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# Application of super hydrophobic dyes toward dyeable polypropylene fibers

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## 1. Introduction

Polypropylene fibers have a number of attractive properties when compared to synthetic fibers. Polypropylene fiber has the strength of 4.5~9.0g/d and the elasticity of 25~60%, which are comparable to those of polyester and nylon fibers in terms of their application to apparel and industrial aspects. In addition, the fiber has excellent chemical resistance as well. They are also known as a floating fiber since the density is 0.90~0.92, the lowest of all kinds of fibers, and expected for the usage for light weight sportswear. Polypropylene fiber can be used in the fields of fast drying and heat insulation materials as moisture regain and thermal conductivity are as low as 0.05% and 0.12W/mK respectively. But polypropylene fibers are limited to their textile application. The dyeable polypropylene fibers were recently developed by Huvis Ltd. The fiber can be dyed using conventional disperse dyes in the manner similar to that used for polyester fibers. The purpose of this study is to improve dyeing properties and wash fastness of dyeable polypropylene with super hydrophobic dyes.

## 2. Experimental

2.1 Materials

Table 1 shows sample specifications of dyeable polypropylene fibers.

Table1. Sample specifications of dyeable polypropylene

| Sample name | Sample Specification | |
|---|---|---|
| | WP | WT |
| KB-1089 I/G | DTY 75/72 FD (9,252yarn 143T) | XND 225/120 (1:1 63T) |
| KB-1090 I/G | DTY 75/72 FD (9,252 yarn 143T) | XND 225/120 (1:1 63T) |
| KB-1091 I/G | DTY 65/204 SD (11,232 yarn 178T) | XND 80/72 (1:1 103T) |
| KB-1092 I/G | DTY 65/204 SD (11,232 yarn 178T) | XND 80/72 (1:1 100T) |
| KB-889 | DTY 75D SD (9,252 yarn 143T) | XND 75D SD (104T) |

2.2 Dyeing

The dyeable polypropylene fibers (10.g) were dyed 5%owf dyes at a liquor ratio of 50:1. The temperature of dye bath was elevated to 130℃ at a rate of 3℃/min maintained at this temperature for 60 minutes (Figure 1). The dyed materials were washed with cold water and reduction cleared to remove the dyes remained at the surface of fibers.

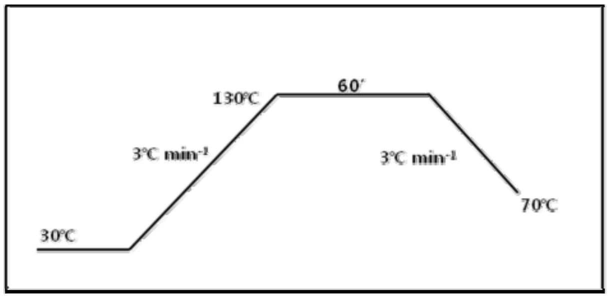


Figure 1. Test profile of dyeing process.

2.3 Reduction clearing

After dyeing, the fibers were rinsed in cold water and reduction cleared at 70℃ for 15min using a 20:1 liquor ratio. The reduction cleared dyeing was rinsed, in cold running water and then dried at room temperature.

2.4 Fastness

The dyed materials were tested for wash fastness.

2.4 Measurement of color strength

The color strength of dyed fabrics was measured by color measurement instrument and expressed by total K/S. The total K/S is the sum of the K/S value in the visible region of the spectrum. Meanwhile, the K/S is the color strength at single wavelength which is calculated from the reflectance(R) of the single wavelength obtained at every 10nm in the range of 400~700nm. The measurement was carried out with 10º standard observer under standard light $D_{65}$.

## 3. Results and Discussion

The dyeability toward dyeable polypropylene fibers were examined for the super hydrophobic dyes. Table 1 shows the colorimetric data obtained for samples which had been cold water rinsed and reduction cleared. From the results of dyeing, it could be concluded that the dyes have an affinity onto dyeable polypropylene fiber, so the dyes can be used in dyeable polypropylene fibers. The color strength of the cold water rinsed samples was slightly higher than that of reduction cleared samples.

Table 1. Colorimetric data of cold water rinsed and reduction - cleared fibers

| Samples | KB-1089 | KB-1090 | KB-1091 | KB-1089 | KB-1089 |
|---|---|---|---|---|---|
| Blue (Total K/S) | | | | | |
| Wash | 83.44 | 79.12 | 69.10 | 74.24 | 151.24 |
| R/C | 71.06 | 63.69 | 49.50 | 62.62 | 132.03 |
| Red(Total K/S) | | | | | |
| Wash | 123.62 | 151.23 | 129.23 | 134.36 | 208.20 |
| R/C | 122.36 | 135.43 | 120.67 | 125.92 | 204.59 |
| Yellow(Total K/S) | | | | | |
| Wash | 253.96 | 211.48 | 196.77 | 199.48 | 232.93 |
| R/C | 228.87 | 202.26 | 176.10 | 183.13 | 205.11 |

Table 2 shows the colorimetric data of multi fibers. The wash fastness of samples reduction - cleared was improved because surplus dye had been removed from the samples by reduction clearing. However, a condition of reduction clearing should be established because the results of wash fastness are not enough.

Table 2. Colorimetric data of multi fibers

| Samples | | KB-1089 | KB-1090 | KB-1091 | KB-1089 | KB-1089 |
|---|---|---|---|---|---|---|
| Blue multi fibers (Total K/S) | | | | | | |
| Wash | Nylon | 7.14 | 5.31 | 7.19 | 8.20 | 7.15 |
| | PET | 3.41 | 2.97 | 3.57 | 3.67 | 3.72 |
| R/C | Nylon | 5.57 | 4.40 | 5.88 | 5.88 | 6.04 |
| | PET | 3.63 | 2.62 | 2.81 | 3.12 | 3.18 |
| Red multi fibers (Total K/S) | | | | | | |
| Wash | Nylon | 8.83 | 5.29 | 8.02 | 6.08 | 4.76 |
| | PET | 12.64 | 6.30 | 11.69 | 9.89 | 4.66 |
| R/C | Nylon | 4.73 | 3.17 | 3.76 | 3.64 | 2.84 |
| | PET | 5.75 | 3.09 | 3.69 | 3.91 | 2.85 |
| Yellow multi fibers (Total K/S) | | | | | | |
| Wash | Nylon | 5.41 | 4.53 | 5.49 | 5.54 | 5.26 |
| | PET | 5.51 | 3.88 | 4.26 | 4.64 | 4.91 |
| R/C | Nylon | 3.21 | 3.34 | 3.77 | 3.73 | 4.01 |
| | PET | 3.53 | 3.70 | 4.31 | 4.19 | 4.31 |

## 3. Result and discussion

The dyeabilities of super hydrophobic dyes on dyeable polypropylene fibers were investigated. When compare the dyeabilities of conventional disperse dyes, the dyeabilites of super hydrophobic dyes onto dyeable polypropylene fibers were as good as the disperse dyes. Consequently the super hydrophobic dyes were possible to apply the dyeable polypropylene fibers.

## 4. REFERENCES

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