

Article

Investigation of Color Reproduction on Linen Fabrics when Printing with Mimaki TX400-1800D Inkjet with Pigment TP250 Dyes

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Abstract: The aim of this research is to investigate related effect of dyeability to linen textiles related to different printing parameters. The study investigated the change in color characteristics when printing on linen fabrics with an inkjet MIMAKI Tx400-1800D printer with pigmented TP 250 inks. The dependence of color reproduction on linen fabrics on the number of print head passes, number of ink layers to be coated, linen fabric density, and different types of linen fabric was investigated. All this affects the quality of print and its mechanical properties. The change in color characteristics on different types of linen fabrics was determined experimentally. We determine at which print settings the most accurate color reproduction can be achieved on different linen fabrics. The difference between the highest and the lowest possible number of head passages was investigated. The possibilities of reproducing different linen fabric colors were determined.

Keywords: digital inkjet printing; linen fabrics; pigmented inks; color measurement

Citation: Tofan, T.; Stonkus, R.; Jasevičius, R. Investigation of Color Reproduction On Linen Fabrics When Printing with Mimaki TX400-1800D Inkjet with Pigment TP250 Dyes. *Coatings* **2021**, *11*, 354. <https://doi.org/10.3390/coatings11030354>

Academic Editor: Csaba Balázsi

Received: 27 February 2021

Accepted: 18 March 2021

Published: 19 March 2021

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1. Introduction

These days, the demand for organic fabrics is growing rapidly. One of these fabrics is flax, which has been used since ancient times [1]. This natural fiber is back in fashion—with linen clothes, the body breathes and does not overheat, the skin is not irritated and the fabric does not become electric. Linen fabrics are extremely durable [2]. It is also necessary that the technology and inks used for printing also meet the ecological requirements [3].

Over time, many investigations have been performed on textile dyeability, yet there is still much room for process improvement. Many researchers discuss the various types of textile dyeing processes and the fabric changes after dyeing processes [4–7]. Additionally, the newest research of inkjet printing on linen textile were reviewed [3,8–10].

Many studies are related to the investigation of the mechanical properties of textiles [11–13]). There are many investigations on textile mechanical properties affected by the water absorption cycles [14,15]. Temperature also has an effect on mechanical properties on textile fibers [16,17].

One of the possible options is to use a Mimaki printer that is capable of printing with ecological textile inks, which are not harmful to health, do not cause allergies, and are easy to clean and dispose of. The main components of the dyes are pigment, binder and water. As the dyes adhere to the fabric only at high temperatures, they are suitable to print on

natural fabrics, such as linen and cotton, which do not contain synthetic materials. One of the main advantages of this printer when printing with textile inks is that it guarantees an environmentally friendly production method [18]. The print is captured immediately after printing without the use of any additional chemistry. No toxic fumes or pollutants are emitted into the environment, so this method of printing on linen is environmentally eco-friendly. In addition, no additional water is used during printing and ink fixing.

Linen comes in different colors: natural, bleached or melange. Melange linen has two different types of threads used to warp and weft directions. In this experiment, the melange linen has bleached thread in a weft direction and natural linen thread in a warp direction. Various units are used to refer to the measurement of a fiber; in this research, for measuring the linear mass density of fibers, tex (g/km) will be used.

Due to the different fabric shades and characteristics, it is more difficult to obtain the corresponding image color on linen fabrics than, for example, on paper [19]. The customer's desire to achieve maximum color matching to the digital standard is limited [20].

When printing, it is very important to choose the most suitable number of ink layers and the number of passes of the print head, as this will significantly differ the print quality and print speed. So, it is very important to know the quantitative and qualitative printing parameters. All this directly affects the company's economic performance. In the case of large orders, the change in the print speed will significantly affect the order execution speed, the number of ink layers, the ink consumption and the mechanical properties of the print.

The aim of this study was to investigate the change in color characteristics by different printing settings when printing on linen fabrics with an inkjet MIMAKI Tx400-1800D printer with pigmented TP 250 inks.

2. Methodology of Investigation

Ten linen fabrics from three different types were selected for the study: bleached, melange and natural linen [21]. The linen fabric was made of different threads in warp and weft directions. Warp threads are the yarns held in the loom during the weaving of the fabric and weft threads are the yarn that is passed through the weft yarns during the weaving of the fabric. The fabrics of each type differ in color, fabric density grammage, thickness and density of the threads (Table 1).

To determine the change in color characteristics of the prints on the linen fabrics, depending on the fabric structure and color, in different printing modes, the generated Barbieri Rasterlink color reproduction scales were printed on all fabrics (Figure 1).

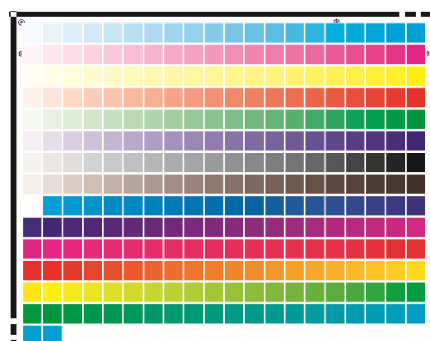


Figure 1. Printed Color scale for testing [22].

