

Application of Microcapsules containing Fragrant Oil on Natural Dyed Fabric

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1. INTRODUCTION

Recently, natural dyes have been gained interests to natural dyed textile products due to environmental concern. It is necessary to impart functionality for better competitiveness of the natural dyed textile products in the current market. For eco-friendly and functional fabrics, a lot of recent researches have been done to satisfy the needs of consumers. The objective of this study is to develop natural dyed cotton fabrics with aroma-therapeutic functionality. Cotton fabrics were dyed with natural indigo from *polygonum tinctorium* and subsequently treated microcapsules containing pine oil. For improving the hand of microcapsule treated fabrics, softener was included in a finishing bath by one-step or in a separate bath by two-step. To investigate the efficacy of microcapsules treatment on natural dyed fabrics, changes of color and performance properties, including stiffness and air permeability, and laundering durability of aroma microcapsules were evaluated.

2. EXPERIMENTAL

Materials

A scoured and bleached 100% cotton fabric(1/2 twill, 145x76/inch², 126.65 g/m², 0.24 mm thickness) was used. Natural indigo slurry was prepared by using Ca(OH)₂ instead of baked oyster powder in the traditional Niram method[1]. The powder form of indigo dye was obtained by oven-drying the slurry at 50°C. Melamine-formaldehyde microcapsules in slurry state containing pine oil were used. The mean particle size of the microcapsules was 2.39 μm. Softener used was Prosoft (Ploychrom, Co., Ltd., Korea). All other chemicals were of reagent grade.

Dyeing

Cotton fabric was dyed at 40°C for 30min with reduced dyebath. 16g/l indigo dye and 5g/l reducing agent(sodium hydrosulfite) were added to the dyebath of liquor ratio of 1:50. Reduction was achieved by gently shaking the solution at 70°C for 30min. Dyed samples followed by air oxidation for 30 min. After complete oxidation, the samples were

rinsed in tap water and dried.

Application of the microcapsules to dyed fabrics

The dyed samples were impregnated with an aqueous solution composed of 2.5% microcapsules (owb) and 5% acrylic binder(owb) in a liquor ratio of 1:25, padded by two-dips/two-nips method, dried at 80°C for 5 min, and cured at 150°C for 3 min. Softener was added to the microcapsules padding bath with 2% and 5%(owb) or treated with 5%(owb) in a separate step after microcapsule treatment.

Evaluation of the treated fabrics

Add-on was calculated from fabric weight before and after microcapsules treatment. Color properties were evaluated in terms of dye uptake(K/S values at 660nm), H V/C values and color difference(ΔE^*) with a Macbeth Coloreye 3100 spectrophotometer. Stiffness and air permeability were evaluated. Color fastness to washing, dry cleaning, rubbing and light were estimated following standard methods. SEM analysis was done to observe microcapsule location and durability after laundering for 20 times.

3. RESULTS AND DISCUSSION

Table 1 shows add-on, K/S value, and color properties of the dyed and microcapsule-treated samples. The K/S value and add-on of dyed fabrics were not affected by microcapsule and softener treatment. On the other hand, Munsell Hue of the dyed fabrics was shifted slightly to more bluish shade after microcapsule and softener treatment. However, the color difference of dyed fabrics after microcapsule treatment is considered acceptable in the range of 1.62~2.08.

Fig. 1 shows SEM photographs of microcapsule treated samples. The microcapsules in the treated samples were located at interstices between the fibers and on the fiber surface. And binder was observed in the microcapsule-treated samples. With this finding, the stiffness of microcapsule-treated samples was also higher than that of the untreated and dyed samples in Fig. 2(a). Air permeability decreased with microcapsules treatment compared with those of the

dyed samples, as expected. As shown in the SEM photographs, the microcapsules and binder filled up the pores of treated fabric samples. In Fig. 2(b), a decrease in the air permeability is clearly shown. On the other hand, softener treatment after microcapsule treatment was improved softness and air permeability of microcapsule-treated fabric samples.

Table 2 shows the color fastness of dyed and microcapsules and softener treated fabrics. All of the samples except for dry cleaning fastness of D/MC-treated fabrics was fairly good as above 4/5 rating.

Table 1. Add-on and color properties of treated fabrics

Treatment*	Add-on(%)	K/S value	H V/C	ΔE^*
D	-	14.15	3.6PB 3.0/4.8	-
D/MC	1.61	14.12	4.3PB 3.0/4.9	1.62
D/MC-S2	1.65	14.08	4.3PB 3.0/4.9	1.76
D/MC-S5	1.68	14.04	4.3PB 3.0/5.0	1.88
D/MC/S5	1.62	14.35	4.5PB 2.9/4.9	2.08

*D: dyed, MC: microcapsule-treated,
 D/MC-S2: treated in a bath with microcapsule + 2% softener,
 D/MC-S5: treated in a bath with microcapsule + 5% softener,
 D/MC/S5: treated with 5% softener in a separate step.

