플라즈마처리가 폴리에스테르 직물의 오염제거성에 미치는 연구

권영아
신라대학교 패션산업학부

Influence of Plasma Treatment on The Soil Release Properties of Polyester Fabrics

Young-Ah Kwon
Silla University, Busan, Korea

1. Introduction

Physicochemical properties of a polymer surface significantly affect adhesion, wetting, and dyeing properties. In recent years, low temperature plasma technology has been widely used for surface modification of polymers. Surface fluorination by low temperature plasma treatment has been employed to improve the water and oily repellency of textile fabrics. However, very few results have been reported on soil release properties of the oxygen plasma treated textile fabrics. In this study, we have used oxygen plasma to investigate the effect of RF plasma treatment on the soil release properties of polyester (PET) fabrics.

2. Experimental

Plasma treatments were carried out in a commercial glow discharge apparatus with a 30 kHz RF generator. Soiling was conducted with carbon black in distilled water. For soil release test, the soiled samples were washed at 50℃ in an Atlas Launder-O-meter using a solution containing 0.2% o. w. f. We determined the percentage soil removal rate (PSR) by measuring the percentage of incident light reflected from the swatches of soiled and of unsoiled before and after washing. We used the relative difference in strength between control and washed samples using the Kubelka-Munk values (K/S values) to calculate the relative soil removal rate between the unsoiled control and the soiled specimens. We considered the control to be a standard. Soiled samples were viewed under SEM to locate the soil in the fabric structure.

3. Results and Discussion

It was observed that for the untreated PET the water based soils were nonuniformly distributed over fiber surface. PET fabrics that had been treated with O_2 plasma appeared to have a heavier deposition of water-based oils than the corresponding untreated fabrics. The water-based soiling value of the fabric as a function of plasma treatment time was not linear due to the change of the chemical and physical surface structure with increasing plasma exposure time. The plasma exposure time over 30 to 180 sec of treatment time resulted in significant increases in soiling values with water based soiling, compared with the soiling of the untreated fabrics. On the other

hand, the plasma exposure time over 240 sec resulted in significant decreases in soiling values with water based soiling compared with the soiling of the untreated fabrics. The PSR of the fabrics was not significantly affected by plasma exposure time.

The soiling level of the plasma treated fabrics with water-based soils was dependent on the discharge power. Both the chemical structure and the topography of fiber surfaces are significant factors in determining soiling level of the O_2 plasma treated fabrics with water-based soils. The soiling level of the O_2 plasma treated fabrics, soiled with water-based soils, increased the discharge power up to 200 W. This result is possibly due to the gradual increase in oxygen functional groups and surface roughness on the fiber when increasing discharge power up to 200 W. However, the soiling values of fabrics treated at an extremely high discharge power range (>200 Watt) were less than those of fabrics treated at lower discharge power range (<200 W). The possible explanation for this observation is that with an oxygen plasma treatment at a high power range, the polymer chains become highly crosslinked, reducing the amount of water-based soiling. The above result appears to be consistent with the demand wettability. The polymer chains were highly crosslinked with power over 200 W, and the amounts of water uptake were smaller than those obtained by O_2 plasma treatment at lower powers.

Increasing discharge pressure led to an increase in the soiling with water-based soils on fabrics. This result is probably because an increase in discharge pressure led to an increase in the cavities on the fiber surface. As expected, the results of the water-based soiling test on fabric show that an oxygen containing groups introduced onto the fiber surface were probably responsible for a strong adhesion to the water-based soil.

4. Conclusion

The objective of this study was to investigate the effect of oxygen low temperature plasma treatment on the soil release properties of PET fabrics. The PSR of the fabrics was not significantly affected by O_2 plasma exposure time. However, increasing discharge pressure led to an increase in the soiling on fabrics. With an O_2 plasma treatment with a high power of 200 W and/or plasma exposure longer than 240 sec, the PET fabrics become highly crosslinked, which would reduce the amount of water-based soiling.

References

1. R. H. Hansen , J. V. Pascale, T. D. Benedictis, and P. M. Rentzepis, *J. of Polym. Sci.: Part A, Polym. Chem. Ed.*, **3**, 2205 (1965).
2. Y. Kwon, Influence of CF_4 plasma Treatment on The Wettability of Polypropylne Fabrics, Fiber and Polymer, (2002).
3. H. Yasuda, T. Hsu, and H. Yasuda, Effect of Glow Discharge on Fibers and Fabrics , *J. of Appl. Polym. Sci.*, **150**, 19-33 (1999).
4. B. Miller and R. A. Young, *Text. Res. J.*, **45**, 359 (1975).