

Changes in Mechanical Properties of Sanitary Nonwoven Fabrics by Chitosan/Nanosilver Mixed Solution Treatment

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1. INTRODUCTION

In the case of sanitary top sheet nonwoven fabrics for disposable diapers, problems such as skin rashes have resulted from increased levels of moisture and chemicals from urine and feces, and infections from bacteria and irritation have arisen from the prolonged friction between the skin and the sheets. As a result, it is imperative to improve surface tactile of the sanitary nonwoven fabrics and functional modification thereof. The nonwoven fabrics have been widely used for disposable goods as well as a durable element for the industry due to the development of various manufacturing technologies.

Chitosan has outstanding bio-degradability and bio-compatibility without inducing environmental pollution. It has complex functions including antimicrobial, deodorization and nontoxicity,[1,2]. Efficiency of treatment, from the economic perspective, can be expected by mixing silver that can provide additional functionality with almost no toxicity to the human body, in order to supplement the weaknesses of chitosan as well as to efficiently elevate the treatment effect[3].

In this research, nonwoven fabric was treated by using admixture of chitosan, which is a natural macromolecule and nanosilver colloidal solution for which improvement of additional capabilities can be expected while supplementing weaknesses of chitosan, as treatment agent, in order to improve performances of nonwoven fabrics. Changes in the mechanical properties according to the admixture ratio of chitosan/nanosilver colloidal solution were reviewed and compared with the properties of nonwoven fabric treated only with chitosan.

2. EXPERIMENTAL

Materials

Material, 100% polypropylene nonwoven fabric (thermal-bonded, 0.16mm, 18.4g/m²) was provided by Korea Vilene, Ltd. The reagent used for the

mixed solution of chitosan (DD=95.3%, 40,000ppm) and nanosilver colloid (particle size 10 nm, 30,000 ppm) was provided by Texan Med. Tech. Co., Ltd. (Korea), and the supplied solution was diluted before use.

Processing of the Fabric

The solutions of chitosan (CH) and nanosilver (NS) were mixed in ratios of 3:1(CH3/NS1), 1:1 (CH1/NS1), and 1:3(CH1/NS3). The fabrics treated with these solutions were compared with the fabric that was treated only with chitosan (CH4). The treatment was performed with one-bath processing. The fabric was immersed in the solution at the liquor ratio of 40:1 for 1 hr, and padded for its wet pick-up at 100±2% and by heating at 100°C for 3 minutes.

In order to determine the mechanical properties of the chitosan/nanosilver treated nonwoven fabrics, 16 mechanical properties of the fabrics relating to tensile, bending, shearing, compression, surface characteristics, weight and thickness were measured using the KES-FB System(Kawabata Evaluation System, Kato Tech. Co. Ltd., Japan)[4]. Primary hand value(HV) such as Koshi, Numeri and Fukurami were calculated using the KN-203-LDY equation, and total hand value(THV) was calculated using the KN-302-W-dress convert equation based on determined primary hand value.

3. RESULTS AND DISCUSSION

Surface Structural Characteristic

The surface structural change in the chitosan/nanosilver treated nonwoven fabrics can be identified by observing the surface attachment state of the treatment agent. At this time, as the nanosilver particles are a colloid composed of ultra fine micro particles, the attachment state of the chitosan/nanosilver mixed solution is expected to have some different aspects than the one treated only by the chitosan. Therefore, to examine the surface structural characteristic of the chitosan nanosilver treated fabrics, SEM photos were compared.

According to Fig. 1, in (c) specimen, which has a large ratio of chitosan in the mixed solution, the attachment of particles was clearly observed; but, in (e) specimen, where the mixing ratio of nanosilver colloid is large, the attachment of particles was small and the surface was smooth.

