

Comparison of digital printed fabrics’ colorimetric attributes based on pretreatment methods

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Background and purpose. Padding mangle has been popular and widely used method to pretreat cotton fabrics for digital textile printing (Tyler, 2005; Ugur Koseoglu, 2019). However, pretreatment through padding mangle may require excessive liquor or paste due to lack of control over the pressure of the mangle (Kolte et al., 2018; Ramya, 2018). On the other hand, pretreatment using screen can also be a potential alternative alternative to the padding mangle method. Nevertheless, no previous study explored on the potentiality of fabric pretreatment using screen method. Therefore, the purpose of the study is to compare among the colorimetric measurements of the digitally printed cotton fabrics based on the pretreatment application methods.

Methods and analysis. Scoured and bleached 2/1 twill 100% cotton (200 grams per square meter, end per inch 96 and picks per inch 48) were pretreated with a typical pretreatment recipe. (table 1). Fabric dimensions were (14 inch ×14 inch) and 20 inches width for screen and padding mangle method, respectively. Two different pretreatment application methods were used in this study, which were pretreatment using screen and padding mangle. Two types of mesh, white mesh (lower mesh thickness 125.7 micron) and yellow mesh (higher mesh thickness 230.48 micron), were used in the screen method. The pretreated substrate was dried at 212°F (100°C). Spot colors (Cyan, Magenta, Yellow and Black) were printed on the pretreated substrates with commercially available reactive inks using Mutoh 1938TX printer. The steaming was done at 220°F followed by the printing in a vertical steamer.

| | |
|---|------|
| Thickener | 300g |
| Urea | 25g |
| Soda ash | 10g |
| Water | 265g |
| Total liquor | 600g |
| <i>Note: Thickener Preparation – 950g Water + 50g Sodium Alginate</i> | |

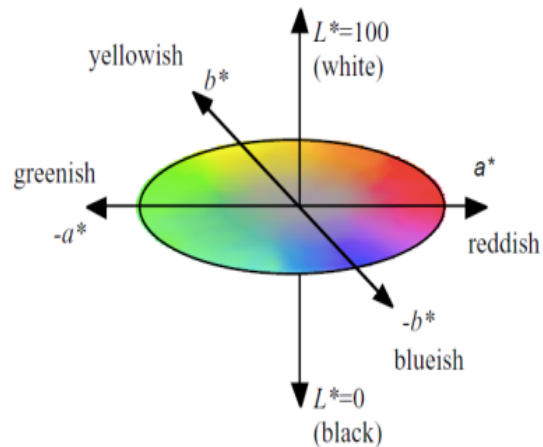


Figure 1: CIEL*a*b* color space (Molino et al., 2013)

The printed colors were measured with a X-rite i1-pro reflectance spectrophotometer (illuminant D65 and 10 degree observer function) for the colorimetric measurements (L^* , a^* and b^* values).

Results and discussion. The colorimetric measurements, L^* , a^* and b^* of printed individual colors found that the pretreated fabrics irrespective of the pretreatment application methods showed reduction in the lightness (L^*). For cyan color, the L^* value was 78.82 for the untreated fabrics, while pretreated fabrics had an L^* values of 63.65 and 67.18 for padding mangle and screen methods, respectively (Table 2). Between white and yellow mesh, the L^* value was higher than the yellow mesh in screen pretreatment method. The results found a similar trend for magenta, and black printed colors. However, for yellow color, the difference in L^* values between treated and untreated were negligible irrespective of the pretreatment application methods. The a^* value was more negative (-32) for cyan color with padding pretreatment method compared to treated with screen method. The a^* value was more positive for magenta color for padding method and b^* value was less negative for the padding mangle and more negative with the screen method.

Table 2: Colorimetric attributes (L^* , a^* , b^*) of the cotton fabrics (untreated, treated through white and yellow mesh, padding mangle)

| Treatment | Cyan | | | Magenta | | | Yellow | | | Black | | |
|-----------|-------|--------|--------|---------|-------|--------|--------|-------|-------|-------|-------|-------|
| | L^* | a^* | b^* | L^* | a^* | b^* | L^* | a^* | b^* | L^* | a^* | b^* |
| UT | 78.82 | -10.10 | -10.19 | 59.15 | 32.36 | -11.69 | 85.16 | -4.15 | 22.31 | 28.52 | 12.19 | -1.31 |
| TWM | 67.18 | -29.11 | -14.59 | 42.27 | 52.27 | -8.70 | 82.78 | -9.19 | 50.50 | 18.28 | 5.95 | -1.39 |
| TYM | 72.55 | -19.19 | -10.83 | 46.80 | 44.95 | -10.87 | 83.99 | -9.08 | 42.17 | 19.68 | 7.74 | -0.86 |
| TPM | 63.65 | -32.05 | -6.17 | 40.97 | 52.16 | -6.53 | 82.04 | -5.51 | 83.95 | 20.40 | 6.70 | 0.61 |

Note: Here, UT= untreated, TWM= Treated through white mesh, TYM= treated through yellow mesh, TPM= treated through padding mangle

Therefore, the results of the L^* value suggests that the padding method can achieve deeper shades for cyan, magenta, yellow and black color. The reason behind the better results in padding mangle method could be more uniform distribution of pre-treatment chemicals across the fabric compared to the screen method. Overall, this study can recommend that to achieve deeper shade, padding mangle provide better performance than the screen method. However, it should be also noted that mesh with lower thickness provided better results compared to screen having high mesh thickness.

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