The Mimaki TX400-1800D printing machine (Mimaki, Tomi-city, Nagano, Japan) has Ricoh GEN4 12 printheads. It can print 7–35 pL, depending on the ink characteristics; suitable ink viscosity should be 10–12 mPa·s. The printhead printing width is 32.4 mm. The number of nozzles is 384 (2 × 192 channels) and the nozzle spacing (within a row) is 0.1693 mm/row. This printhead is suitable to print with different inks, such as UV, solvent, Aqueous, pigment and other.

Textile pigment TP 250 dyes (cyan, magenta, yellow, black, light cyan, light magenta, orange, blue) were used for the experiments. Mimaki textile pigment dyes contain a binder and a binding agent. The colors fix to the fibers by heating the textile to 180 °C. Printed fabrics do not lose their breathability and water absorbability.

Investigated: cyan-C, magenta-M, yellow-Y, red-R, green-G, blue-B, black-K, CMY color reproduction only at 100% color tone coverage. The Mimaki TX400 8c Tp250 Liverpool v1 profile provided by the printer manufacturer was used for the research.

After the printing dyes were cured with 180 °C temperature in a roll-to-roll heating machine, measurements of color characteristics were performed with a BARBIERI SpectroPad spectrophotometer [22]. All textile color measurements were made according to BS EN ISO 105-J01:2000 standards 24 h after the textile finally cools down after printing [23].

Table 1. Linen fabrics selected for investigation.

No.	Types of Linen Fabric	Sample Article	Grams Per Square Metre (g/m ²)	Thickness of Thread (tex)		Threads q-ty per 10 cm	
				Warp	Weft	Warp	Weft
1	Bleached	OBR 840	140	38	38	199	150
2	Bleached	OBR 0114	170	42	42	193	194
3	Bleached	OBR 491	190	56	56	176	142
4	Bleached	OBR 1542	245	87	87	156	118
5	Melange	OBR 052	150	38	38	199	182
6	Melange	OBR 831	190	56	56	176	142
7	Melange	OBR 482	280	110	110	142	102
8	Natural	OBR 166	125	30	30	226	174
9	Natural	OBR 051	150	38	38	199	184
10	Natural	OBR 1041	240	83	83	160	112

To change the characteristics of colors CIE $L^*a^*b^*$ values, and to determine the difference in color reproduction, ΔE as the digital values of CMYKRGB color $L^*a^*b^*$ were taken as reference in Table 2.

Table 2. Digital reference values of CMYKRGB colors $L^*a^*b^*$.

Color	L^*	a^*	b^*
C	62	−44	−50
M	52	81	−7
Y	95	−6	95
R	52	74	54
G	57	−74	30
B	25	25	−55
K	12	2	0
CMY	23	1	−2

The color difference is calculated according to the following equation:

$$\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \quad (1)$$

where L^* is lightness value (0 for black and 100 for white); a^* —position between red and green value (negative—green, positive—red); b^* —position between blue and yellow value (negative—blue, positive—yellow) [24], Figure 2.

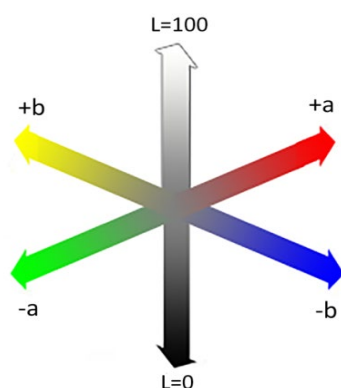


Figure 2. CIE $L^*a^*b^*$ color system.

Difference in ΔL^* , Δa^* and Δb^* was calculated using the following equation:

$$\Delta L^* = \sqrt{(L_1^* - L_2^*)^2} \quad (2)$$

$$\Delta a^* = \sqrt{(a_1^* - a_2^*)^2} \quad (3)$$

$$\Delta b^* = \sqrt{(b_1^* - b_2^*)^2} \quad (4)$$

where, depending on the comparison, L_1^* , a_1^* , b_1^* represents primary fabric value and L_2^* , a_2^* , b_2^* represents the second coat of dyes or dyed fabric value.

Mean value was calculated by using the following equation [25]:

$$\bar{x} = \frac{\sum x}{n} \quad (5)$$

Standard deviations were determined using the following equation [25]:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} ; \quad (6)$$

Standard error of the mean was calculated using the following equation [25]:

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}} \quad (7)$$

The description of the differences of the ΔE value is presented in Table 3.

Table 3. ΔE values and their corresponding color differences [26].

ΔE	Meaning
0–1	Normally invisible difference
1–2	Very small difference, only obvious to trained eye
2–3.5	Medium difference, also obvious to untrained eye
3.5–5	Obvious difference
>5	Very obvious difference

3. Results of Research on Color Properties

The shades of linen fabrics are very different (Figure 3). This has a fairly significant effect on the reproduction of the print colors by coating the fabric with different colors of paint. Linen textile woven fabric structure is illustrated in Figure 4. Therefore, it is worth comparing how the shade of linen differs from the reference white ($L^* = 100$, $a^* = 0$, $b^* = 0$) color (Figure 5).

