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RAM SPEED EFFECT IN HOT MICRO-EXTRUSION

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Numerical computer simulation using the finite element method (FEM) is a reliable technique to describe metal flow phenomena during forming operations. In this work FEM simulations of hot micro-extrusion of an aluminum alloy were performed and the effect of the ram velocity on the metal flow phenomena was investigated. The presented study was performed with the numerical code DEFORM 2D in axisymmetric mode using experimental material flow curves of AA 7108 alloy. The extrusion ratios were 16 and 100, and the ram speed ranged from 0.5 to 20 mm/s. The initial temperatures of the billet and tooling were 400oC. The metal flow was analyzed from the strain rates, temperature, velocity, and stress maps. It was found that the velocity profile at the exit changed as the ram speed was increased. This effect was associated to the high strain rates that increase the flow stress and results that the material at the center flows faster than the material at the edge of the die hole. This velocity profile promoted a stress field just behind the die orifice and the material deformed more intensely to achieve the equilibrium velocity and, moreover, the final velocity was lower than the predicted. This indicates that in higher ram speed hot micro-extrusion the material could expand its diameter and it should be evaluated for critical dimensional tolerances.