DEVELOPMENT OF A NEW DESIGN METHODOLOGY FOR COMPLEX PROFILE EXTRUSION DIE WITH THE AID OF OPENFOAM

A. RAJKUMAR, L.L. FERRÁS, C. FERNANDES, O.S. CARNEIRO,
J.M. NÓBREGA
IPC/I3N – Institute for Polymers and Composites, Department of Polymer Engineering,

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The unique design nature of thermoplastic profile in acquiring complex shapes accounts for extensive applications. The prime extrusion die design challenge is achieving a uniform flow at the die exit. With the usual methodologies employed to design the die, based on experimental trial-and-error procedures, high resources consumption are involved, which significantly increase their cost and time to market. Moreover, designing a complex profile (and corresponding die) having no previous experience with similar geometries, will present additional difficulties. Therefore, novel die design approaches are mandatory in order to reduce the required resources and to guarantee a good performance for the produced profile.
The main objective of this work is to develop a new design methodology for complex profile extrusion dies with the aid of OpenFOAM Framework. Considering the polymer melt rheology, an improved solver was developed to simulate the steady flow of an incompressible generalized Newtonian fluid under non-isothermal conditions. The solver was verified using the Method of Manufactured Solutions (MMS). In-order to exemplify the application of the design methodology, a complex die flow channel, intended for the production of a polycarbonate [TRIREX 3027U (M1)] protection bar profile, was developed. The accuracy of the solver was verified using data collected in industrial extrusion runs, showing the effect of the die heaters temperature in the flow balancing at the outlet of a swimming pool cover profile die.