03E01

Cotton-Based Laminates from Spunbond Line

Hageun Suh[1], Larry C. Wadsworth and H. Charles Allen. Jr.*

Textiles and Nonwovens Development Center, The University of Tennessee, Knoxville, TN 37996

** Cotton Incorporated, Raleigh, NC 27612, USA*

1. Background

Disposable nonwovens entered the medical field over four decades ago, beginning with basic paper-like face masks and proceeding through sterilization wrap, specialty drapes and gowns. These medical nonwovens have proven to be invaluable in products ranging from drape sheets to surgical gowns to adult pads and underpads by utilizing a gamut of nonwoven structures. The combining of nonwoven technologies has enabled the industry to offer products with properties hitherto though impossible.

Now that cotton has successfully re-established itself as a major fiber in the conventional textile market, it is believed that the nonwovens filed will also experience a resurgence of interest for it beyond the original use of cotton linters and waste fibers in nonwovens. Cotton's probability for growth in nonwovens should be high because of its potential in end use markets such as medical/surgical products and sanitary products. Its unique properties such as high absorbency and natural comfort properties attract consumers, while recently, its improved processability has made cotton extremely versatile for nonwoven manufacturing.

Preliminary researches (1-6) were performed at the Textiles and Nonwovens Development Center (TANDEC) at The University of Tennessee to develop laminates containing bleached carded cotton cores with outer layers of meltblown (MB) webs (meltblown/cotton/meltblown or MCM). In applications where greater strength is required, spunbond webs are used on one side in place of MB webs to produce spunbond/cotton/meltblown (SCM) laminates. The properties of the cotton laminates were compared to commercial spunbond/meltblown/spunbond (SMS) medical gown fabrics. The drawback of the MCM, SCM and SCS laminates was their lack of extensibility and aesthetics that could be attained if cotton was on the surface. Therefore, it was desirable to produce in one step a laminate with on one or both surfaces, which also had a degree of extensibility.

---

1. The author's present address is Research Institute of Clothing and Textile Sciences, Yonsei University, 134 Shinchon-Dong, Suhdaemoon-Gu, Seoul, KOREA 120-749.

2. Experimental

A trial was made to fabricate cotton and polypropylene (PP) spunbond (SB) laminates on the SB line. Two types of cotton nonwoven fabrics were used: 100% cotton chemical bonded fabric and thermal bonded 60% coton/40% polypropylene fabrics (TCPP). While producing the PP spunbond web, the cotton fabrics were fed into the calender (Figure 1). The chemically bonded webs did not bond to the spunbond, but the thermally bonded fabrics did. This allows for online production of a cotton-spunbond laminate, which can be used as the base fabric to produce a stretchable fabric. Seven laminates were produced using this method (Table 1). Two PP SB webs having different basis weights and three TCPP webs having different basis weights, bond areas and widths were used. It should be noted that samples #2 (SB2-TCPP1) and #3 (TCPP1-SB2) have the same composition, except that during the thermal laminating step, the SB web was placed on top in #2 so that it contacted the upper steel diamond heated roller. On the other hand, in the sample #3 the SB web was against the lower smooth steel heated roller. The laminate fabrics (#1-#5) contained two layers and the samples #6 and #7 were three layer laminates.

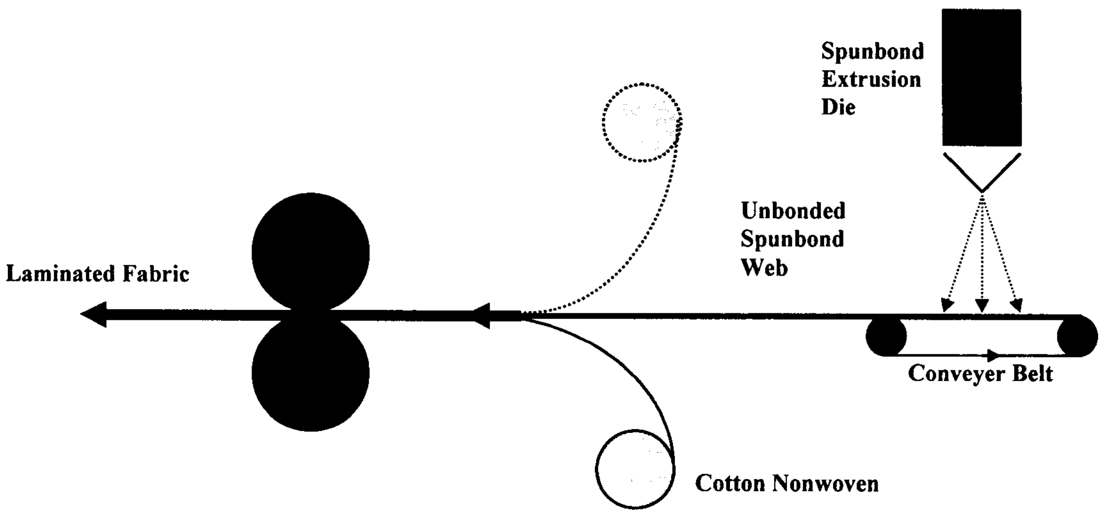

Fig. 1. Lamination on the spunbond line.

