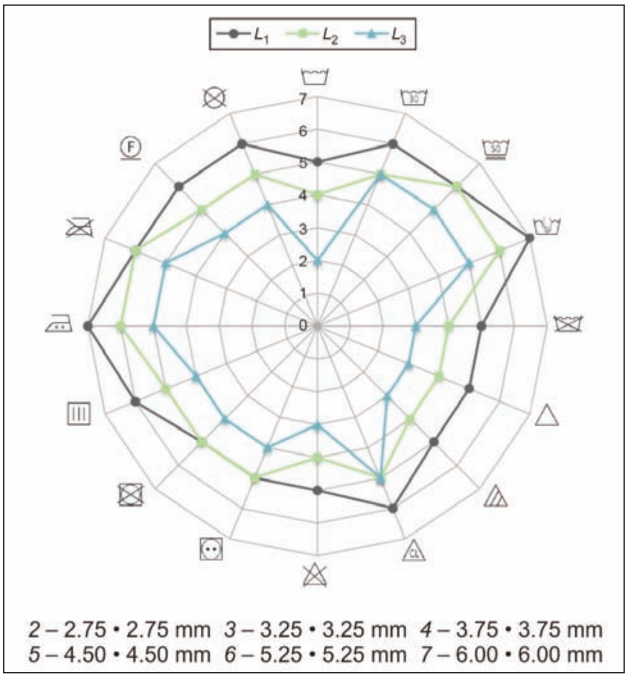


Fig. 1. Minimal textile care symbol size with satisfactory visibility, printed with one, two and three layers of ink after fifth wash

Typographic properties of prints

The typographic tonal density (*TTD*) of typefaces, each in different size, was measured before and after each of five washes. The *TTD* of tested typefaces according to the used type sizes, printed with different layers of ink is presented in tables 2, 3 and 4. The differences in the *TTD* of printed typefaces after five washes are demonstrated in figure 2. The differences in the *TTD* of printed typefaces in different sizes after each of five washes are presented in figure 3. In figure 4, all tested typefaces in size 6 pt printed with different layers of ink after the fifth wash can be seen. Figure 5 includes the differences in *TTD* after each of the five washes.

The results show an expectedly higher *TTD* at the sans-serif typeface (tables 2, 3, 4), due to the differences in the letter stroke width being smaller. The lowest *TTD* was observed at the transitional typeface Times. Times has its thick stroke thinner than the typeface Blaznic. The highest values of TTD were given by three printed layers of ink (L_3), which is a consequence of a greater amount of applied ink. It is also evident that the smallest values in *TTD* were given by a single printed layer of ink (L_1).

Table 2

TTD OF TESTED TYPEFACES PRINTED WITH L_1 IN DIFFERENT SIZES

Typeface	*TTD*, %			
	6 pt	8 pt	10 pt	12 pt
Times	21.83	22.19	19.33	16.11
Arial	28.34	27.47	23.66	18.82
Blaznic	26.02	26.88	21.25	18.66

Table 3

TTD OF TESTED TYPEFACES PRINTED WITH L_2 IN DIFFERENT SIZES

Typeface	*TTD*, %			
	6 pt	8 pt	10 pt	12 pt
Times	31.83	29.53	23.37	19.65
Arial	37.42	33.79	28.84	22.62
Blaznic	35.37	33.96	25.61	22.05

Table 4

TTD OF TESTED TYPEFACES PRINTED WITH L_3 IN DIFFERENT SIZES

Typeface	*TTD*, %			
	6 pt	8 pt	10 pt	12 pt
Times	37.38	33.50	26.04	21.96
Arial	41.38	37.88	31.11	23.79
Blaznic	39.76	38.01	29.16	24.48