Comparing the color characteristics of linen fabrics with the reference white color, certain regularities were found (Figure 5). The lowest ΔE values are obtained by comparing bleached linen fabrics and the highest are obtained by comparing natural linen fabrics.

The shade of linen fabric surfaces has a significant effect on the reproduction of print colors.

Bleached linen OBR 840 was selected to determine the change in color characteristics depending on the number of paint layers and the number of passages. 1 to 5 layers of paint coating were printed on this fabric in different 4 and 16 pass modes. From the three possible pass modes (4, 8, and 16), the minimum and maximum numbers of passes were deliberately chosen for better difference detection. The results of color reproduction are presented in Figures 6 and 7.

There is a significant difference between layers 1 and 5 (from 3% to 55%), while there is a relatively small difference between layers 3 and 4 ($\leq 5\%$), and between layers 4 and 5 ($\leq 4\%$).

Comparing the 4 and 16 pass print modes, the same patterns of ΔE color characteristic changes remain. Comparing the difference in color reproduction from the number of passages, it was observed that the color difference is insignificant ($\Delta E \leq 3$), except for the green color.

When printing in the selected four-pass printing mode, it was analyzed and found to have the greatest influence on the change in color characteristics of ΔE . The change in $L^*a^*b^*$ values at different paint layers is shown in Figures 8–10.



Figure 3. Linen fabrics selected for investigation.

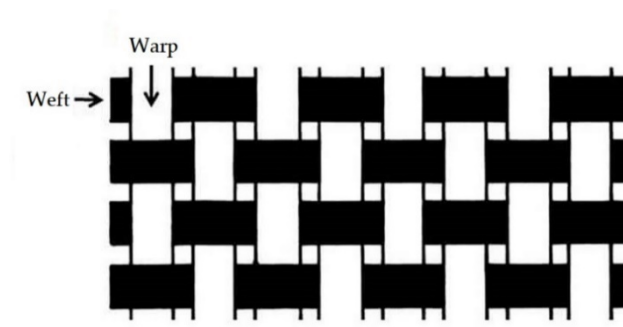


Figure 4. Woven fabric structure characteristics.

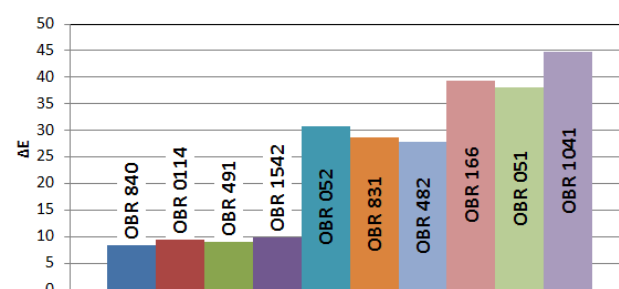


Figure 5. Color difference ΔE of linen fabric surface without print with the reference white color.

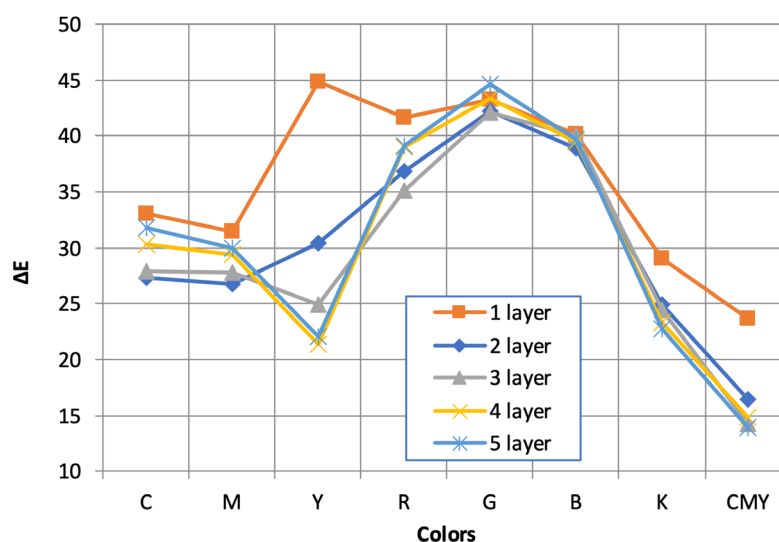


Figure 6. Different colors changes of ΔE value depending on dye layers when printing in 4 passes.