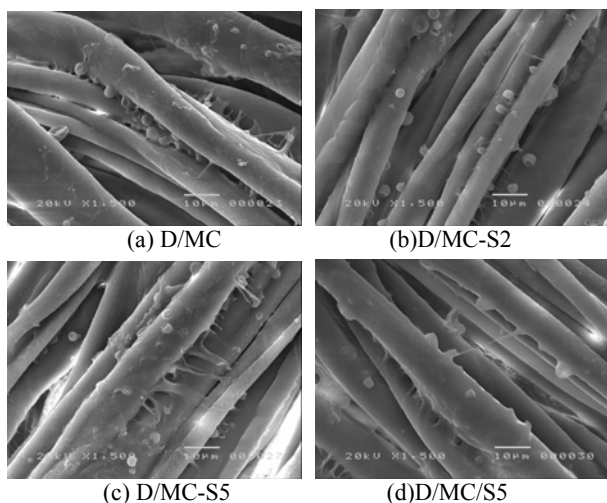


Fig. 1. SEM photographs(1500X) of microcapsule-treated fabrics

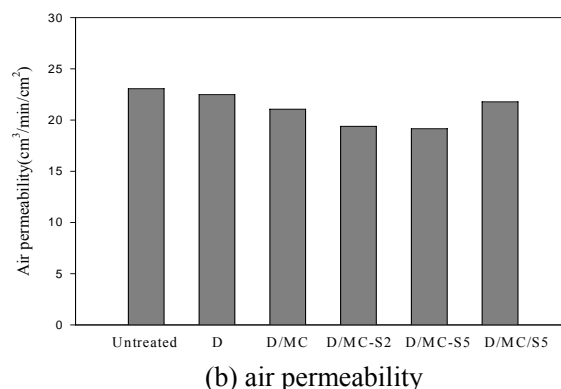
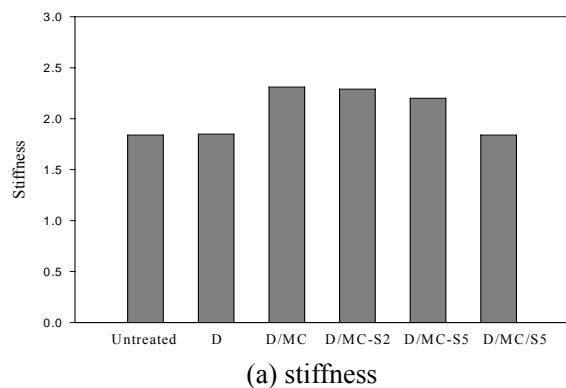


Fig. 2. Effect of treatment process on (a) stiffness and (b) air permeability.

Table 2. Color fastness of the treated fabrics

Treatment	Washing		Dry cleaning		Rubbing		Irradiation (20hr)
	Color change	Stain	Color change	Stain	Dry	Wet	
D	4/5	5	4/5	5	4/5	4/5	4/5
D/MC	4/5	5	4	5	4/5	4/5	4/5
D/MC-S2	4/5	5	4/5	5	4/5	4/5	4/5
D/MC-S5	4/5	5	4/5	5	4/5	4/5	4/5
D/MC/S5	4/5	5	4/5	5	4/5	4/5	4/5

SEM photographs after laundering for 20 times were shown in Fig. 3. The microcapsules were observed on the fiber surface and at the interstices between the fibers. This resulted in the fragrant fabric with washing durability.

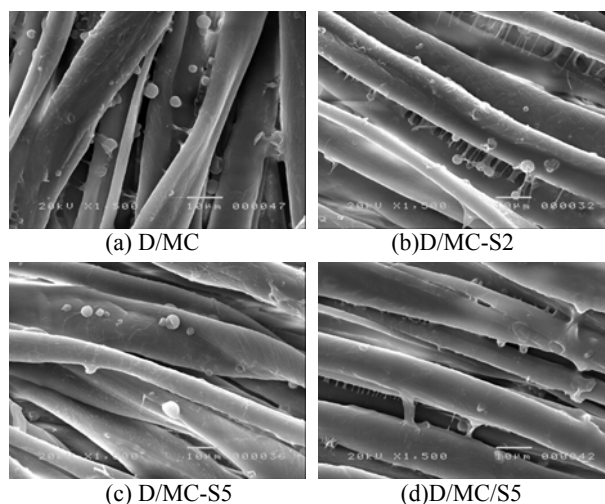


Fig. 3. SEM photographs(1500X) of microcapsule-treated fabrics after 20 times of laundering.

REFERENCES

[1] Y. Shin, K. Son, and D. I. Yoo, *Journal of the Korean Society of Clothing and Textiles*, 32(12), 1963-1970(2008).