Dyeability of photooxidized meta-aramid fabrics to cationic dyes

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Abstract

Aramid fabrics were photooxidized by UV/O_3 irradiation. The UV irradiation caused the oxygen content of the aramid fabric surface to increase and reduced the surface zeta potential, coupled with improved water wettability. The modified aramid fabrics showed higher affinity to cationic dyes which may be resultd from the newly introduced electrostatic interaction between cationic dyes and anionic dyeing sites on the photooxidized surface layers. Although color fastness to both staining and rubbing were good to excellent, color fastness to shade change was moderate.

1. Introduction

Aramid fibers are hard to dye due to their high crystallinity and glass transition temperature. The dyeing methods for aramid fabrics involve supercritical fluid, liquid ammonia, carrier, solvent-dyeing and surface modification. However, expensive machine and large energies must be employed for supercritical fluid. The treatment with liquid ammonia modified the aramid structure. carrier dyeing discharges contaminated water, which is not environmentally friendly. Solvent dyeing deteriorates the mechanical properties of the yarn. Furthermore, conventional surface modification such as chemical etching, surface grafting and polymerization may degrade aramid fabric heavily and cause its mechanical properties to decrease.

UV/O_3 has been known to be a highly successful method for the surface modification because the UV/O_3 treatments can be carried out continuously under atmospheric pressure using simple and inexpensive equipments. In this study, aramid fabrics were photooxidized by UV/O_3 irradiation, then cationic dyes were used to access the dyeability of the modified aramid fabric.

2. Experimental

2.1 Materials

Meta-aramid fabrics (295g/m^2) supplied by Yantai Spandex Co. Ltd were used for the study. Cationic dyes

of Rifa Cationic Prink FG (C.I. Basic Red 13) and Rifa Cationic Blue GRL 300 (C.I. Basic Blue 41) were used for cationic dyeing.

2.2 Cationic dyeing

Aramid fabrics treated with different UV energies were dyed using an IR dyeing testing machine with two cationic dyes of C.I. Basic Red 13 and C.I. Basic Blue 41. The effect of different dyeing conditions involving dye concentration and dyeing temperature were investigated. After dyeing, the dyed fabrics were thoroughly rinsed with running water and dried.

3. Conclusion

Fig. 1 showed that both the K/S values and exhaustion of the modified aramid fabrics increased remarkably with UV irradiation. That was due to the introduction of electrostatic or polar interaction between the cationic dyes and the modified aramid surface by the UV treatment. From Fig. 2, it can be seen that the K/S values increased with increasing dye concentration to 3%owf and then leveled off, implying that there were limited numbers of anionic dyeing sites available for the adsorption.

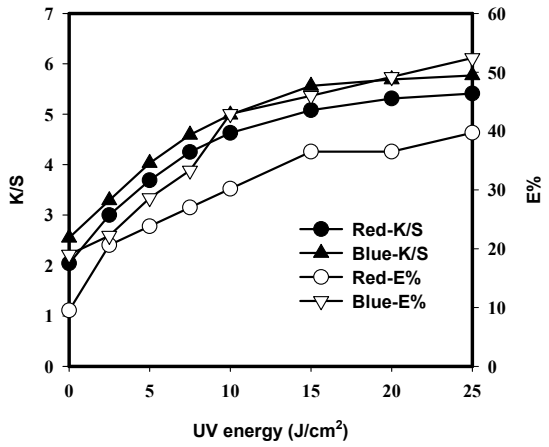

Fig. 1. Effect of UV energy on K/S and exhaustion (3%owf, pH5.5, 80℃, 60min)

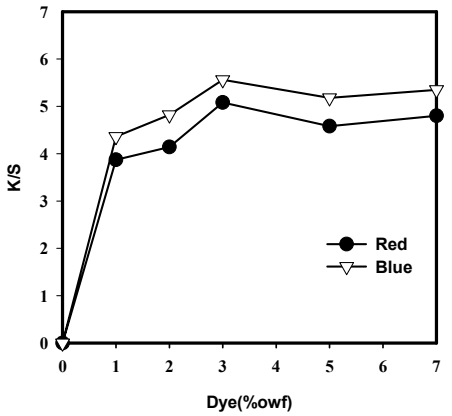

Fig. 2. Effect of dye concentration on K/S and exhaustiion (UV energy 15J/cm2, pH5.5, 80℃,60min)

Acknowledgements

본 연구는 지식경제부와 한국산업기술재단의 지역혁신인력양성사업으로 수행된 연구결과임.