

나노 은 콜로이드를 이용한 다기능성 양모섬유의 제조

기획연, 여상영, 정성훈
한양대학교 공과대학 섬유고분자공학과

Preparation of Multifunctional Wool Fibers with Nano-Silver Colloid

Hee Yeon Ki, Sang Young Yeo, and Sung Hoon Jeong

Department of Fiber and Polymer Engineering, Hanyang University, Seoul, Korea

1. Introduction

Recently, the works about antibacterial finishing have been actively investigated in textile industry because of increasing environmental pollution. Wool can easily be an medium for microorganisms growth under proper temperature and humid condition. These microorganisms can result in damages, skin irritations, and infections in wool products. For this reason, the wool materials must be protected against microorganisms in order to suppress their growth and dissemination as well as fiber damage. Silver is one of non-toxic and safe antibacterial agents to the human body, and can kill many harmful microorganisms. When silver has a small size, the number of silver particles may be increased in unit area. The total surface area of the nano-sized silver particles is larger than that of large-sized silver in identity volume then antibacterial ability of the former is more effectiveness than the latter. In our laboratory, some researches of textile fabrics treated with nano-silver have been studied for several years. In this work, we treated wool fibers using super nano-silver colloid (SNSE), having superior antibacterial activity with sulphide, evaluated antibacterial efficacy of the treated wool fibers using AATCC 100-1999 test method.

2. Experimental

2.1. Materials

Super nano-silver colloids(SNSE), silver colloidal solution containing sulphide prepared from ethanol base, were supplied from NP-Tech Co., Ltd., Korea. The diameter of silver particles in the solution was estimated at 2~5 nm. Pure wool fibers, wool spun yarns, and knitted fabrics which were composed of fibers treated with 20ppm silver were supplied from Suh Han Wool Textiles Co., Ltd., Korea. The wool fibers were treated with various silver contents using the SNSE by a pad-dry-cure method.

2.2. Measurements

Antibacterial activity of the nano-sized silver colloids and the samples treated with colloidal solution were quantitatively evaluated using AATCC 100-1999 test method by calculation of bacteria reduction ratio against both *Staphylococcus aureus* (ATCC 6538) and *Klebsiella pneumoniae* (ATCC 4352). Resistance to certain insect pests for treated wool fibers with the nano-silver colloids was determined that conditioned voracity untreated and treated wool fibers of known mass are placed in contact with selected larvae for 14 days. The mass loss of all samples and the condition of the test larvae are ascertained to assess the resistance of each test sample. Scanning electron microscope (SEM) was performed at 5 kV on JEOL JSM-6330F with up to 30,000 magnification for the surface observation of the treated wool textiles.

3. Results and Discussions

Table 1. shows the results of antibacterial test to the nano-silver colloids, the treated wool fibers, and the treated wool fabrics with the SNSE. The SNSE solution containing only 3 ppm silver showed completely disinfection effect. It is revealed that the SNSE is superior to the original NSE in antibacterial activity. Perhaps, it is implied due to smaller average diameter of the SNSE than that of the NSE. For antibacterial effect of the wool fibers, the content of the nano-silver colloids were padded with 5 ppm, 10 ppm, 20 ppm, and 30 ppm in original fibers. Treated fibers were displayed excellently antibacterial activity over 5 ppm of silver concentration. The sequent tests were confirmed spun yarns and knitted fabrics manufactured by wool fiber treated with 20 ppm of silver concentration are not inferior in antibacterial activity. All the samples were exposed to be perfectly antibiotic materials, hence SNSE including nano-sized silver was certified as antibacterial finishing agent for the wool fibers.

In wool textile product, it is required to mothproofing due to composed of proteinic fibers. The 20ppm nano-silver treated on the wool fibers was conducted to test about resistance to insect pests, according to ISO 3998-1977. Insect resistance on the wool fibers was appeared to average weight loss and reliving larvae nonexistence after 14 days. The average weight loss of the neat wool fibers and the treated wool fibers with the nano-silver colloids were 40.54g and 6.32g, respectively. Moreover, There is no existent reliving larvae on the latter sample. Through the facts, resitant effect to insect were found in wool fibers with nano-sized silver.

4. Conclusion

We confirmed antibacterial effect of the nano-silver colloid, and its practical application to wool fiber. Wool fibers finished with nano-sized silver revealed the functional material which have an mothproof efficacy besides antibacterial activity.

5. References

- 1) S. Y. Yeo, S. H. Jeong, *Polymer International*, **52**, pp. 1053-1057 (2003).
- 2) S. Y. Yeo, H. J. Lee, and S. H. Jeong, *Journal of Materials Science*, **38**, pp. 2143-2147 (2003).
- 3) H. J. Lee, S. Y. Yeo, and S. H. Jeong, *Journal of Materials Science*, **38**, pp. 2199-2204 (2003).
- 4) S. G. Oh, *Materials Integration*, **15**, pp. 69-74 (2002).
- 5) M. Diz, M. R. Infante, and P. Erra, *Textile Research Journal*, **71**, pp. 659-700, (2001).

Table 1. Antibacterial evaluation of the nano-silver colloids and the treated wool textiles

Samples	Silver content (ppm)	Bacteria reduction (%)	
		<i>Staphylococcus aureus</i>	<i>Klebsiela pneumoniae</i>
Nano-silver colliods	12	99.9	99.9
	3	99.9	99.9
Wool fibers	30	99.9	99.9
	20	99.9	99.9
	10	99.9	99.8
	5	99.9	99.8
	0	39.4	29.1
Spun yarns	20	99.8	99.9
Knitted fabrics	20	99.8	99.8