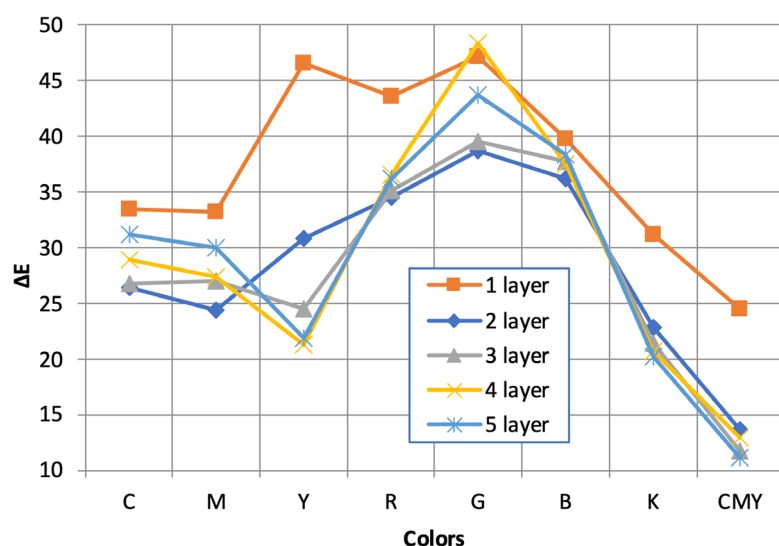


Figure 7. Different colors changes of ΔE value depending on dye layers when printing in 16 passes.

It was observed that the value of lightness (L^*) changes the most in the overall color (Figure 8). It was found that, by changing the number of layers of ink to be coated, the cyan color lightness changes the most, changing from 48.99 for one-layer printing to 68.29 for five-layer printing; the brightness of green color lightness also differs quite strongly; the color darkens by as much as 26.5% when printed with five layers compared to one layer. Yellow is the least sensitive to the change in the number of paint layers (change is 6%). The most sensitive to the change in the number of paint layers are cyan (28% change) and green (26% change). Comparing the change in brightness of all the colors lightness analyzed in the diagram, it is clear that it changes the most when printing with two and three layers of ink, while when printing with an additional four and five layers, the change in lightness is insignificant (average change, 2%–4%, respectively). It can also be seen that the differences in blue, black and CMY colors between layers 2, 3, 4 and 5 are very slight, and the difference between magenta, red and green is very small between layers 3, 4, 5.

It was observed that the values of a^* have practically no effect on determining the color difference of ΔE (Figure 9). The difference between the first and fifth coats of paint is ≤ 3 , less than 5%.

When analyzing the b^* values (Figure 10), it was observed that the yellow color value changes the most: the difference between the first layer was 50.60, and for the five layers it was 76.84, 34%. This may have been influenced by the color of the fabric, as the coating of one coat of paint is not sufficient to represent the color. Other values are almost the same; the difference between one and five coats of paint does not exceed 3.

Therefore, it can be concluded that most of the ΔE color difference is due to lightness (L^*). It also shows that the difference between paint layers 3, 4 and 5 is not very significant and practically invisible. This again shows that printing with more than three coats of toner is not relevant.

The change in color characteristics of prints on linen fabrics with four passes and coating with two coats of dye was further analyzed. This is the most commonly used print setting, at which the printer reproduces colors well and prints fast enough.

All three different types (bleached, melange, natural) of linen fabrics compared to two coats of paint are compared. The results of the study are presented in Figures 11–13.

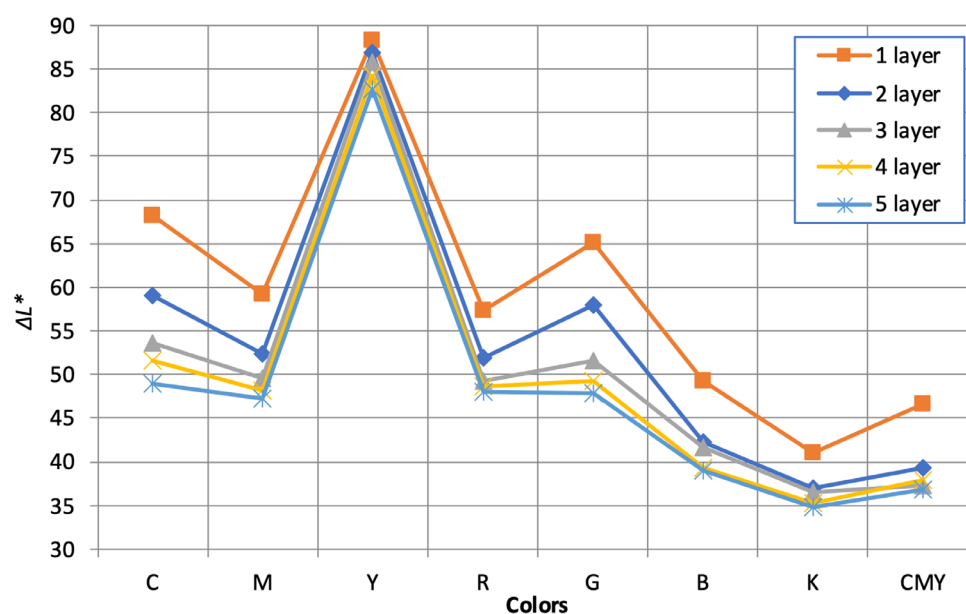


Figure 8. Different colors changes of ΔL^* value depending on ink layer when printing in 4 passes.

