Isothermal simulation of an aluminum extrusion process with a multi-hole die

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Introduction

In aluminum extrusion roadmap, a number of research areas were defined to improve the product functionality such as reducing the cost and decreasing the construction complexity. Achieving improvements within these areas can be accomplished through process modeling and simulation. For example, the aluminum extrusion for four L-shaped profiles with two different thickness is studied. Four different pockets are constructed in the die.

Objective

The simulation aims at:(1) exploiting FEM codes capabilities and users' knowledge in the simulation of an industrial extrusion process, (2) checking the effect of pocket shape on process behavior, (3) checking the effect of profile thickness on pocket effectiveness.

Method

The die is assumed to be rigid and boundary conditions are applied to the billet. The bearing area is modelled by an average normal construction. Finally the billet is descretized with 10 nodes tetrahedron element where each node has 3 dof and an ALE/eulerian formulation is applied.

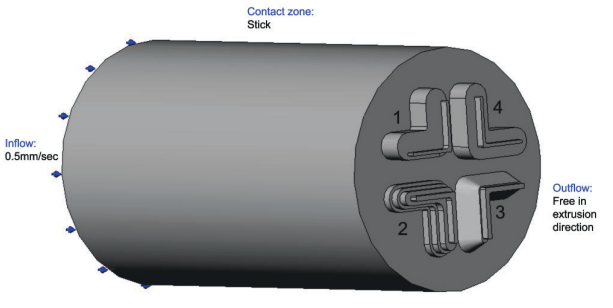

Figure 1 : Boundary conditions applied on the billet.

Results

In fact, the results are predicted after the die is being filled. The steady state profiles' velocities and the extrusion force are plotted as shown in figures 2 and 3.

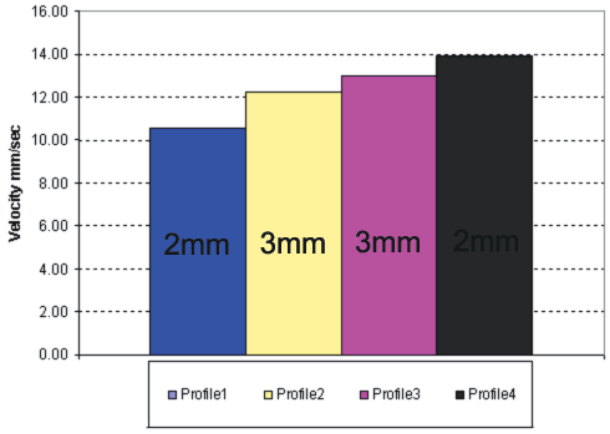

Figure 2 : Velocity distribution for 2mm and 3mm profiles' thickness.

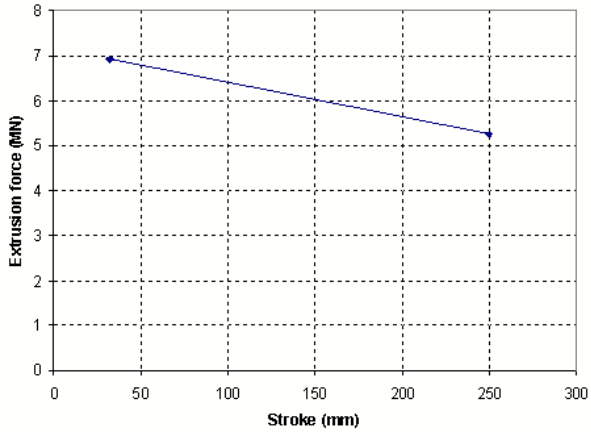

Figure 3 : Extrusion force versus ram's stroke.

Discussion

The simulation takes quite a long time due to the large number of degrees of freedom and the usage of an iterative solver. It is observed from the current simulation that the influence of the pocket's shape on the process behavior is obvious but the influence of the profile thickness on the pocket effectiveness is not recognized.