Union Dyeing of the Photografted PET/Wool Blend Fabrics

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1. INTRODUCTION

Wool is known to be soft and warm material, and can be dyed easily, while has facile alkaline degradation, high shrinkage during washing. PET has outstanding mechanical and physical properties, but its strong hydrophobicity lowers the wettability and dyeability. PET/wool blend fabrics have many superior properties such as crease recovery, mechanic properties and abrasion resistance, fast drying, and dimensional stabilitly.

Usually, dyeing of PET/wool blend fabric requires two types of dyes. In this study, union dyeing of the blend fabric was investing after using a wool-reactive dye. So this method is more effective. Dimethylaminopropyl methacrylamide(DMAPMA) was grafted onto PET/wool blend fabrics via UV irradiation. Moreover, reactive lanasol dyes were used to assess its dyeability change.

2. EXPERIMENTAL

2.1 Materials

PET/wool (56/44) blend fabrics were used for the study. Dimethylaminopropyl methacrylamide (DMAPMA), benzophenone(BP), Triton X100 were used as a monomer, a photoinitiator, and a wetting agent for grafting respectively. Lanasol Red 6G (C.I.Reactive Red 84), Lanasol Blue 3R(C.I.Reactive Blue 50) and Lanasol yellow 4G(C.I.Reactive Yellow39) were used for dyeing.

2.2 Potografting via UV irradiation

PET/wool blend fabrics were pretreated by a UV apparatus enclosing a H-blub of 10J/cm^2 intensity. PET/wool blend fabric was immersed into a grafting solution of DMAPMA, BP and TritonX100 for a short while, and then the wetted fabric was padded to a WPU of about 90% using a squeeze mangle. UV irradiation was carried out using a continuous UV irradiator enclosing D-bulb of 80W/cm intensity. UV energy was controlled by adjusting the conveyor speed and passing cycles of a conveyor belt. After irradiation, the UV-irradiated samples were thoroughly rinsed with acetone and subsequently with running water. Percentage of grafting (%G) and grafting efficiency(GE) were calculated as following:

$$G\%=(w_3-w_1)/w_1*100\% \quad (1)$$
$$GE\%=(w_3-w_1)(w_2-w_1)*100\% \quad (2)$$

where w_1 is the weight of original fabric, w_2 and w_3 are weights of the treated fabric after UV irradiation and after solvent extraction respectively.

2.3 Reactive dyeing

The grafted PET/wool fabrics were dyed with three reactive dyes. The effect of different dye conditions involving dyeing temperature, dye concentration, dyeing time, and pH value were investigated as well as NaCl addition. After the dyeing process, the dyed fabrics were washed first with 2% detergent solution at 50 ^{o}C then with distilled water at 50 ^{o}C, finally with tap water to remove the unfixed dyes on the fabrics.

All the dyeing were carried out using an IR dyeing machine (DL-6000, Starlet Co. Ltd.). The laundering of dyed fabrics were carried out with a Launder-O-meter(ATLAS, Type LP2)

2.4 The evaluation of dyeing

A UV/vis spectrophotometer (Agilent Technologies, US/8453) was used for measuring the exhaustion based on the remaining dyeing liquor at the maximum absorption wavelength before and after dyeing. K/S were calculated from reflectance at λ_{max} measured with a reflectance spectrophotometer (Gretag Macbeth, Coloreye 3100).

3. RESULTS AND DISCUSSIONS

Optimization of UV energy is very important for the surface photografting, which depends on the reactivity of monomers and the initiation efficiency of photoinitiator. The UV energy used for all the experiment was 25J/cm^2 and BP concentration was 30%owm(on the weight of monomer). Both the grafting and grafting efficiency(GE) increased with increasing DMAPMA concentration. That is because more monomers were available for the grafting when fabrics were padded with higher monomer concentration.

Table 1 Effects of DMAPMA concentration on grafting

DMAPMA(%owf)	G%	GE%
0	0	0
10	10.3	97.8
20	16.8	95.3
40	33.7	97.8
60	50.3	98

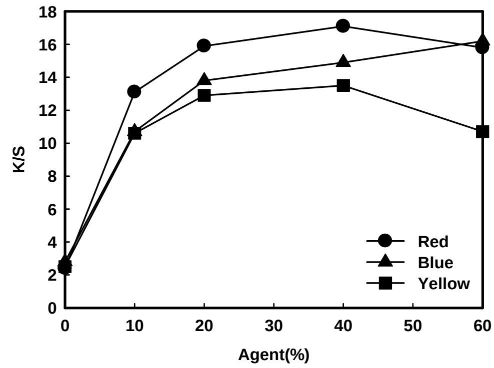

Fig.1. Effect of dye concentrations on K/S value

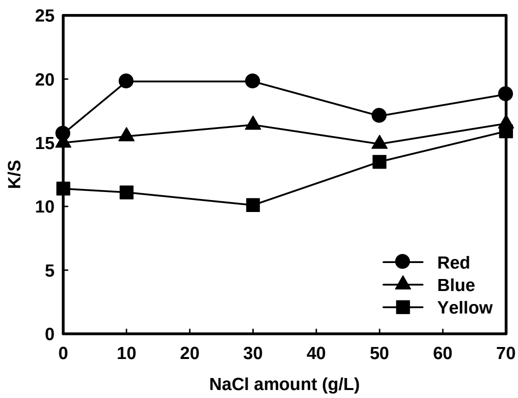

Fig.2. Effect of NaCl amount on K/S value

The effect of DMAPMA concentration and NaCl amount on K/S of PET/wool blend fabric were shown in Fig.1 and Fig.2 respectively. From the Fig.1, the K/S value of the grafted blend fabrics increased with increase in DMAPMA concentration. This is due to the higher monomer concentration gave a higher grafting yield. The DMAPMA contains a secondary amino group in the molecular structure and the covalent bonds formed between secondary amine groups in DMAPMA and dye molecules. From the Fig.2, it can be drawn that with adding NaCl into the dyebath, the dyeability of the grafted fabrics was increased. The electrolyte addition may promote dye uptake and hence dye fixation on the fabric.

Moreover, the effect of pH value and the dyeing temperature were also investigated. The dye was evenly adsorbed under a neutral pH envioronment, because the wool will be degraded under alkaline condition. The dyeing temperature was chosen to 60℃, since the blend fabric was damaged at higher temperature especially above 120℃.

4. CONCLUSIONS

DMAPMA was easily grafted onto the PET/wool fabrics by continuous UV irradiation under ambient condition. The dyeability of PET/wool blend fabrics to reactive lanasol dyes improved apparently by the potografting. With increasing DMAPMA application, higher grafting yield can be obtained. The K/S value for the grafted fabrics increased remarkably due to the formation of covalent bonds between secondary amine groups in monomer and reactive groups in the dye molecules. And in order to protect the wool component in the PET/wool blend fabric, the dyeing should be carried out under neutral condition at low temperature.

5. REFERENCES

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6.ACKNOWLEDGEMENTS

This work was supported by grant No.RTI04-01-04 from the Regional Technology Innovation Progam of the Ministry of Knowledge Economy(MKE).