섬유집합체의 교차구조를 위한 물/초음파 시스템의 응용

강전영, 주창환
충남대학교 섬유공학과

Application of Water/Ultrasonic System for Interlacing Pattern of Fibrous Assemblies

Jeon Young Kang and Chang Whan Joo
Dept. of Textile Engineering, Chungnam National University, Daejeon, 305-764 Korea

1. Introduction

Ultrasonic wave has three classes of applications such as communication, inspection, imagination and processing. In processing, ultrasonic is used web bonding for nonwovens with applications including floppy disks, medical devices and many automotive part. The important components of ultrasonic system are power supply, converter, booster, horn, anvil roller, pressure system and hold time controller. In this process, the ultrasonic bonding of nonwoven fabrics is accomplished by applying high frequency vibration to be web weld together. And ultrasonic wave in water used cleaning system. When intense ultrasonic is in water, it causes cavitation, small vapour bubbles from which, in a few microseconds, grow and collapse. These effect used to interlacing pattern of fibrous assembles. The horn and anvil roller of ultrasonic system sink in water chamber, the wet web passed between horn and anvil roller. The producing of wet web sheet(WWS) by water/ultrasonic process is formed interlacing structure. This process can be new technology making for wet laid nonwovens. Thus, in this study, we investigated the surface structure and strength properties of WWS produced by water/ultrasonic system.

2. Producing principle

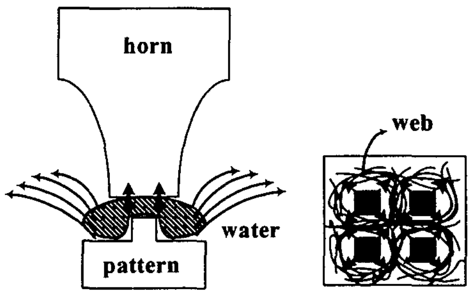

Figure 1. Behavior of water and web in water/ultrasonic system

Figure 1 shows the behavior of water and web in ultrasonic system. The web and water are place between horn and anvil roller. Water/Ultrasonic system is similar to spunlace process. The spunlace process is versatile process for bonding nonwoven fabric by fine, closely-spaced, high velocity jets of water to rearrange and entangle loose arrays of fibers. Meanwhile, in this process the high velocity jet is replaced by water/ultrasonic system. When ultrasonic is contact with water, the ultrasonic waves become alternating low and high pressure wave that create very small bubbles, cavities and vibration. The water is sprayed between patterns of anvil roller. In this behavior, the fiber of wet web is rearranged between patterns. The strength of web is maintained with entangle loose arrays of fibers.

3. Experimental

3.1 Preparation of sample

Figure 2 shows the schematic diagram of water/ultrasonic system. The paralleled web was passed by machine direction of water/ultrasonic system. The kind of web was PET fiber and the basic weight was 8g/m^2. The used WWS was made at laboratory and the producing conditions with 5kgf/cm^2 applied pressure and 30cm/min feed speed were used to make samples. The pattern shape was rectangular and size was 1(width)×1(length)×1(height)mm.

We used SEM(S-2350, Hitachi) and video micro camscope(SV-32, Sometech) to observe the surface structure.

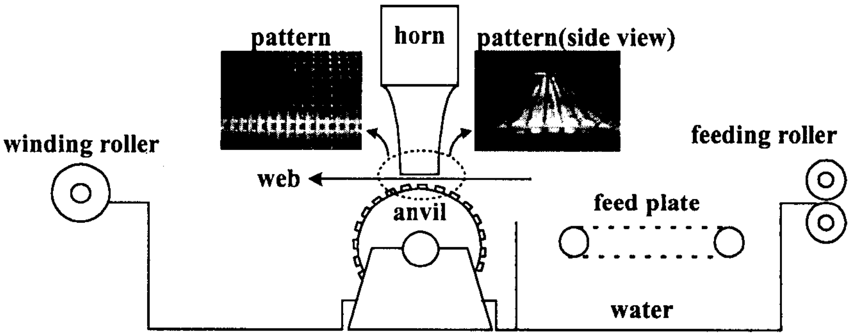

Figure 2. Schematic diagram of water/ultrasonic system

3.2 Strength properties

The strength properties of WWS were measured by tensile tester(Instron 4467). Figure 3 shows the experimental diagram of tensile testing. The (a) is tensile test method of the water/ultrasonically treated sample, (b) is untreated sample. The sample size was 2.5cm × 8cm. The crosshead speed was 10mm/min and the load cell used 5kgf.

