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DEVELOPMENT OF VALUE-ADDED THERMALBONDED-NEEDLEPUNCHED COTTON COMPOSITES: NEW APPROACH AND APPLICATIONS

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Introduction

Needlepunched nonwoven substrates are known to be weaker as the bonding mechanism is basically fiber interlocking. One method of enhancing the strength of needlepunched nonwoven a fabric is to compliment the needlepunching operation with the thermalbonding operation. The thermalbonding operation is basically melting the low melt polymer fibers that have been mixed with the base substrate before the needlepunching operation. To have a uniform distribution of low melt fibers in the web, it is important to have the blending done manually and then subsequently in the hopper feeder of the needlepunching line. The present study elaborates the results on the thermalbonding of cotton webs. Two different blend proportions have been used in the study.

Method and Materials

The nonwoven fabrics were first needlepunched on a "state-of-the-art" H1 needlepunching nonwoven machine and then thermalbonded using a through-air thermal bonding machine. The details of the cotton and the low melt polypropylene used are given in Tables 1 and 2. Table 1 gives the basic cotton properties characterized using the HVI 900A. Table 2 gives the properties of the polypropylene fibers as given by the commercial manufacturer. Three different needlepunched-thermalbonded samples were developed and details are given in Table 3.

Experimental Results

Important mechanical properties such as weight, tensile strength and elongation were measured. Since the aim of the study was to examine the enhancement in strength due to thermalbonding, efforts were focused only on the tenacity measurements. Breaking load values in both machine (MD) and cross directions (CD) are given in Table 4. Figure 1 delineates the breaking load values in machine and cross directions. As is evident, there is not much difference in the tenacity values between machine and cross directions. Elongation values are given in Table 5. There seems to be marginal increase in the elongation values in the cross direction. Figure 2 pictorially depicts the elongation values.

Structural Characterization

The arrangement of cotton and polypropylene fibers in the web is clearly evident in the scanning electron micrograph (Figure 3). The melting of polypropylene fibers that have circular cross sections is clearly evident in the scanning electron micrograph.

Conclusions

The general conclusion from the preliminary study is that the thermalbonding process significantly enhances the strength of needlepunched nonwoven webs. Furthermore, there seems to be no appreciable change in the tenacity values of thermalbonded webs between machine and cross directions.

Acknowledgements

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Table 1. Cotton Details.

Micronaire	Length	Uniformity	Strength	Elongation	Leaf	Rd	+b	CG
4.9	1.03	79.8	27.6	3.9	1	77.7	12.0	13-1

Table 2. Polypropylene Properties.

Product Type	T133
Denier	1.7g/9000m
Elongation	200%
Crimp	22.0 CPI
Finish	0.45%
Cohesion	5.5grams/gain
Melt flow rate	30.0 dg/min

Table 3. Samples Developed.

Sample	Material	(% Composition)	Punching	Weight [gm/sq.m]
B1T	Cotton/Polypropylene	80/20	Single punched	68
B3T	Cotton/ Polypropylene	80/20	Single punched	82
C3T	Cotton/ Polypropylene	60/40	Single punched	109

Table 4. Breaking Strength in Machine and Cross Direction.

Sample	Weight (gm/sq.m)	Breaking load (N) in MD	[SD]	Breaking load (N) in CD	[SD]
B1T	60	30.12	[2.89]	29.73	[3.50]
B3T	80	29.89	[1.32]	34.35	[1.91]
C3T	65	47.76	[4.59]	44.52	[4.08]

Table 5. Elongation in Machine and Cross Direction.

Sample	Weight (gm/sq.m)	Elongation (mm) in MD	[SD]	Elongation (mm) in CD	[SD]
B1T	60	75.62	[3.44]	97.34	[6.14]
B3T	80	81.51	[1.49]	84.98	[3.04]
C3T	65	55.44	[3.01]	69.87	[2.67]

