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Experimental Analysis of Bonding Force on the Point Bonding Carbon Fiber Bundles(PBCFB).

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INTRODUCTION

Thermal bonding, the use of heat to bond thermoplastic fibers together, has become an established and successful technique in the nonwoven industry. In order to make strong thermal bonding nonwovens, the major technical problem to give strong bonds without any adverse effects is to find a combination of fiber type, bonding temperature, bonding pressure and so on. The binder fibers commonly used are made of polymers with comparatively low melting points, such as polypropylene, copolyester, and nylon 6 fibers[1]. However, the use of these binder fibers causes weak bonding force[1]. Thus, we used polyester and SPECTRA® as binder fibers to improve the bonding force of high modulus fibers such as carbon and glass fibers.

The research work was undertaken to develop a model structure composed of fiber and binder segments to represent thermal point bonding nonwovens and to predict their mechanical properties. The ultimate aim of this study is provided to evaluate the effect of various fibers and binder properties, on the thermal point bonded nonwovens, and to design thermal bonding nonwovens suitable to the end-use of the required mechanical characteristics.

EXPERIMENTAL

For the study, carbon fiber bundle(Thornel™, T-300 12K) and glass fiber bundel(E glass, RS128KA30, Lucky Co.) are used carrier fiber. Polyester and SPECTRA® are used binder fiber. The sample was produced as shown in Fig.1. Binder fibers are mounted between two carbon fiber bundles and then carbon fibers and binder fibers are thermal point bonding on the LABO PRESS(FSMP-37).

To study the effect of bonding temperature, bonding pressure and bonding structure effect on the bonding force between carrier fiber and binder fiber, we made samples with the manufacture conditions as seen in Table. 1.

In order to determine the bonding force between carrier fiber and binder fiber, four tensile models were developed, as illustrated in Fig. 2. The samples were the extended on an Instron Tensile Tester at a extension of 10%/min.

A differential-scanning-calorimetry study was performed by using a Perkin-Elmer DSC-4 instrument to characterize the thermal properties of binder fiber with before and after heating treatment.

Table. 1 Sample manufacture conditions

Binder fiber	Bonding temperature (℃)	Fiber contact angle(°)	Binder content(g)	Bonding pressure (kgf/cm^2)	Carrier fiber	Number of point
PET	265~285	0~90	0.001	10~100	Carbon Glass	1~4
SPECTRA®	160~180	0~90	0.001	10~100	Carbon Glass	1~4

RESULTS AND DISCUSSION

Fig. 3 shows the effect of bonding temperature on the bonding force between carrier fiber and binder. It can be observed that bonding force has maximum value at 280℃ bonding temperature. This result is due to the fact that binder fiber was degraded over 280℃ and changed the morphological structure. The effect of bonding pressure on the bonding force between carrier fiber and binder is shown in Fig. 4. Bonding force increased up to 70kgf/cm^2 and then decreased. This result is due to the heat transfer more efficient than low bonding pressure and above 70kgf/cm^2 bonding pressure caused the thermally degradation of binder fiber and crushed carrier fiber.

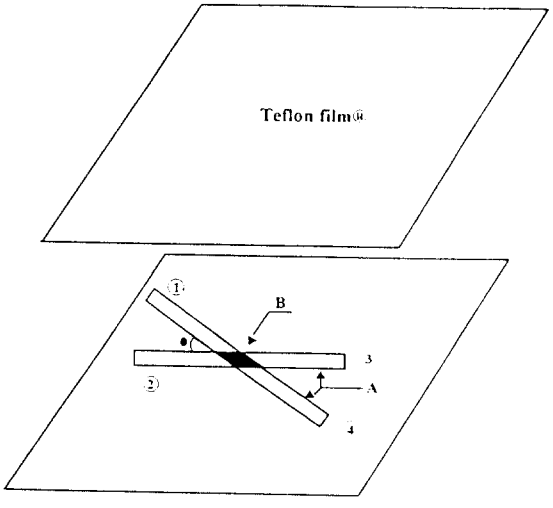

Fig. 1 Test specimen for the thermal bonding force between carbon fibers and binder fiber.
A: carbon fibers b: binder fibers θ: fibers contact angle