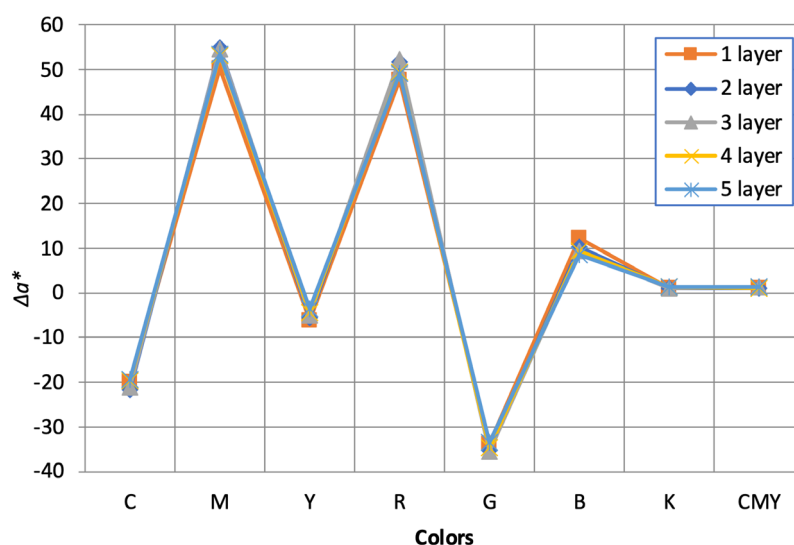


Figure 9. Different colors changes of Δa^* value depending on ink layer when printing in 4 passes.

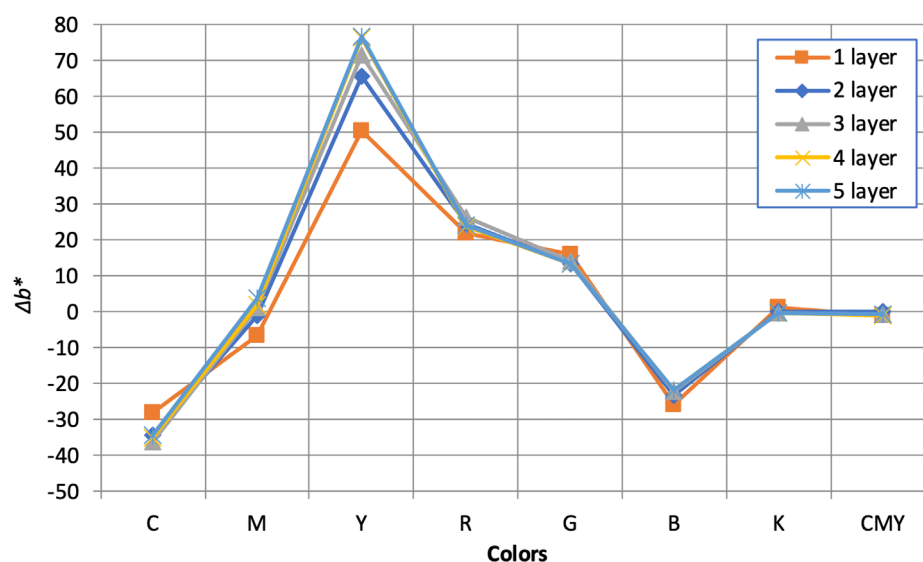


Figure 10. Different colors changes of Δb^* depending on ink layer when printing in 4 passes.

In the study of the application of the two dye layers on bleached fabrics (Figure 11), it was observed that the thickest OBR 1542 fabric has the smallest change in ΔE color characteristics. It was also observed that the thinnest linen OBR 840 reproduces red, green, blue, black and brown. Additionally, when printing with two coatings, the color reproduction is very good on OBR 0114, and the change in color characteristics is very similar to OBR 1542. The color characteristics ΔE values were found to be very similar for all bleached fabrics; the difference between them is not large (≤ 4).

When studying the reproduction of color characteristics on melange fabrics (Figure 12) in the presence of two layers of paint, it was observed that the colors are best reproduced on the thickest linen fabric OBR 482. Slightly worse colors are reproduced on the thinnest OBR 052 fabric. The color difference between different tissues is not large (≤ 4). The color yellow is reproduced practically equally on all fabrics.

In the study of color reproduction on natural fabrics in the presence of two coats of paint (Figure 13), much larger changes in color characteristics were observed between different fabrics. The largest difference was observed in yellow. It was also observed that the colors are much better reproduced on the OBR 051 fabric, slightly worse on the OBR 166

fabric, and the largest difference was obtained on the thickest linen fabric of the OBR 1041, except for the dark colors.

Figure 14 shows the ranges of reproducible print colors on different linen fabrics in the a^* and b^* plane without evaluating the color lightness L^* .

