Simulation-Based Optimization of Spinneret Hole Patterns and Experimental Validation with Pre- and Post-Optimization Spinnerets

Walter Arne*†[1], Hannes Elmer*‡[2], and Jörg Schreiber*§[3]

[1]Fraunhofer Institute for Industrial Mathematics – Germany
[2]Elmer Gesellschaft m.b.H. – Austria
[3]Dienes Apparatebau GmbH – Germany

Abstract

KEY MESSAGE
We demonstrate how simulation-based optimization of spinneret hole patterns improves cooling and moisture removal in wet spinning, leading to more stable operation and enhanced fiber quality and validate the results with experimentally manufactured spinnerets on an industrial line.

ABSTRACT CONTENT
In wet spinning, spinneret geometry and hole pattern strongly affect mass and heat transfer and thus fiber quality and process stability. We present a simulation-based workflow for optimizing hole patterns, starting from an industrial reference design. Flow and transport simulations are combined with mathematical optimization to improve cooling, moisture removal and flow homogeneity. Optimized spinnerets are manufactured with industrial partners (Elmer GmbH, Dienes Apparatebau GmbH) and tested on a real spinning line. Comparisons of the original and optimized designs show improved process robustness and fiber properties, demonstrating the practical value of simulation-driven spinneret design.

Keywords: Wet Spinning, Spinneret Design, Fiber Quality, FIber Properties, Simulation

*Speaker
†Corresponding author: walter.arne@itwm.fraunhofer.de
‡Corresponding author: h.elmer@elmergmbh.at
§Corresponding author: j.schreiber@dienes.net