Finite Element Modelling of Pilger Rolling of Tubes

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ABSTRACT

Pilger rolling is a cold working process used during manufacturing of seamless tubes. The tube with a mandrel inside is fed forward and rotated in stepwise increments, while the rolling chair moves back and forth. The total plastic deformation of the tube is such that the cross-sectional area of the tube decreases and the length of the tube increases during the process. However, this is performed in many small incremental steps, where the direction of deformation in a material point changes at each stroke.

Neumann and Siebel developed simple 2D axisymmetric models to compute the rolling forces [1]. Yoshida *et al.* measured the contact zone and strains on a grid on the outside of the tube, and used the information to build a simplified 3D model [2]. Furugen and Hayashi [3] partioned the cross-section into groove and flange parts to build another simplified 3D model. 3D FEA of a few strokes of the pilgering process was demonstrated by Montmitonnet *et al.* [4]. Recent works use 3D FEA of the complete process, e.g. [5]. In this work, the strain history of the tube during the pilgering process is investigated in greater detail using 3D FEA.

Most published models of pilgering use simplified material models. In reality, the flow stress is dependent on temperature, strain rate, strain history and microstructure. Many papers report good resemblance between experimental and numerical results without taking these parameters into account, e.g. [2-3, 5]. The influence of these parameters on calculation of the rolling forces is discussed in the current work.

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