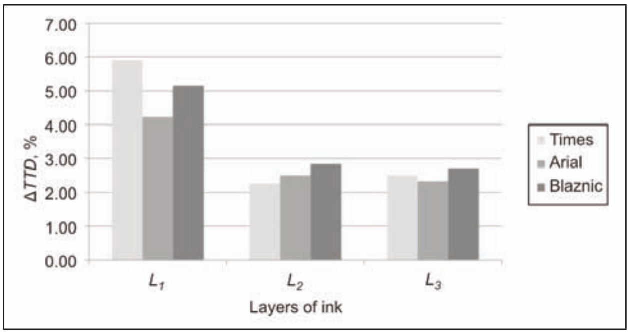


Fig. 2. Average difference in TTD of tested typefaces printed with different layers of ink ($L_1 - L_3$)

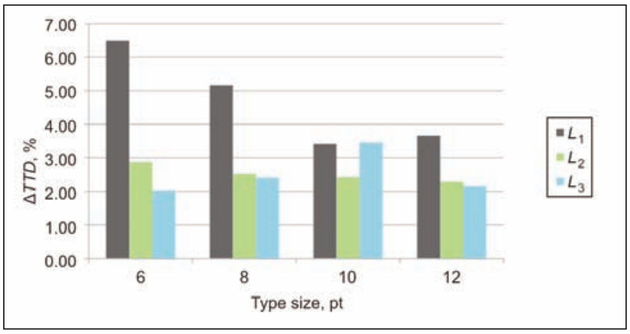


Fig. 3. Average difference in TTD of tested typefaces in different type sizes printed with different layers of ink ($L_1 - L_3$)

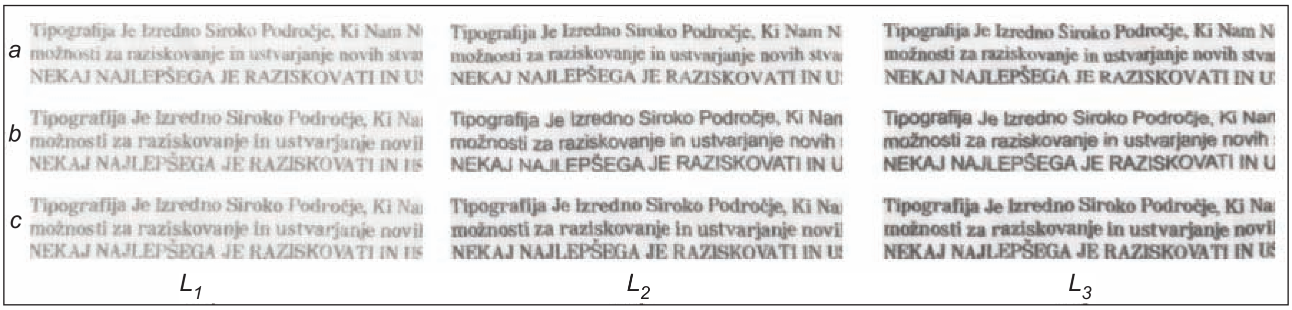


Fig. 4. Samples of tested typefaces Times (*a*), Arial (*b*), Blaznic (*c*) printed in size 6 pt with all three printed layers of ink ($L_1 - L_3$) after fifth wash

After a different number of washes, the smallest difference in *TTD* was observed on the prints printed with three layers of ink (L_3), while the largest difference was seen on the prints with one layer of ink (L_1). This was expected due to the textile material being directly printed on [3] and the smallest amount of ink. The most noticeable average difference in *TTD* occurred at the Times (transitional) typeface (fig. 2).

The obtained results show the biggest differences at the typefaces used in sizes 6 and 8 pt (fig. 3). *TTD* at smaller sizes of the typeface is usually higher due to a smaller counter size of letters and leading. Furthermore, the differences were more evident after the washing, especially on the prints printed with just one layer of ink (L_1). From figure 4, it is seen that the typefaces with differences in stroke width (i.e., Times and Blaznic) were more influenced by a smaller amount of ink. It is also clear that at very small type sizes, uppercase letters are more legible than lowercase letters.

While comparing the influence of a different number of washes (fig. 5), it can be seen that the differences in *TTD* on the prints printed with a various number of ink layers ($L_1 - L_3$) were smaller after the second wash. After the third wash, the prints printed with three layers of ink (L_3) stabilised.

Colorimetric properties of prints

The analysed achromatic K 100 and K 40 intensity fields were made with the prints of pure black ink with three different numbers of ink layers at direct printing.

