FABRICATION OF NANOFIBER NON-WOVENS ON THE MELT BLOWING DIE WITH AIR BY-PASSES

by

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The air flow field of the melt blowing die with air by-passes is simulated. The results show that fibers fabricated on the die with air by-passes are much finer than those without air by-passes, which indicates an energy-saving approach to fabricating nanofibers on the melt blowing equipment.

Key words: *melt blowing, air by-pass, air flow field, nanofiber*

Introduction

Melt blowing can fabricate non-wovens made up of superfine fibers. The polymer melt will swell when extruded from the spinnerette orifice because of the elastic effect. Extrusion swelling will cause back air flow between the swelling melt and the die, which is unfavorable to the polymer drawing. In this paper, two air bypasses are added to the melt blowing die. The air bypass starts from the upper part of the air slot and has an arcuate upper and a linear lower passage. The axis of the lower passage is parallel to the orifice axis. The air flow field of the melt blowing die with air bypasses is simulated and fiber diameters are measured and compared with those fabricated without air by-passes.

Results and discussions

The Fluent software is used to simulate the air flow field. The initial air velocity and temperature are 350 m/s and 300 °C, respectively. Figure 1 is the air velocity vector diagram and fig. 1(b) is a partial enlarged view. It can be seen that the air by-passes reduce the back air flow region remarkably and form forward air flow near the orifice, which is favorable to the polymer drawing.

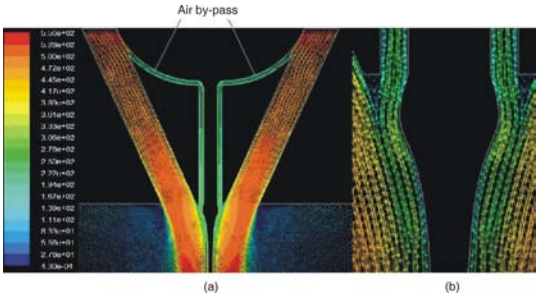

Figure 1. Air velocity vector diagram

Melt blown non-wovens are fabricated on the die with and without air by-passes and fiber diameters are measured using an

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Table 1. Fiber diameters fabricated with and without air by-passes

No.	Width of air by-pass [mm]	Height of air by-pass [mm]	Arc radius of air by-pass [mm]	Diameter with air by-passes [nm]	Diameter without air by-passes [μm]	Diameter reduction [%]
1	0.20	50	45	641	1.62	60.4
2	0.15	45	35	428	1.02	58.0
3	0.10	40	35	479	1.18	59.4
4	0.15	50	40	823	1.91	56.9

image processing method [1]. Table 1 shows the measured fiber diameters. As can be seen, fibers fabricated on the die with air by-passes are at least 56% finer than those fabricated without air by-passes and nanofibers are obtained with the aid of air by-passes.

Conclusion

The air flow field of the melt blowing die with air by-passes is simulated. The fiber diameters are compared with those fabricated on the die without air by-passes. The results show that fibers fabricated on the die with air by-passes are much finer than those without air by-passes, which indicates an energy-saving approach to fabricating nanofibers on the melt blowing equipment.

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