Designing the dyeing process of mixture fabrics with disperse-reactive dyes

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1. INTRODUCTION

Producing textile goods with mixture fabrics can express unique properties which are not possible to get from the single fabric itself. Recently mixture fabrics are widely used based on the needs of the consumers. Dyeing of mixture fabric is required of careful treatments because the component fibers have different dyeing and physical properties. The two-bath dyeing method, even though the processing time is quite long, is frequently employed in dye-house to secure one-tone effect and acceptable color fastnesses of the mixture fabric. The one-bath dyeing, which can save considerable processing time and energy, often results in deteriorating quality of dyeing and color fastness, caused by the staining one fiber with a dye for the other fiber. One of the possible way to achieve efficient one-bath dyeing of blends or mixture fabrics is the development of a universal dye which alone is capable of dyeing component fibers in a blend or mixture fabric[1]. Disperse dyes with reactive group are considered to be the most appropriate to the dyeing of blend or mixture fabrics[2,3]

The purpose of this study is to design the dyeing process with four disperse dyes having sulphatoethyl - sulphone group on mixture fabrics.

2. EXPERIMENTAL

Four reactive disperse dyes, whose chemical structures are shown in Figure 1, were synthesized and purified by the standard procedures. HPLC(ACME 9000), FTIR(Jasco 300E), UV/Vis(UV Mini 1240) were used for characterization of synthesized dyes.

Dyeing was carried out in the sealed dyepot (Labomat), pH was adjusted with buffer solutions according to the substrate, and a liquor ratio was 20:1. Temperature was raised from 30℃ to the highest dyeing temperature through one step or two steps(N/P 120℃, 130℃; N/C 60℃, 60-100℃, 80℃, 80-100℃; P/C 120℃, 120-80℃, 120-100℃, 100-120℃), and dyeing was continued at the temperature totally for 60 min, then the temperature was lowered to 80℃. Dyed fabric was reduction cleared, rinsed and dried.

All chemicals used in the synthesis, analysis and dyeing were laboratory grade reagents. N/P mixture fabric(warp, nylon 70d/68f; weft, PET 150d/288f; N/P=53/47), N/C mixture fabric(warp, nylon 70d/24f; weft, CM 24's; N/C=35/65), P/C mixture fabric (warp, PET 150d/288f; weft, CM 30's; P/C=65/35) were used for dyeing.

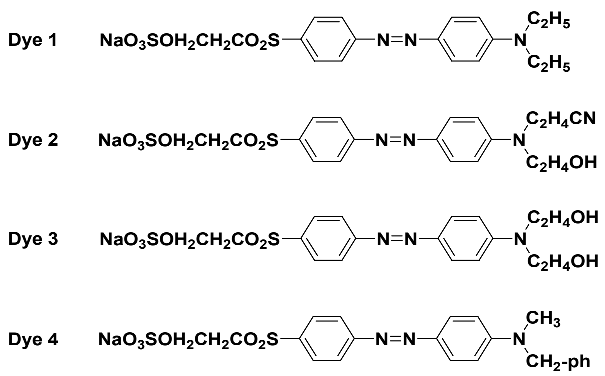

Fig. 1. Chemical structures of four disperse- reactive dyes.

3. RESULTS AND DISCUSSION

N/P mixture fabrics were dye at 1% o.w.f. with various pH to find appropriate pH of the dye bath. Figure 2 shows pH of the dye bath does not make big differences. It is derived that pH 7 is the most suitable since it is neutral.

Distribution of Dyes 1 and 4 between nylon and PET with 1% o.w.f. at 120℃ and 130℃ dyeing were measured and shown in Figure 3. Dyes were mainly absorbed by nylon fiber at the early stage of dyeing and started to be absorbed by PET above 120℃ (90min). The final color strength(K/S) of nylon was higher than that of PET with both dyes at 120℃ and 130℃. The color difference is smaller at 120℃ than 130℃, thus dyeing at 120℃ is more energy effective.