Although these fabrics had notably more extensibility than could have been obtained by laminating the cotton nonwovens to pre-bonded SB fabrics, to improve their stretchability substantially these fabrics were carried through the TANDEC web consolidation process (1-6). This post-treatment process heats the fabric while it is being drafted in the machine direction (MD), if cross direction (CD) elasticity is desired. During the process, the fabric increases in length and decreases in width. After cooling, the fabrics exhibit stretch and recovery characteristics in CD. Table 2 shows the processing condition of the stretching process and the properties of the fabrics produced.

In order to determine the relative wettability of the cotton-surfaced laminates, a strike-through-time test using a simulated urine solution was performed on the samples, which is based on EDANA Standard Test Method 150.2-93. A Lenzing Lister strike-through-time instrument with an RS 232 PC interface was utilized. The cotton-surfaced sides of the laminates were placed on the filter paper backup layers. For the three-layered laminates having only cotton surfaces, the patterned sides were placed on the paper layers. Whenever the SB side was tested, it was placed on the paper layers.

Table 1. Sample designation, basis weight and thickness results of the laminates produced on spunbond line.

SAMPLE NO.	SAMPLE DESIGNATION[1]	BASIS WEIGHT (oz/yd^2)			THICKNESS (mm)
		Layers	Targeted	Actual	
1	SB1-TCPP1	1.0/0.7	1.7	1.64 (61 g/m^2)	0.572
2	SB2-TCPP1	0.5/0.7	1.2	1.26 (47 g/m^2)	0.509
3	TCPP1-SB2	0.7/0.5	1.2	1.50 (56 g/m^2)	0.497
4	SB2-TCPP2	0.5/0.6	1.1	1.05 (39 g/m^2)	0.361
5	SB2-TCPP3	0.5/1.5	2.0	1.88 (70 g/m^2)	0.536
6	TCPP1-SB1-TCPP1	0.7/1.0/0.7	2.4	2.45 (91 g/m^2)	0.804
7	TCPP1-SB2-TCPP1	0.7/0.5/0.7	1.9	1.91 (71 g/m^2)	0.753

Note:
1. SB1 - 1.0 oz/yd^2 polypropylene (PP) spunbond webs
SB2 - 0.5 oz/yd^2 polypropylene spunbond webs
TCPP1 - Thermally bonded 60/40 cotton/PP with 0.7 oz/yd^2 basis weight, 18% bond area and 36" width
TCPP2 - Thermally bonded 60/40 cotton/PP with 0.6 oz/yd^2 basis weight, 40% bond area and 20" width
TCPP3 - Thermally bonded 60/40 cotton/PP with 1.5 oz/yd^2 basis weight, 20% bond area and 20" width

Table 2. *Stretching processing conditions and fabric properties after processing.*

SAMPLE NO.[1]	PROCESSING CONDITIONS		BASIS WEIGHT (g/m^2)	THICKNESS (mm)	Elastic Recovery in CD Direction at 50% Extension	
	Oven Temp. (°F)	Draw Ratio[2]			Instantaneous[3] (%)	Time Dependent[4] (%)
1	283	2.0	107	0.867	90	75
2	300	1.4	93	0.732	93	77
3	300	1.4	86	0.707	88	76
4	296	1.3	78	0.515	91	73
6A	306	1.4	161	1.023	89	73
6B	300	1.4	146	1.039	85	70
6C	295	1.4	137	1.025	84	68
7A	295	1.6	125	1.056	85	68
7B	300	1.6	125	1.060	83	70

Note:
1. Sample designation, see Table 1
2. Draw ratio = wind speed/unwind speed
3. Instantaneous extension and release and one minute recovery time
4. Instantaneous extension, three minutes of constant loading and one minute recovery time

3. Results

1. The stretching process increased the basis weight of the fabrics. (Tables 1 and 2).
2. The stretching process increased the fabric thickness (Tables 1 and 2).
3. Instantaneous elastic recovery at 50% extension and one-minute recovery time was in the range of 83-93% (Table 2).
4. Time dependent elastic recovery at 50% extension and three-minute recovery time was in the range of 68-77% (Table2).
5. Although the strike-trough times greatly exceed those of diaper cover stocks, for which the test was designed, it appeared that useful wettability data were obtained (Figure 2).
   a. Sample #1 (SB1-TCPP1) had phenomenally high strike-through times both before and after stretching process. This sample containing the lowest cotton content had the heavier SB layer (SB1) which might act as a barrier for the liquid not to be absorbed quickly.

b. The two-layered laminate samples, #2, #3 and #4, showed a similar trend in the wettability result. The lowest strike-through times as measured with cotton side against the backup paper were resulted, since the cotton side probably helped the liquid to be absorbed quickly. The wettability of the laminates after stretching process was decreased along with the increases in strike-through times.

c. Strike-through times of the three layered samples, #6 and #7, were lower than those of sample #1 regardless of the basis weight of the SB webs, which is probably due to the higher cotton content. Their wettability was decreased after the stretching process, proportional to the increase in basis weight.

