아라미드 스펀레이스부직포의 구조와 기계적 성질에 있어 공정인자의 영향

김진일*, 안성민, 주창환
*(주)코오롱 중앙기술원, 충남대학교 섬유공학과

Influence of Processing Factors on the Structure and Mechanical Properties of Aramid Spunlace Nonwovens

Jin Il Kim*, Seong Min Ahn and Chang Whan Joo
**Kolon, R&D Center, Gumi, Korea*
Department of Textile Engineering, Chungnam National University, Daejeon, Korea

1. Introduction

The hydroentangling technology in various forms has existed for over forty years. Chicopee developed the basic concepts in the early 1950's using a low energy patterning process. DuPont started up the first high-energy spunlaced plant in 1974 using proprietary high-speed web forming and hydraulic needling(hydroentangling) technology. The physical characteristics of spunlaced nonwovens such as softness, flexibility, hand, drape, bulk, conformability, moldability, high strength and delamination resistance make this process unique among the other nonwovens process. In order to manufacture the high performance nonwoven, we are used aramid staple fiber. In this study, we have investigated the influence of processing factors on the structure and mechanical properties of aramid spunlace nonwovens.

2. Experimental

The characteristics of the produced aramid spunlace nonwovens are listed in Table 1. The SEM(JSM-6300, JEOL Ltd., Japan) was used to observe the morphological structure of samples. The tensile and tearing properties of samples were measured by tensile tester(Instron 4467). Air permeability of spunlace nonwovens was measured by the FX-3300(Textest)tester with the KS K 0570 method.

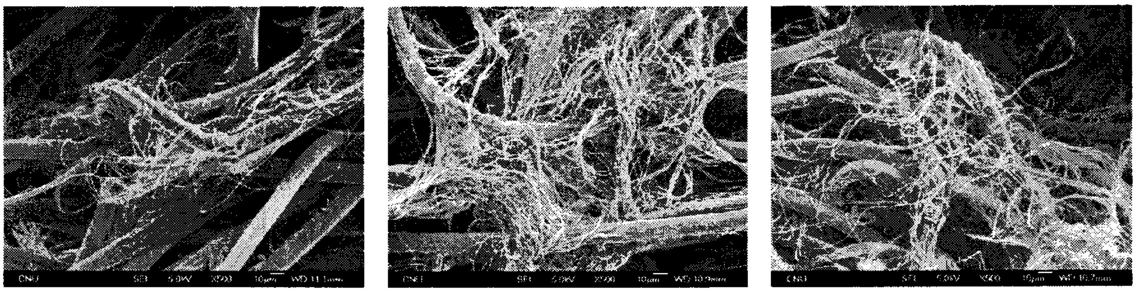
Table 1. Characteristics of aramid spunlace nonwovens with processing factors

<table>
<tr><th>Sample ID</th><th>Basis weight (g/㎡)</th><th>Thickness (㎜)</th><th>Feed velocity (m/min)</th><th>Water pressure (bar)</th><th>Portion ratio (para/meta)</th></tr>
<tr><td>F-7</td><td>106.9±2.85</td><td>0.97±0.04</td><td>15</td><td rowspan="2">Pre-wetting(50/150)
Surface(250/350)
Back(250/280)</td><td rowspan="3">10/90</td></tr>
<tr><td>F-8</td><td>110.3±2.25</td><td>1.01±0.04</td><td rowspan="7">10</td></tr>
<tr><td>F-9</td><td>102.6±9.66</td><td>0.89±0.02</td><td rowspan="6">Pre-wetting(50/200)
Surface(250/385)
Back(250/280)</td></tr>
<tr><td>F-10</td><td>123.9±2.59</td><td>1.05±0.02</td><td>30/70</td></tr>
<tr><td>F-11</td><td>102.8±2.27</td><td>0.89±0.04</td><td>50/50</td></tr>
<tr><td>F-12</td><td>108.5±2.05</td><td>0.86±0.03</td><td>70/30</td></tr>
<tr><td>F-13</td><td>101.6±6.15</td><td>1.04±0.70</td><td>80/20</td></tr>
<tr><td>F-14</td><td>130.6±3.90</td><td>1.00±0.01</td><td>100/0</td></tr>
</table>

3. Results and discussion

3.1. Morphological structure

The surface structure of aramid spunlace nonwovens is shown in Figure 1. The fibrillation degree of fibers increased with increasing para-aramid staple fiber portion. Thus, fibrillation of web occurred from the para-aramid staple fiber by impact of high water pressure.



(a) 10/90 (b) 50/50 (c) 100/0

Figure 1. SEM photographs of aramid spunlace nonwovens(×500)

3.2. Tensile properties

Figure 2 shows stress-strain curves of the sample with different para and meta-aramid fiber portion. Tensile strength of machine direction in spunlace nonwovens manufactured with all para-aramid staple fibers was larger than that of cross-machine direction due to the fiber reorientation by fibrillation of para-aramid fibers.

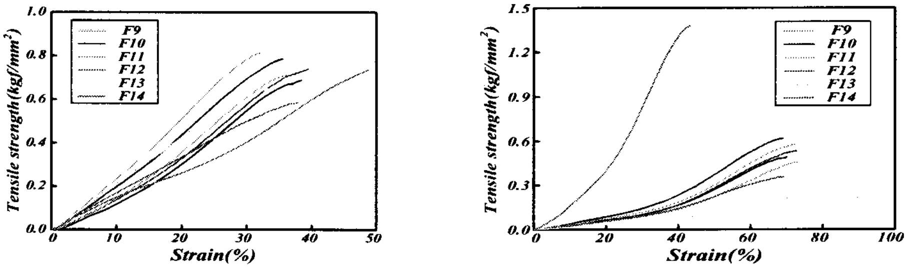


Figure 2. Stress-Strain curves of aramid spunlace nonwovens

4. Conclusions

The optimal processing conditions for obtaining high performance spunlace nonwovens are to select as feed velocity at 10m/min and to determine low water pressure, and the 50/50 of para/meta-aramid fiber portion ratio.

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