Distribution of Dye 2 and 3 on nylon and cotton at 100℃ and 60℃ were measured and shown in Figure 4. When the highest dyeing temperature is 100℃, nylon fiber quickly absorbed most of the dyes and reached the equilibrium at 90℃ (60min) while cotton only got a little with both dyes. Different trend was shown at 60℃. Cotton fiber absorbed dyes from the start of dyeing and reach the apparent equilibrium at 60℃ (60min). Nylon fiber started to absorb dyes after 30 min, but continue to absorb dye molecules to final stage of dyeing. Dye 3 which had two hydroxyl groups was expected to be absorbed onto cotton fibers more easily than Dye 2, but the result showed the color strength did not increase at all.

Color strength of P/C fabrics with Dyes 1 and 4 at different temperatures were measured and shown in Figure 5. Dyeing at 120℃ for 60 min gave higher color strength than dyeing at 120℃ for 30 min and dyeing at different temperature for 30 min as 1-bath-2 step dyeing. Dye 1 showed better performance at all temperature conditions except for 100 to 120℃. Dye 1 has smaller molecular weight which makes Dye 1 go into the PET fabric well. It also explains 100 to 120℃ showed higher color strength since PET got enough time to relax its structure for accepting bigger Dye 4 molecule. In addition, P/C fabric has cotton portion which explains Dye 4 has disadvantages to be absorbed into cotton fiber as Dye 4 is the most hydrophobic dye.

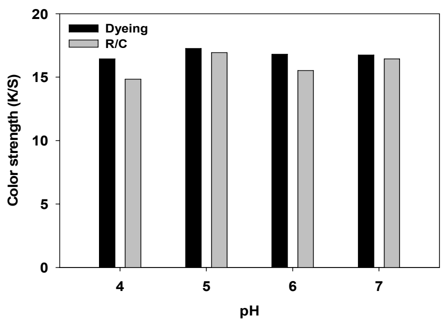

Fig. 2. Color strength(K/S) of the N/P fabrics with different pH.

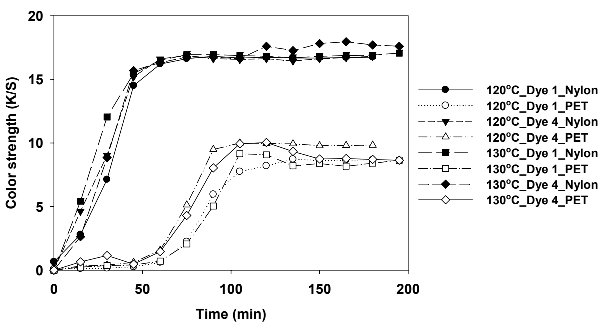

Fig. 3. Distribution of Dyes 1 and 4 between nylon and PET at different temperatures.

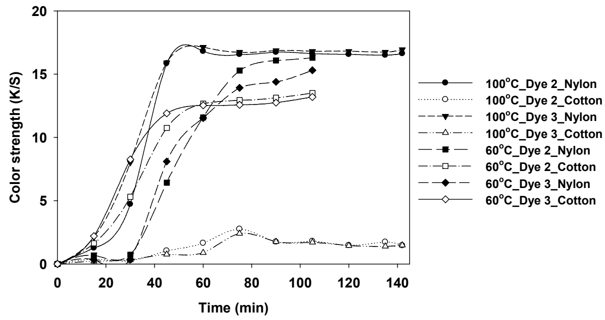

Fig. 4. Distribution of Dyes 1 and 4 between the nylon and cotton fabrics at different temperatures.

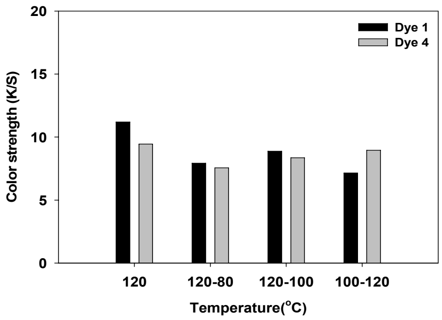

Fig. 5. Color strength of P/C fabrics at different temperatures.

4. CONCLUSIONS

N/C mixture fabric could be dyed with Dyes 2 and 3 at 60℃ to decrease the color difference. Dyes 1 and Dye 4 at 120℃ were appropriate to dye N/P and P/C mixture fabrics.

5. REFERENCES

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