The results were very encouraging, especially, since this was the first attempt at producing cotton laminates with a spunbond, on-line. It is also the first time that these fabrics have been through the stretching process. There is ongoing work to determine the processing conditions that will yield optimum fabric performance.

These fabrics would be suitable for medical isolation gowns, head covers, shoe covers, bed sheets, and pillow cases. They could also be used for consumer applications such as disposable underwear, towels, wipers, and personal hygiene products.

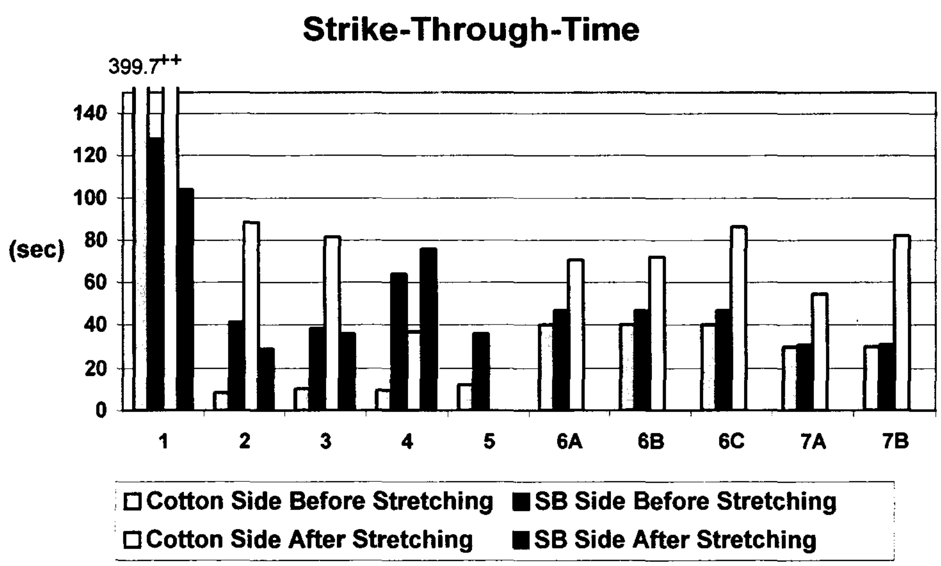

Fig. 2. Strike-through-times of the laminates

4. Conclusions

Stretchable cotton-containing nonwovens were produced having good elastic recovery. The composite base fabrics can be produced on-line by using standard spunbonding equipment. A post-treatment is used to create elasticity in the cross direction of the fabric. It appears that the computer interfacial strike-through-time test may be another useful tool in determining the effects of the laminate fiber composition and of the post-treatment process on the wettability properties of the fabrics.

Cotton is an important component of all these fabrics because of its soft hand, comfort, water holding capacity, moisture vapor transfer, wet strength, and consumer appeal. Finally, it appears that an inexpensive technology has been developed, which with additional refinement, could hasten the consumers' ready acceptance of nonwovens as highly desirable textile apparel.

5. Acknowledgment

The authors are thankful to Cotton incorporated for funding this project. Also, Exxon chemical Company is thankfully acknowledged for providing the Reicofil® spunbond line to TANDEC. Finally the sharing of the SB line time by TANDEC for this project is appreciated.

6. References

1. Wadsworth, Larry C. and Hassenboehler, Charles B., "Stretchable Fabric Technology Options," Nonwovens World, Spring 1994, P 49-56.
2. Hassenboehler, Charles B. and Wadsworth, Larry C., "Expending Roll Goods Value by Easy Stretch Processing," INDA-TEC 97 International Nonwovens Technical Conference, Book of Papers, INDA Associations of the Nonwoven Fabric Industry, Cary, NC, P 14.1-14.5.
3. US Patent Re-issue No. 35,206 of US Patent 5,244,482 to Hassenboehler and Wadsworth of The University of Tennessee, April 16, 1996.
4. US Patent 5,441,550 to Hassenboehler and Wadsworth of The University of Tennessee, August 15, 1995.
5. US Patent 5,441,606 to Hassenboehler and Wadsworth of The University of Tennessee, August 22, 1995.
6. US Patent 5,599,366 to Hassenboehler and Wadsworth of The University of Tennessee, Feb. 4, 1997.