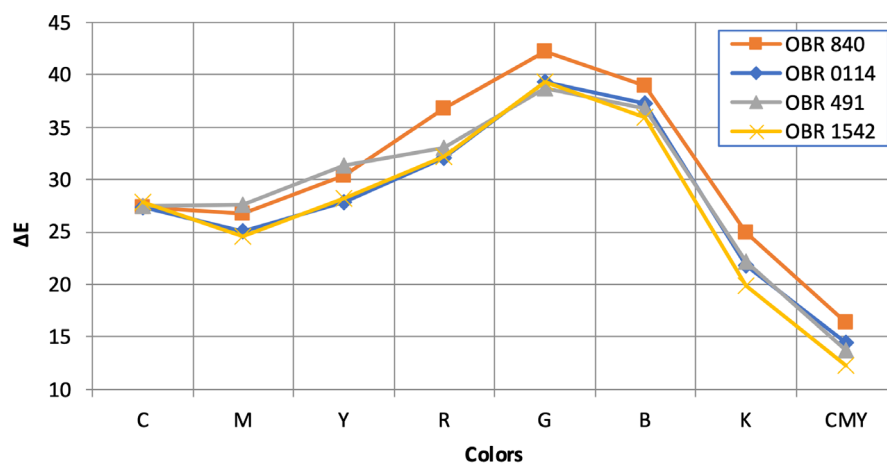


Figure 11. Different colors changes of ΔE on bleached linen fabrics when printing in 4 passes with 2 ink layers.

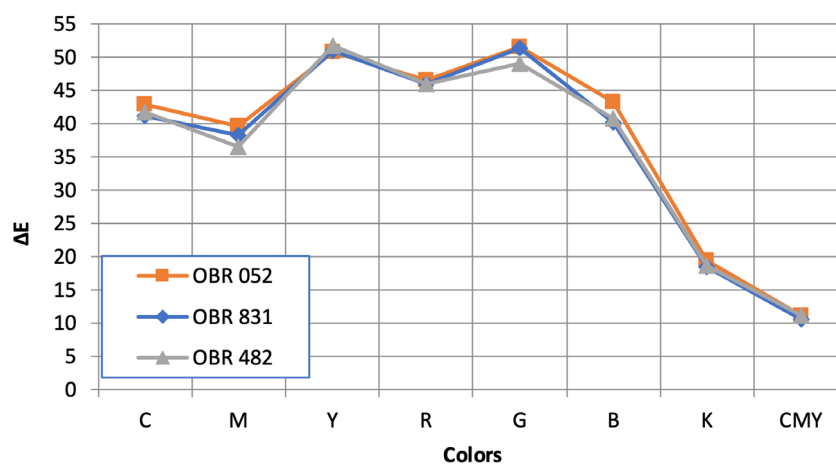


Figure 12. Different colors changes of ΔE on melange linen fabrics when printing in 4 passes with 2 ink layers.

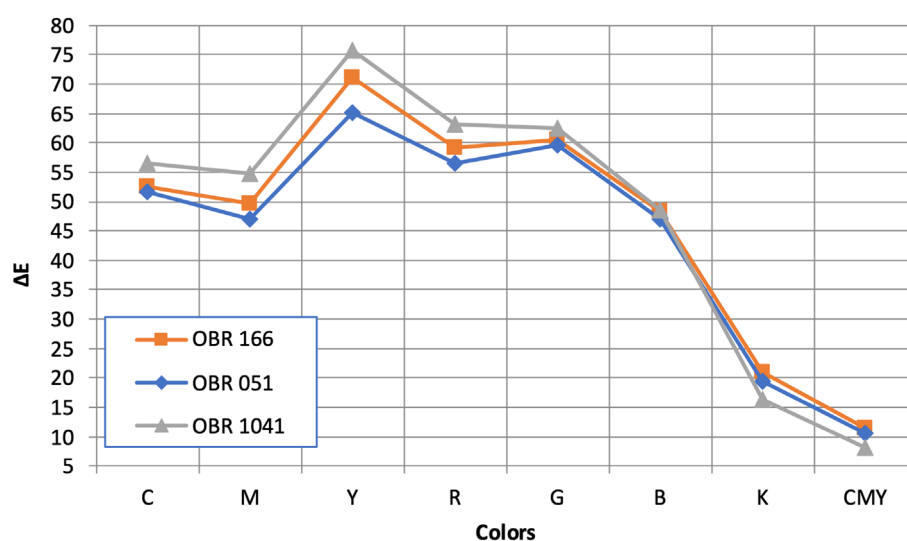


Figure 13. Different colors changes of ΔE on natural linen fabrics when printing in 4 passes with 2 ink layers.

