The Influence of Enzymatic Treatment on Wool Fineness -Factors affecting wool degradation-

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1. INTRODUCTION

The use of enzymes on wool finishing processes has received much attention because it could replace the traditional chemical treatments such as chlorine-Hercosett process [1,2]. Accordingly, considerable amount of enzymatic works has been carried to improve wool properties. However, the improvement of wool properties by enzymatic treatment was hardly achieved by enzyme alone without the aid of auxiliaries, pre-treatment or enzyme-modification [3].

Since the surface of wool fibers is covered by cuticle, it is difficult for enzyme to contact the keratin. In the early stage of enzymatic treatment, pre-treatment using alkaline solutions generally used open-up the cuticle. In Seddon's work [4], ionic-liquid was employed to improve enzyme efficiency on wool finishing as increasing solubility of keratin.

Although enzymes hard to attack the surface of untreated wool fibers but once the protection is broken enzymes penetrate into the fiber and damage inner part of the wool fiber [5~7]. Therefore, recent researches concentrate on enzyme modification in order to control wool degradation by enzyme. The modification was carried usually to increase the molecular size of enzymes to inhibit their penetration into the fiber.

This present work investigated the influence of various factors that were used to improve enzymatic treatment on wool fiber properties, especially on fiber fineness. The fiber fineness was dealt as a main concern here because the fineness relates to the wool handle and the price of wool product. The purpose of this work was to find if the pre-treatment or aids was really needed for enzymatic wool processing in order to improve softness or handle property.

2. EXPERIMENTAL

2-1. Material

Wool-top and wool fabrics used in the experiments were composed of fibers ranges from 16μ m to 24μ m (average 21μ m). Savinase 16L and Alcalase were supplied by Novozymes Korea. The non-ionic surfactant used in this work is DGA supplied by Dong-A chemical company. All other chemicals used were technical grade purchased from Sigma-Aldrich Co. Ltd.

2-2. Enzymatic treatment of wool

The specimens were divided into two-groups and one group of specimens was pre-treated with 0.2g/L sodium carbonate. Enzymatic treatment was carried out in a shaking water bath as follows: 5gram of substrate (wool top or fabric) was incubated in 200ml solution containing 1g/L DGA, 0.4%owf enzyme for 60 minutes at 50°C. Three different kinds of salts were applied during enzymatic treatment to see the salt effect on enzyme efficiency for wool degradation. Following enzyme treatment, the substrate was rinsed thoroughly and air-dried.

2-3. Evaluation

Enzyme treated wool-top and fabrics were subjected to following evaluation: Felting shrinkage, tensile properties, weight loss, fiber fineness, and handle assessment.

3. RESULTS AND DISCUSSION

The results showed that the fibers were finer after the enzymatic treatments (Fig. 1). Savinase treated fibers showed the largest reduction in fiber diameter among the treated samples. Although the treated samples with savinase and di-sodium phosphate together showed the highest weight reduction, the change of fineness did not showed as much as savinase only treated one (Fig. 2). This could be possibly happened if the enzyme penetrates inside of the fiber with aid of salt and degrade inner part of the fiber. The subjective assessment of the handle indicated that there was no major difference between the handle of the untreated and enzyme treated samples. However, the handle of treated samples was slightly better than that of untreated ones.