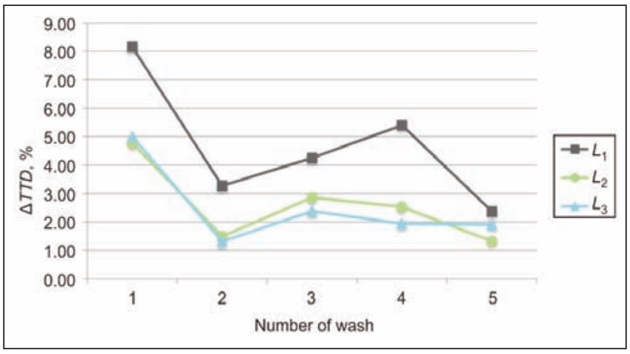
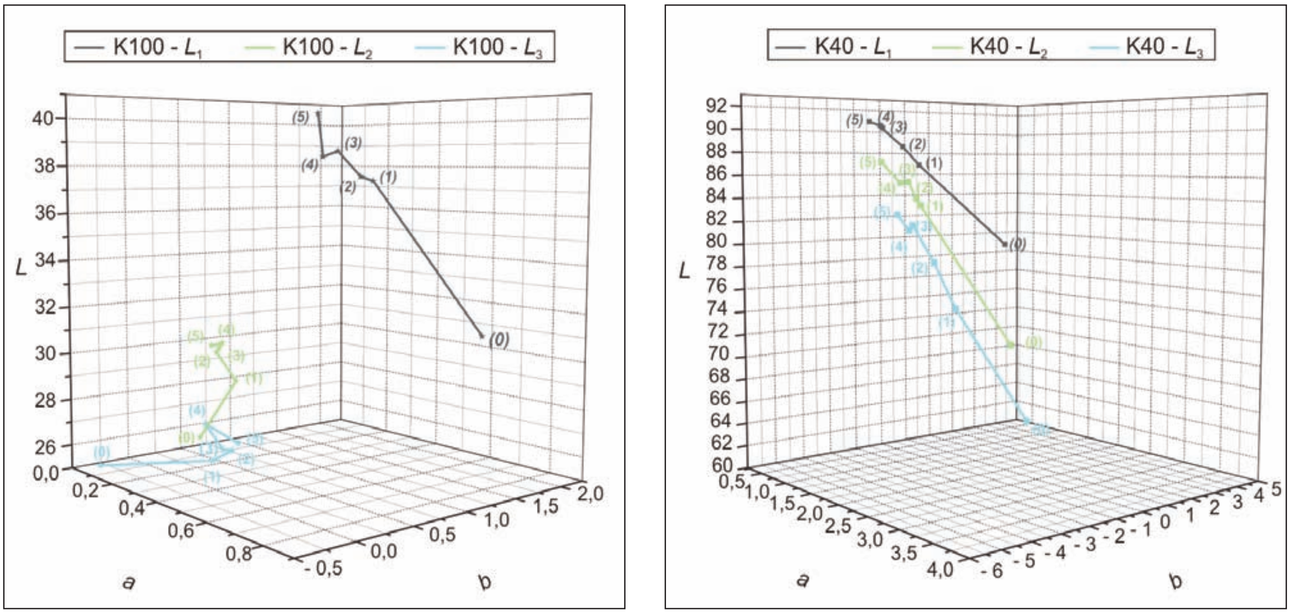


Fig. 5. Average differences in *TTD* after each of five washes printed with all three different layers of ink ($L_1 - L_3$)

Figure 6 shows the CIE L*a*b* values of spectrophotometric measurements of the prints before and after the washes. In tables 5 and 6, the differences in colour (ΔE_{00}), lightness (ΔL_{00}), chromaticity (ΔC_{00}) and hue (ΔH_{00}) are given for the prints (K 100, K 40) after a different number of washes.