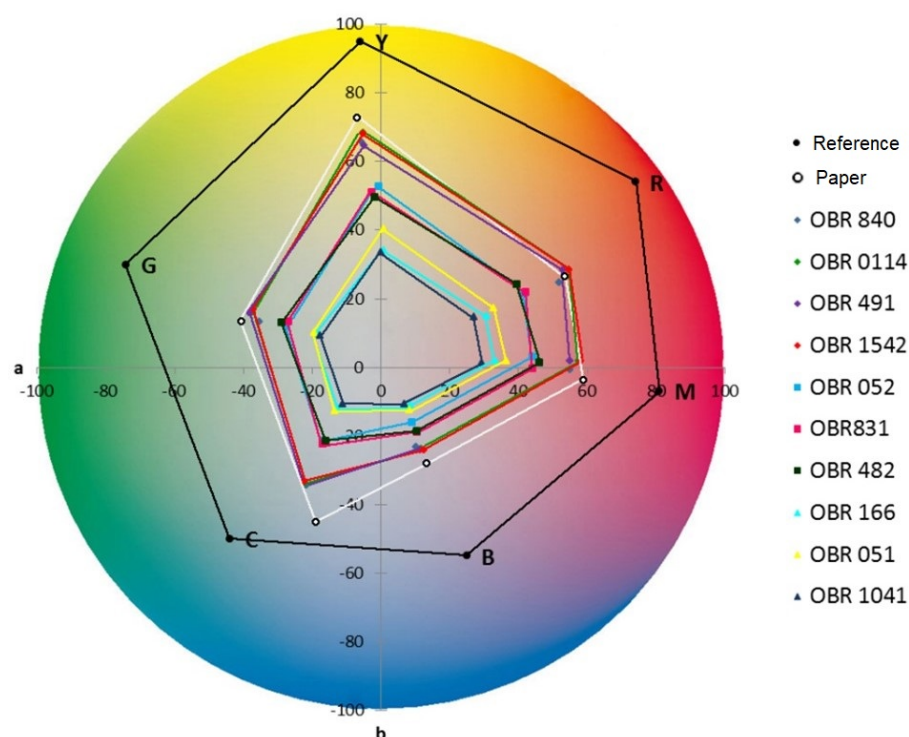


Figure 14. Color reproduction on different linen fabric in a^*b^* when printing in 4 passes with 2 ink layers.

The range of digital reference colors (black line) show that it is possible to reach the limits of maximum rich colors and the range of colors is reproduced in the print on paper (white line). Limited color saturation reproduction on all types of linen fabrics is clearly visible. The most affected are cyan and blue (B) color saturation. Color reproduction in prints on bleached linen fabrics is closest to color reproduction on paper. There is a very limited reproduction of color saturation in prints on natural linen fabrics. This is due to the fact that the fabrics of natural linen are quite dark, and the color of the dye is “suppressed”.

Other studies on inkjet printing can also be acknowledged. There are many different articles with experiments measuring textile color using digital inkjet printing technology

[27]. Textile digital inkjet printing allows for better quality control, faster prepress, reduction in the use of material and better repeatable color prints on textile substrates [27]. Experiments with a digital inkjet printer on different pretreated textiles were also performed here to find the best method of pretreatment. It was emphasized that simulated colors should be compared with original colors under daylight illuminance. To obtain more accurate results, we took into account this assumption. As well as this, a dye's physical properties have a very important effect on the print quality [28]. Here, the inkjet printing of cotton with natural dyes with different physical and rheological properties (pH, conductivity, surface tension, and viscosity) of the inks was investigated. Parameters were measured over a period of 90 days for the evaluation of ink stability and suitability for the digital inkjet printing. We took this into account for the evaluation of ink stability and suitability.

It could also be mentioned that, in our work, textile pretreatment before printing and different dyes characteristics are investigated. We looked at the research from a different angle, and our work is focused on the investigation of different printer parameters (number of printing drops and the thickness of the ink layer) to affect color reproduction on different natural linen textiles.

4. Conclusions

1. Color reproduction when printing both 4 and 16 passes is very similar. The difference between the values of ΔE of the change in color characteristics between the different passages does not exceed 3;
2. The number of applied paint layers has the greatest influence on the change in lightness (L^*);
3. The best color reproduction is achieved with two coats of dye;
4. When printing with 1 layer of ink, the color reproduction is the worst;
5. Printing in different passes setting does not increase color reproduction, but printing in a smaller passes number increases printing speed a lot;
6. At layers 4–5 of paint, the change of color characteristic ΔE increases and colors are reproduced less effectively than at dye layers 2–3;
7. In prints on bleached linen fabrics, the colors are best reproduced on the thickest linen fabric and the worst on the thinnest;
8. On melange linen fabrics, the worst colors are reproduced on the thinnest linen fabric and the color change in its surface without printing is the largest;
9. In the study of natural and melange linen fabrics, the color change in the surface without pressure has a significant influence on color reproduction.

