142b Using Computational Fluid Dynamics to Study and Improve Multihole Schwarz Melt-Blowing Dies

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Melt-blowing dies are used industrially to fabricate fine polymer fibers. The Schwarz die is a type of melt blowing die that uses multiple rows of polymer orifices and associated air jets. One Schwarz multihole die that has been used industrially consists of 165 jets in three columns and 55 rows. Using computational fluid dynamics, the experimental measurements of the air flow field from this Schwarz die can be reproduced using the k-ε turbulence model. In order to study the effect of changing the orifice spacing on the flow field, six different multihole die geometries were simulated in 3D with this model. The interactions between the jets lead to a flow field that is very different from that of a single annular jet. When compared with the flow field of a single jet, the velocity maximums occurred closer to the die face for an array of jets. The spreading rates for the center column jets of the multihole dies were similar to each other, and close to 0.5, while the spreading rate of a single round jet has been observed to be close to twice this value. In addition, the different multihole geometries showed variations from each other, leading to observations concerning multiple jet interactions. The distance required for the inside column of jets to affect the outside jets was determined as a function of the jet orifice spacing. Based on the simulation results, correlations were developed to help predict different characteristics of the flow field based on the jet spacing. The turbulence intensities of the different jet geometries were also compared, but the turbulence intensities of all the simulated flow fields did not vary as significantly as the velocity profiles.