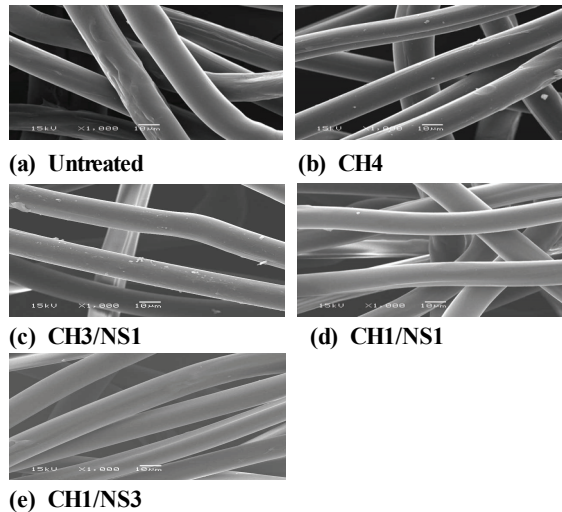


Fig. 1. Scanning electron micrographs($\times 1000$) of the chitosan/nanosilver treated nonwoven fabrics.

Mechanical Properties

Surface Characteristics are involved in the smoothness of the fabrics. When it comes to sanitary nonwoven fabrics, the touch of the surface is very important. The sensory test investigates the values of MMD/SMD, which are closely related to smoothness. It is well established that the smaller the value of MMD/SMD, the surface is the smoother. As shown in <Fig. 2>, values of MMD/SMD noticeably decrease when CH1/NS3 mixed solution was used for treatment. It is considered that nanosilver colloid is more evenly attached onto the surface, which leads to the excellent surface smoothness of the nonwoven fabrics.

As shown in <Fig. 3>, Koshi was decreased that meant the treated nonwoven fabrics became more flexible. In light of this, it is desirable to treat sanitary nonwoven fabrics which touch with the skin directly. Numeri is the smooth feeling we feels when we touch fabrics, which is influenced considerably by surface characteristics. Numeri was improved and in turn the surface of the treated fabrics became smoother after its treatment with chitosan/nanosilver mixed solution. It seemed that Fukurami of the treated fabrics increased regardless of chitosan/nanosilver mixed ratio. It presumed that the treated fabrics became bulky after the treatment with chitosan/nanosilver.

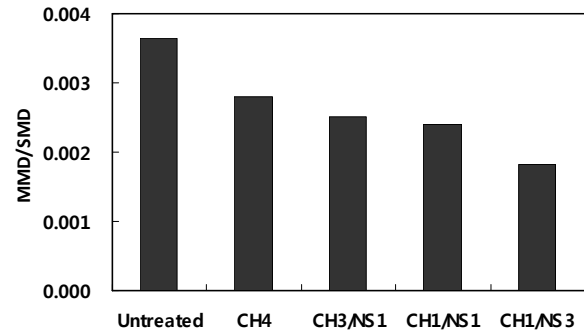


Fig. 2. MMD/SMD of the chitosan/nanosilver treated nonwoven fabrics.

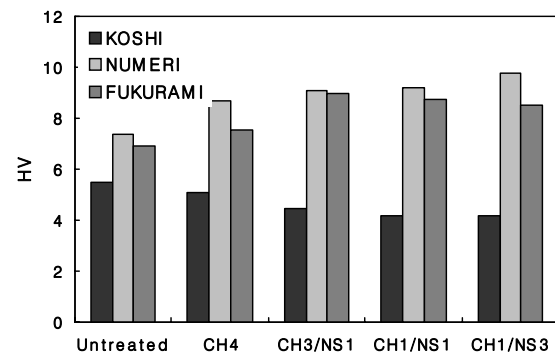


Fig. 3. Primary hand value(HV) of the chitosan/nanosilver treated nonwoven fabrics.

According to Table 1, B/W was decreased after treatment, the treated fabrics improved drapability. 2HG/G was decreased after treatment, it became to improve shape stability. W/T was decreased, it meant that air content in the fabrics was decreased. THV was increased after treatment with chitosan/nanosilver mixed solution.

Table 1. Variation of basic properties on wearing sensation of the chitosan/nanosilver treated nonwoven fabrics

Properties	Untreated	CH4	CH3/NS1	CH1/NS1	CH1/NS3
B/W	0.013	0.013	0.005	0.007	0.006
2HG/G	1.716	1.252	1.237	1.387	1.617
MMD/SMD	0.004	0.003	0.003	0.002	0.002
W/T	8.302	3.713	3.472	3.458	3.353

4. REFERENCES

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