11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

MODELLING SQUEEZE FLOW OF VISCOUS POLYMER MELTS

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Key Words: *squeeze flow, finite element analysis. thermoplastics, welding*

In the present work, squeeze flow between rigid platens of viscous polymer melts was investigated through two dimensional rigid-viscoplastic finite element simulations using MSC Marc. The polymer under investigation was a thermoplastic with a processing temperature above its melt temperature. The aim of the present work is to develop a finite element modelling framework that is capable of simulating squeeze flow of polymer melts. The frame work developed will be experimentally validated and used to model thermoplastic flow during welding for different geometries and processing parameters, thus providing useful information for the optimisation of welding processes.

Analytical solutions exist to the squeeze flow problems of simple geometry and material models. These include solutions for squeeze flow between parallel circular discs as well as infinite length parallel plates [1, 2], between non-parallel plates [3, 4], and between concave and convex plates [5].

Rigid-viscoplastic finite element analysis was conducted by assuming that the plates were non-deformable (rigid) and the thermoplastic was a viscous fluid. The predicted variables, namely speed (displacement) and pressure under constant applied pressure and constant applied speed respectively, were compared to those calculated from the analytical solution [1]. They were found to be in good agreement for both types of loading conditions considered. For example, a parametric study was conducted for squeeze flow of polymer melts initially measuring up to 70 mm in width and up to 500 µm in thickness between infinitely long parallel plates. Loading at a constant pressure for 15 minutes, the average and maximum difference in thickness calculated between the FE and analytical solutions were respectively 0.9% and 5% for the wide range of geometries considered.

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