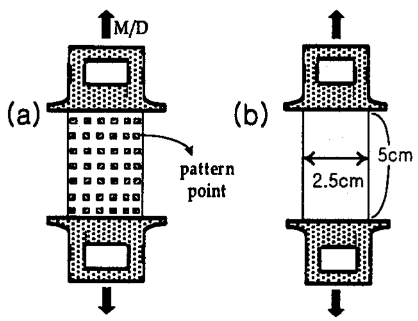

Figure 3. Schematic diagram of tensile testing

4. Results and discussion

4.1 Surface structure

Figure 4 shows the producing line of water/ultrasonic system. The spraying was occurred between horn and anvil roller. When the horn of high frequency contact with water, the movement of water was vibrated and sprayed. Figure 5 shows the fibers arrangement between patterns. The fiber of web was arranged between patterns. The behavior of fibers under horn was moved together by alternated pressure wave. In the process, the fibers of loose web on anvil roller was entangled. Figure 6 shows the sample produced by water/ultrasonic system. In photographs, the depression shape was pattern position and the fibers of web were random arrangement around the this position. It has strength and interlacing shape with entanglement of fibers.

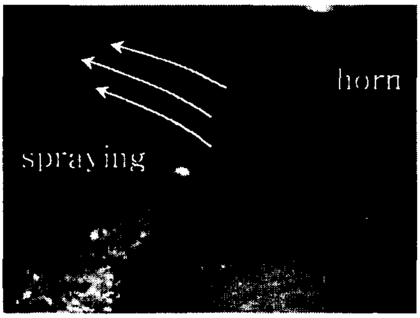

Figure 4. Photograph of producing sample

Figure 5. Photograph of fibers arrangement between patterns

Figure 6. Photographs of samples produced by water/ultrasonic system

4.2 Strength properties

Figure 7 shows the strain/stress curves of WWS and untreatment web. The breaking strength and modulus of WWS were larger than untreatment web. The strength of WWS increased about four times than that of original web strength value. Because the fibers are pushed down by water/ultrasonic from horn surface to anvil roller and deflected by the patterns. This results appeared with the rearrangement and interlacing of the fibers. And then the web has strength and interlacing structure.

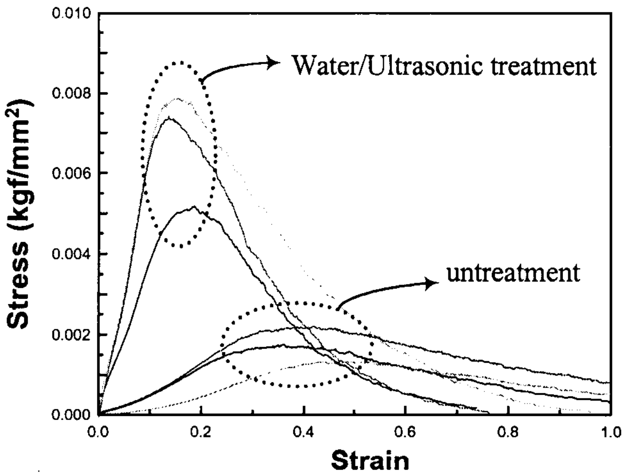

Figure 7. Strain/Stress curves of WWS and untreatment web

5. Conclusions

The paralleled PET web produced WWS using water/ultrasonic system. The surface structure of WWS was interlacing shape as the fiber of web rearranged and entangled. The breaking strength of WWS was $7g/mm^2$, it was four times larger than untreatment web. This result in the rearrangement and intermingling of the fibers.

6. References

1. Z. Mao and B. C. Goswami, INJ, 38-47(2001)
2. E. Ghassemieh, M. Acar and H. K. Versteeg, Composite 61, 1681-1694(2001)