By applying different layers of UV drying ink ($L_1 - L_3$), the colour degradation of black (K 100) dyed cotton prints considerably decreased (fig. 6, table 5). After the first washing process, the samples showed the largest colour changes. In further washing processes, the degradation process slowed down, yet it still remained visible. The standard black prints (L_1) underwent a great colour change during the experimental washing (ΔE > 5.00), which rapidly decreased with the increased application of black ink. With three



a *b*

Fig. 6. CIE L*a*b* values of prints with different layers of ink (L_1– L_3), before washing (0) and after different number of washes (1–5): *a* – K 100; *b* – K 40

Table 5

COLORIMETRIC DIFFERENCES IN K 100 PRINTS OF DIFFERENT INK LAYERS L_3 - L_3, AFTER EACH OF FIVE WASHES					
	Colorimetric differences in K 100 prints	ΔE_{00}	ΔL_{00}	ΔC_{00}	ΔH_{00}
L_1 (K 100)	K 0 wash – K 1 wash	5.52	–5.42	0.82	0.6
	K 0 wash – K 2 wash	5.71	–5.57	0.89	0.88
	K 0 wash – K 3 wash	6.59	–6.38	0.93	1.32
	K 0 wash – K 4 wash	6.43	–6.20	0.97	1.38
	K 0 wash – K 5 wash	7.73	–7.44	0.78	1.92
L_2 (K 100)	K 0 wash – K 1 wash	2.40	–2.37	–0.21	0.31
	K 0 wash – K 2 wash	3.34	–3.31	–0.16	0.39
	K 0 wash – K 3 wash	3.60	–3.56	–0.24	0.48
	K 0 wash – K 4 wash	3.80	–3.78	–0.28	0.52
	K 0 wash – K 5 wash	4.12	–7.44	–0.53	0.76
L_3 (K 100)	K 0 wash – K 1 wash	0.73	–0.27	–0.12	–0.67
	K 0 wash – K 2 wash	1.09	–0.79	–0.23	–0.71
	K 0 wash – K 3 wash	1.10	–0.87	–0.19	–0.65
	K 0 wash – K 4 wash	1.96	–1.88	–0.20	–0.53
	K 0 wash – K 5 wash	1.60	–1.42	–0.34	–0.65

Table 6

COLORIMETRIC DIFFERENCES IN K 40 PRINTS OF DIFFERENT INK LAYERS L_3 - L_3, AFTER EACH OF FIVE WASHES					
	Colorimetric differences in K 100 prints	ΔE_{00}	ΔL_{00}	ΔC_{00}	ΔH_{00}
L_1 (K 40)	K 0 wash – K 1 wash	4.40	–5.45	1.99	4.59
	K 0 wash – K 2 wash	8.84	–6.48	1.15	5.90
	K 0 wash – K 3 wash	10.43	–7.42	–0.07	7.33
	K 0 wash – K 4 wash	10.66	–7.51	–0.31	7.56
	K 0 wash – K 5 wash	11.26	–7.66	–0.96	8.19
L_2 (K 40)	K 0 wash – K 1 wash	11.59	–10.54	1.48	4.60
	K 0 wash – K 2 wash	12.15	–10.98	1.15	5.08
	K 0 wash – K 3 wash	13.46	–11.99	0.29	6.12
	K 0 wash – K 4 wash	13.75	–11.95	–0.35	6.78
	K 0 wash – K 5 wash	15.11	–13.05	–1.10	7.54
L_3 (K 40)	K 0 wash – K 1 wash	10.73	–10.05	2.04	3.14
	K 0 wash – K 2 wash	14.16	–13.30	1.56	4.61
	K 0 wash – K 3 wash	16.91	–15.75	0.50	6.15
	K 0 wash – K 4 wash	16.83	–15.49	0.10	6.58
	K 0 wash – K 5 wash	17.95	–16.44	–0.48	7.20

layers of ink (L_3), a minimal aberration, scarcely visible to the naked eye (ΔE < 2.00), was achieved. The change of lightness resulted primarily in the mentioned colour changes. The prints with a standard ink layer (L_1) became lighter and lighter (values on the coordinate L^* increased). The only exception was the prints with three layers of ink (L_3), at which the process stabilised after the fourth washing (lightness did not increase any more). Minor changes were visible on the coordinates a^* and b^*. On the prints with one and two layers of ink (L_1, L_2), the changes were visible in the chromaticity decrease and on the coordinates a^* and b^*, where the tones neared the ideal achromatic axis. The application of three layers of ink (L_3) led at the beginning to the print which was the nearest to the achromatic axis; however, the greatest chromatic change appeared (the change on the coordinates a^* and b^*) after the first experimental washing. During the further washing processes, the black tones again neared the ideal achromatic axis.

