POLYMER DRAWING IN THE UNSYMMETRICAL AIR FLOW OF MELT BLOWING: NUMERICAL SIMULATION

by

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The unsymmetrical air flow of the dual slot die in the melt blowing process is simulated. The diameter and transverse displacement of the threadline are obtained numerically. The result shows that the threadline diameter in the unsymmetrical air flow is larger than that in the symmetrical one. This paper helps to point out the research direction for producing finer melt blown fibers.

Key words: *melt blowing, polymer drawing, unsymmetrical air flow field*

Introduction

Melt blowing is a non-woven process for producing superfine fibers. The fiber diameter is strongly affected by the air flow field. The symmetrical air flow field was studied before [1]. In this paper, the unsymmetrical air flow field will be simulated. The polymer drawing model will be solved based on the simulated air flow field to predict the threadline diameter and transverse displacement.

Numerical simulation of the unsymmetrical air flow field

The computational fluid dynamics software FLUENT is utilized to simulate the air flow field. The slot width is 1.3 mm, the head width is 2.56 mm, and the slot angle is 60°. For conventional air flow fields of the dual slot die, the initial air velocity of both inlets is the same, such as 300 m/s. For the unsymmetrical air flow field, the initial air velocity of each inlet is 285 m/s and 315 m/s, respectively.

Experimental verification of the polymer drawing model

Experiments are performed on a HDF-6D melt blowing non-woven equipment to verify the polymer drawing model. Details about the experiment and polymer drawing model can be found in [2]. The predicted threadline diameter is 1.72 μm and the measured threadline diameter is 1.90 μm. The prediction error is 9.47%, which confirms the effectiveness of these models.

Results and discussion

As can be found in fig. 1, the threadline diameter in the unsymmetrical air flow field is larger than that in the symmetrical air flow field. Unsymmetrical air jet flows cause lower air velocity along the spinneret axis where the threadline lies in, which thus is unfavorable to the polymer drawing.

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Figure 2 shows the threadline transverse displacement in the unsymmetrical air flow field. The threadline swings to the left side because of the higher velocity of right slot. If velocities of each inlet change alternately, may the threadline be attenuated much finer? This will be our future subject.

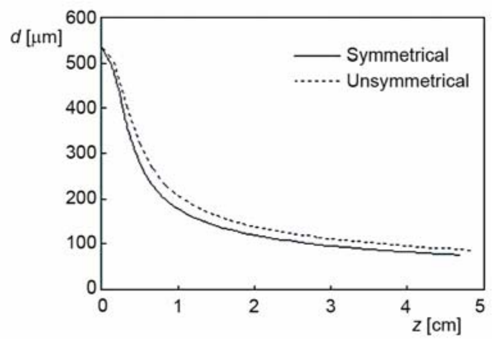

Figure 1. Threadline diameter profile

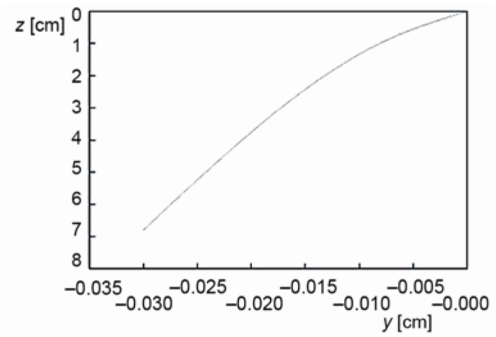

Figure 2. Transverse displacement of threadline

Conclusions

The unsymmetrical air flow field of the dual slot die in the melt blowing process is simulated. The polymer drawing model is then solved based on the simulated flow field. The diameter and transverse displacement of the threadline along the spinline is obtained. The result shows that the threadline diameter in the unsymmetrical air flow field is larger than that in the symmetrical air flow field. This paper helps to point out the research direction for producing finer melt blown fibers.

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Reference

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