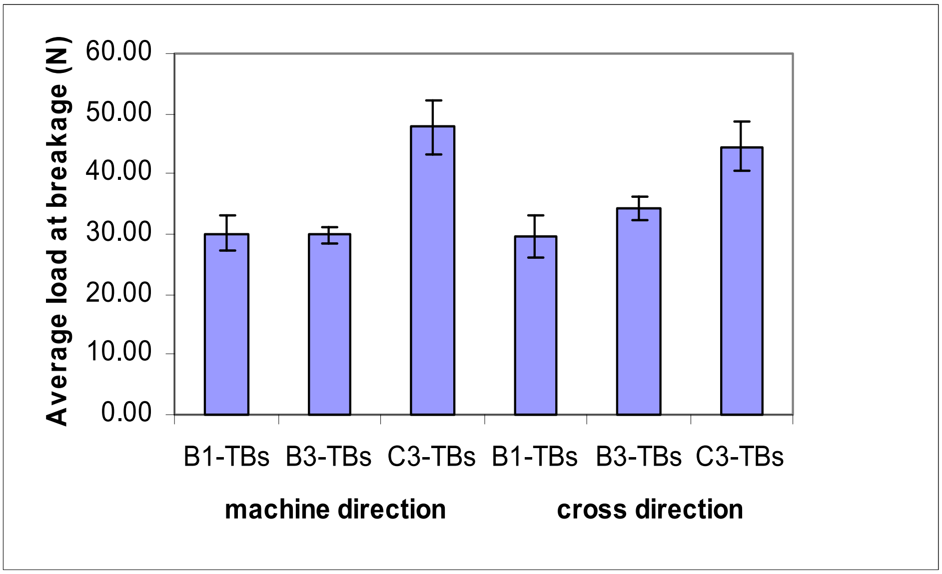

Figure 1. Breaking load – Machine and Cross directions.

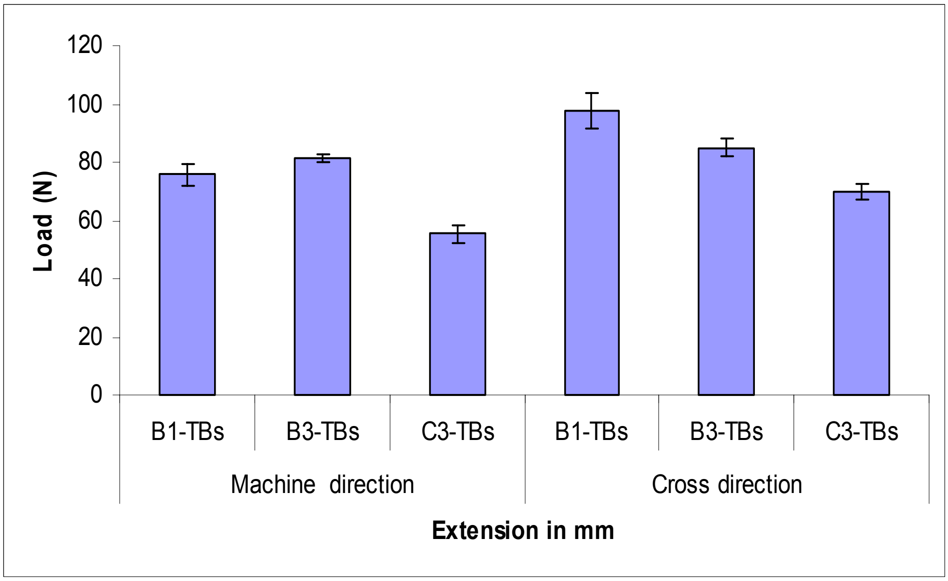

Figure 2. Elongation in Machine and Cross Directions.

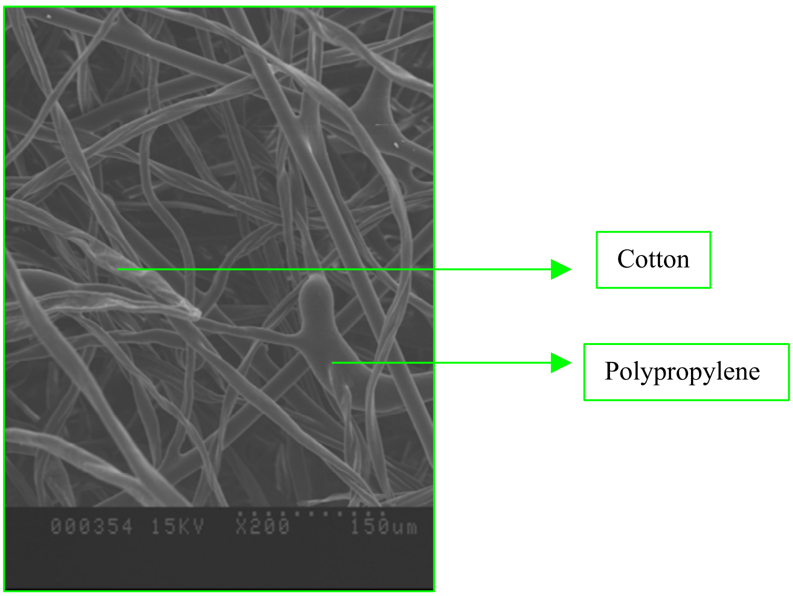

Figure 3. SEM image of thermal bonded Cotton/Polypropylene at magnification: x200.