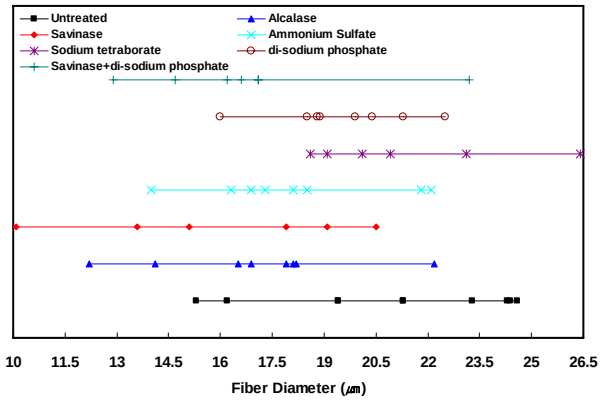


Figure1. Fiber diameter of enzyme treated wool fiber

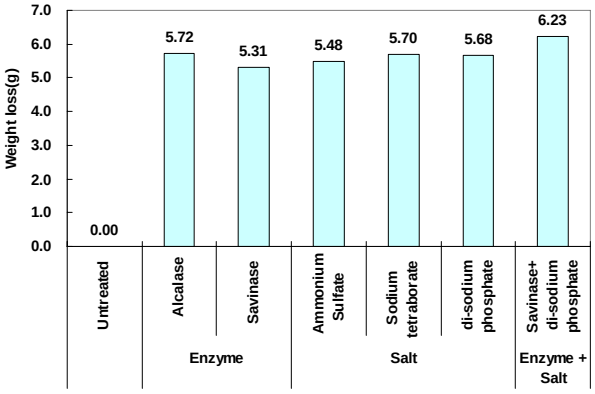
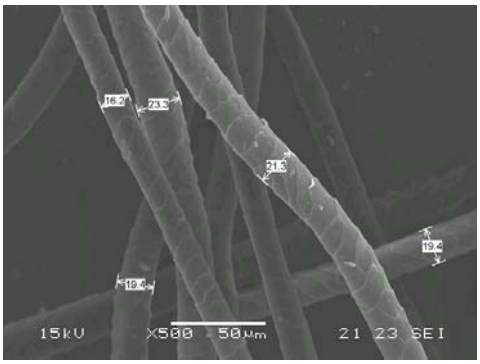
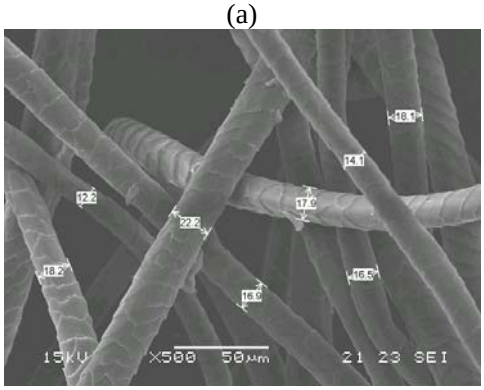


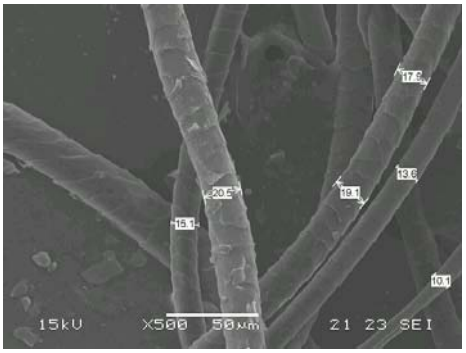
Figure2. Weight loss of enzyme treated wool fiber



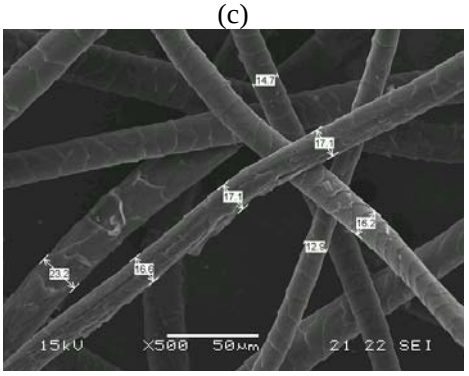
(a)



(b)



(c)



(d)

Figure3. SEM images of treated wool fibers;
(a) untreated, (b) Alcalase treated,
(c) Savinase treated, (d) Savinase-salt treated

4. CONCLUSION

It has shown that the fineness of wool fibers appears to be changed by enzymatic treatment without aid of any other auxiliaries.

5. REFERENCES

[1] S. Jus, M. Schroeder, G. M. Guebitz, E. Heine, V. Kokol; *Enzyme and Microbial Technology*, 40, 1705-1711(2007).

[2] K. Schumacher, E. Heine, H. Hocker: *J. Biotechnol.* 89, 281-288(2001).

[3] D. M. Lewis; *Society of Dyers and Colorists*, 1-51(1992).

[4] K. R. Seddon; *Chem. Biotechnol.* 2, 351-356(1997).

[5] W. S. Simpson, G. H. Crawshaw; Wool: *Science and Technology.* Cambridge Woodhead Publishing Ltd, 2002.

[6] E. Heine, H. Hocker; Enzyme treatments for wool and cotton Rev.Prog, *Colorat,* 25, 57-63(1995).

[7] CJSM. Silvia, M. Prabaharan, G. Guebitz, A. Cavaco-Poulo; *Enzyme Microbial Technol.*, 36, 917-922(2005).