In the reproduction, the most complicated area was that of 40% screen value, where the printing elements were the most sensitive to the increased application of ink. In the relation to prints with K 100, the K 40 prints had much more intensive colour changes after the first washing (fig. 6, table 6). In this connection, the prints printed with a thicker ink layer had much more expressed colour changes which increased with further experimental washing processes.

The colour analysis of prints showed that the changes were more intensive in lightness. The difference in lightness was smaller than on the prints with one ink layer (L_1) in the relation to those with two or three ink layers (L_2, L_3). The relation of lightness and ink thickness was proportional. The changes of chromaticity parameters (ΔC) behaved completely different. The textile samples printed with only one ink layer (L_1) had a greater difference than the samples printed with more ink layers (L_2, L_3). The changes on the coordinate b^* were much more substantial than the ones on the coordinate a^*. In other words, the appeared colour changes were in the direction of violet blue.

CONCLUSIONS

Print fastness is influenced by the application of ink. The application of a larger amount of ink is more suitable for direct printing onto a fabric, resulting in better print fastness. The prints made with direct printing (inkjet) and one layer of ink cannot boast of the best fastness. The best fastness was measured at the prints made with three or at least two layers of ink, respectively. Furthermore, the used printing technology does not enable precise printing of smaller graphic elements, e.g., thin strokes and serifs at smaller letter sizes, and complex textile care symbols. The smallest size of simple symbols for textile care should be 4.50 · 4.50 mm, whereas more complex symbols have to be larger in size. To ensure suitable visibility and recognition of symbols even after several washes, it is recommended that the symbols not be smaller than 6.00 · 6.00 mm. The biggest difference in the fastness of prints after a different number of washes was measured at smaller type sizes (6 and 8 pt). The most substantial difference in the typographic tonal density was measured at the transitional typeface, which has the thinnest thick stroke among the tested typefaces. Therefore, the use of sans-serif typefaces and uppercase letters instead of lowercase letters is recommended for smaller type sizes.

To achieve suitable visibility of textile care symbols printed with the inkjet printing technology, special attention has to be paid to the symbol size in connection with the applied amount of ink.

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BIBLIOGRAPHY

[1] Kiatkamjornwong, S., Putthimai, P., Noguchi, H. *Comparison of textile print quality between inkjet and screen printings*. In: Surface Coatings International, Part B: Coatings Transactions, 2005, vol. 88, no. 1, pp. 25–34

[2] Majnarić, I., Bolanča, Z., Bolanča Mirković, I. *The influence of the accelerated ageing on the black screen element of the electroink prints*. In: Journal of Physics, 2010, Conference Series 231, no. 012018, pp. 1–10

[3] Rat, B., Majnarić, I., Možina, K. *Visibility of care labelling code symbols*. In: Tekstil, 2011, vol. 60, no. 6, pp. 251–257

[4] Reynolds, L. *Legibility of type, baseline*. In: International Typographic Journal, 1988, vol. 10, pp. 26–29

[5] Možina, K. *Barva in tipografija*. In: Interdisciplinarnost barve - Part 1, Društvo koloristov Slovenije, Maribor, 2001, pp. 341–364

[6] Gaultney, V. *Balancing typeface legibility and economy*: *practical techniques for the type designer*, research essay. University of Reading, Reading, 2001, pp. 1–9

[7] Tracy, W. *Letters of credit: A view of type design*. David R. Godine, Boston, 2003, pp. 30–32

[8] Keyes, E. *Typography, color, and information structure*. In: Technical Communication, 1993, vol. 4, pp. 638–654