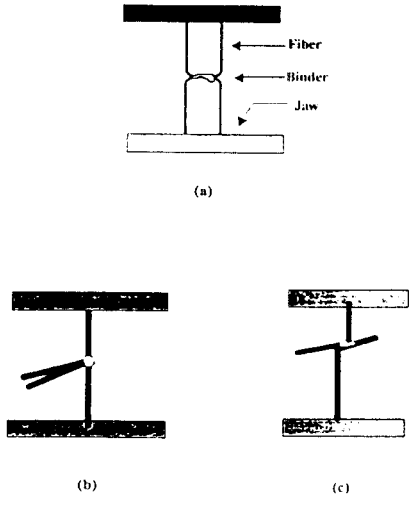

Fig. 2 Model of mechanical properties on the thermal bonding fibers.
(a) tensile model (b) tearing model (c) shear model

CONCLUSION

Bonding temperature and pressure are important factors to the bonding force between high modulus fibers and thermoplastic binder fibers, as well as, general trends are as follows:

(1) Bonding force between carbon and polyester fibers has maximum value at 280℃ of bonding temperature and glass fiber has similar trend.
(2) As the effect of bonding pressure, the bonding force increases with increasing bonding pressure up to 70kg/cm^2 and decreasing.

REFERENCES

1. S.K. Mukhopadhyay, J.W.S. Hearle and P.W. Foster, *Text. Inst.*, 2, 235(1988)
2. J.W.S. Hearle and V. ozsanlay, *Text. Inst.*, 73(1), 1(1982)
3. R.I.C. Michie, *Text. Res. J.*, 33(6), 403(1963)
4. T.H. Grindstaff and S. M. Hansen, *Text. Res. J.*, 56, 383(1986)

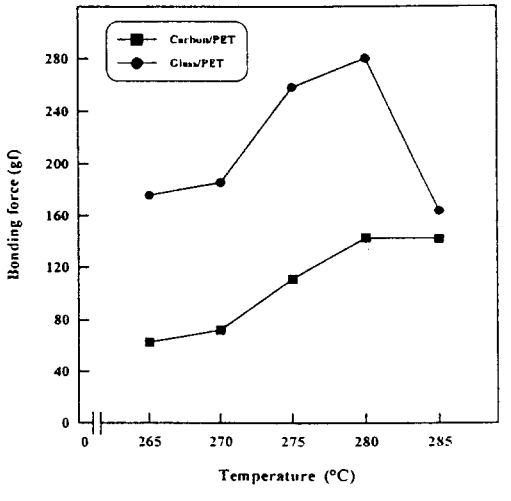

Fig. 3 Effect of the bonding temperature on the bonding force.

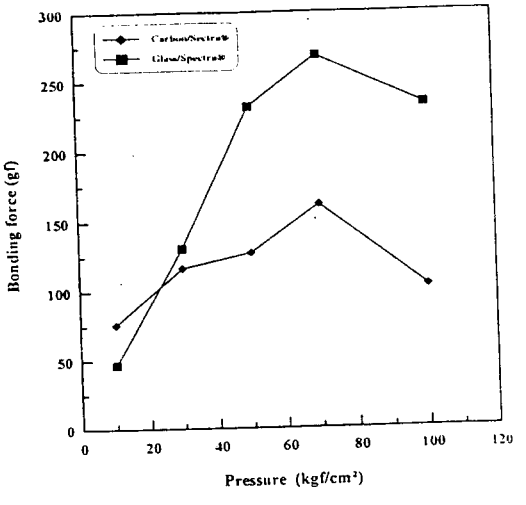

Fig. 4 Effect of the bonding pressure on the bonding force.