Author Contributions: T.T., R.S. and R.J. conceived the presented idea, processed and analyzed the data and wrote the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Vilnius Gediminas Technical University.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Strand, E.A.; Frei, K.M.; Gleba, M.; Mannering, U.; Nosch, M.L.; Skals, I. Old textiles—new possibilities. *Eur. J. Archaeol.* **2010**, *13*, 149–173.
2. Buchert, J.; Pere, J.; Johansson, L.S.; Campbell, J.M. Analysis of the surface chemistry of linen and cotton fabrics. *Text. Res. J.* **2001**, *71*, 626–629.
3. El-Hennawi, H.M.; Shahin, A.A.; Rekaby, M.; Ragheb, A.A. Ink jet printing of bio-treated linen, polyester fabrics and their blend. *Carbohydr. Polym.* **2015**, *118*, 235–241.
4. Baaka, N.; Ticha, M.B.; Haddar, W.; Amorim, M.T.P.; Mhenni, M.F. Upgrading of UV protection properties of several textile fabrics by their dyeing with grape pomace colorants. *Fibers Polym.* **2018**, *19*, 307–312.
5. Bernava, A.; Reihmane, S. Influence of modification methods on colour properties of a linen fabric dyed with direct dyes. *Proc. Est. Acad. Sci.* **2018**, *67*, 131–137.
6. Burkinshaw, S.M.; Salihu, G. The role of auxiliaries in the immersion dyeing of textile fibres: Part 1 an overview. *Dye. Pigment.* **2019**, *161*, 519–530.
7. Jabar, J.M.; Ogunmokun, A.I.; Taleat, T.A.A. Color and fastness properties of mordanted *Bridelia ferruginea* B dyed cellulosic fabric. *Fash. Text.* **2020**, *7*, 1–13.
8. Özgüney, A.T.; Bozacı, E.; Demir, A.; Özdoğan, E. Inkjet printing of linen fabrics pretreated with atmospheric plasma and various print pastes. *AATCC J. Res.* **2017**, *4*, 22–27.
9. Rekaby, M.; Abd-El Thalouth, J.I.; Abd El-Salam, S.H. Improving reactive ink jet printing via cationization of cellulosic linen fabric. *Carbohydr. Polym.* **2013**, *98*, 1371–1376.
10. Liang, Y.; Liu, X.; Fang, K.; An, F.; Li, C.; Liu, H.; Qiao, X.; Zhang, S. Construction of new surface on linen fabric by hydroxyethyl cellulose for improving inkjet printing performance of reactive dyes. *Prog. Org. Coat.* **2021**, *154*, 106179.
11. Tan, P.; Tong, L.; Steven, G.P. Modelling for predicting the mechanical properties of textile composites—A review. *Compos. Part A Appl. Sci. Manuf.* **1997**, *28*, 903–922.
12. Kan, C.W.; Yuen, C.W.M.; Lam, Y.L. Effect of enzyme treatment and dyeing on the mechanical properties of linen. *Coloration Technol.* **2009**, *125*, 269–276.
13. Miller, S.A. Natural fiber textile reinforced bio-based composites: mechanical properties, creep, and environmental impacts. *J. Clean. Prod.* **2018**, *198*, 612–623.
14. Kim, H.J. Effect of water absorption fatigue on mechanical properties of sisal textile-reinforced composites. *Int. J. Fatigue* **2006**, *28*, 1307–1314.
15. Ding, Y.; Shamey, R.; Chapman, L.P.; Freeman, H.S. Pretreatment effects on pigment-based textile inkjet printing—colour gamut and crockfastness properties. *Coloration Technol.* **2019**, *135*, 77–86.
16. Hufenbach, W.; Gude, M.; Böhm, R.; Zscheyge, M. The effect of temperature on mechanical properties and failure behaviour of hybrid yarn textile-reinforced thermoplastics. *Mater. Des.* **2011**, *32*, 4278–4288.
17. Nguyen, T.H.; Vu, X.H.; Larbi, A.S.; Ferrier, E. Experimental study of the effect of simultaneous mechanical and high-temperature loadings on the behaviour of textile-reinforced concrete (TRC). *Constr. Build. Mater.* **2016**, *125*, 253–270.
18. Sharma, A. Eco-friendly Textiles: A boost to sustainability. *Asian J. Home Sci.* **2013**, *8*, 768–771.
19. Javoršek, D.; Javoršek, A. Colour management in digital textile printing. *Coloration Technol.* **2011**, *127*, 235–239.
20. Osaki, K. High quality color reproduction on jacquard silk textile from digital color images. *AUTEX Res. J.* **2003**, *3*, 173–179.
21. ORSHA Lnen Mill. Available online: <https://linenmill.by/product-category/tkani/bazovye-tkani/> (accessed on 16 January 2021.)
22. BARBIERI Electronic. Portable Spectrophotometer for Professional Digital Printing. Available online: <http://www.barbierielec-tronic.com/en/digital-imaging/1-0.html> (accessed on 16 January 2021)
23. British Standards Document BS EN ISO 105-J01 Textiles. Test for colour fastness. General Principles for Measurement of Surface Colour. Available online: <https://doi.org/10.3403/02058086U> (accessed on 28 February 2021)
24. Sidaravičius, D.J. *Densitometric and Colorimetric Control of Printing Materials and Prints*; Technika: Vilnius, Lithuania, 2012.
25. Crowle, G. Effects of Cotton Structure and Surface Interactions on Dye Uptake. Ph.D. Thesis, Deakin University, Geelong, Australia, 2017.
26. Electronics for Imaging, Inc. Delta E, Delta H, Delta T: What Does It Mean? Available online: https://help.efi.com/fieryxf/KnowledgeBase/color/Delta%20E_H_T.pdf (accessed on 26 February 2021.)
27. Javoršek, D.; Weingerl, P.; Starešinič, M. Digital Textile Printing Using Color Management. In *Textiles: History, Properties and Performance and Applications*; Mondal, Md.I.H., Ed.; Nova Science Publishers, Inc.: New York, NY, USA, 2014; pp. 53–80.
28. Savvidis, G.; Karanikas, E.; Nikolaidis, N.; Eleftheriadis, I.; Tsatsaroni, E. Ink-jet printing of cotton with natural dyes. *Coloration Technol.* **2014**, *130*, 200–204.