[9] Možina, K., Černič, M., Demšar, A. *Non-destructive methods for chemical, optical, colorimetric and typographic characterisation of a reprint*. In: Journal of Cultural Heritage, 2007, vol. 8, no. 4, pp. 339–349

[10] Možina, K., Medved, T., Rat, B., Bračko, S. *Influence of light on typographic and colorimetric properties of ink jet prints*. In: Journal of Imaging Science and Technology, 2010, vol. 54, no. 6, pp. 060403-1–060403-8

[11] Rat, B., Možina, K., Podlesek, A., Bračko, S. *Influence of temperature and humidity on typographic and colorimetric properties of ink jet prints*. In: Journal of Imaging Science and Technology, 2011, vol. 55, no. 5, pp. 050607-1–050607-8

[12] El-Molla, M. M., Schneider, R. *Development of ecofriendly binders for pigment printing of all types of textile fabrics*. In: Dyes and Pigments, 2006, vol. 71, no. 2, pp. 130–137

[13] Eser, B., Özgüney, A. T., Özerdem, A. *Studiu privind utilizarea diferitelor tipuri de agenţi de îngroşare la imprimarea cu jet de cerneală, folosind coloranţi reactivi.* In: Industria Textilă, 2012, vol. 63, issue 2, pp. 85-90

[14] Kipphan, H. *Handbook of print media*. Springer-Verlag, Berlin, 2001, pp. 60–67

[15] Možina, K. *Knjižna tipografija*. University of Ljubljana, Ljubljana, 2003, pp. 160–179, 184–191

[16] Bringhurst, R. *The elements of typographic style*. Hartley & Marks, Point Roberts, 2002, pp. 127–132

[17] Igathinathane, C. *Shape identification and particle size distribution from basic shape parameters using ImageJ*. In: Computers and Electronics Agriculture, 2008, vol. 63, no. 2, pp. 168–182

[18] Tse, M. K. A *predictive model for text quality analysis*: *Case study*. Proceeding IS & T's NIP23: International Conference on Digital Printing Technologies, Anchorage, Alaska, USA, 16–21 September 2007, pp. 419–423

[19] Luo, M. R., Cui, G., Rigg, B. *The development of the CIE 2000 Colour – Difference formula: CIEDE2000*. In: Color research and application, 2011, vol. 26, no. 5, pp. 340–349

[20] *Colorimetry*, 3rd edition. Commission Internationale de l'Eclairage, CIE Publication, 2004, vol. 15, pp. 20–22

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DOCUMENTARE

Confecții textile

AȚĂ DE CUSUT CU CARACTERISTICI ANTIINSECTE ŞI ANTIMICROBIENE

Prima aţă de cusut şi primele fermoare cu proprietăți antiinsecte au fost lansate de către producătorul de aţă industrială şi materiale textile de larg consum ***Coats Plc***., din Uxbridge/UK.

Compania a dezvoltat *Coats Insectiban*, un tratament chimic antiploşniţe, care se aplică pe aţa de cusut şi pe fermoarele, destinate confecționării saltelelor pentru pat. Acest tratament este bazat pe extracte şi uleiuri vegetale.

Deoarece ploşniţele se cuibăresc în cusăturile şi chingile saltelelor ori în diferite spații ale mobilierului, unde își depun ouăle, aţa de cusut şi fermoarele tratate chimic vor ajuta la controlul infestărilor, chiar dacă ţesătura şi alte elemente ale lenjeriei de pat nu au fost supuse acestui tratament.

Coats Plc. a lansat, de asemenea, o nouă gamă de aţe de cusut cu proprietăți antimicrobiene, care inhibă dezvoltarea microbilor şi a bacteriilor, în jurul cusăturilor. Aţele de cusut cu proprietăţi antibacteriene şi antifungice vor fi comercializate sub denumirea *Coats Protect*.

Tratamentul inovator aplicat aței de cusut oferă o protecţie maximă împotriva microbilor şi creează o "zonă de inhibiţie", care ajută la prevenirea dezvoltării bacteriilor şi agenţilor patogeni, ce generează pete şi un miros neplăcut în jurul cusăturii.

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