Proceedings of the Canadian Society for Mechanical Engineering International Congress 2022
CSME Congress 2022
June 5-8, 2022, Edmonton, AB, Canada

Computational optimization of a drafter for spunbonding polypropylene-based filaments

Behrang Mohajer[1], Mohammadmehdi Ataei[2], Markus Bussmann[3], Chul B. Park[4]
[1234] Department of Mechanical and Industrial Engineering, University of Toronto, Canada
[1]bmohajer@mie.utoronto.ca, [2]ataei@mie.utoronto.ca, [3]bussmann@mie.utoronto.ca, [4]park@mie.utoronto.ca

ABSTRACT

We present a CFD optimization of a spunbonding drafter using a compressible OpenFOAM solver to model the airflow. The optimization goals are to (1) maximize skin friction and thus the draw on the filaments, (2) minimize the expensive pressurized air consumption rate, and (3) achieve maximum drawing uniformity and thus production quality.

We present 49 step-by-step CFD simulations and recommend optimum dimensionless geometrical values for a drafter. We identify a braking effect on the filaments and find that small changes in the drafter mixing zone can significantly enhance the internal airflow, and thus, the drawing process. We assess the key parameters of the drafter design and compare the mass flow rate variation: the flow uniformity in the mixing zone would be greatly improved by widening the drafter. Furthermore, a linearly diverging flow mixing would greatly increase the drawing force while maintaining drawing uniformity.