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Adaption of a Carreau fluid law formulation for residual stress determination in rotary friction welds

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Abstract

For the numerical simulation of the rotary friction welding process in prior works a modified Carreau fluid law has been successfully adopted, which can so far not be used for the residual stress prediction due to the basic assumptions in this model. Therefore, an extension is proposed accounting for elastic effects, thermal induced stresses and hardening of steels using the data of continuous cooling transformation (CCT) phase diagrams. For the validation of the model, measurements from literature as well as own measurements utilizing partial cut-outs are used. The numerical results correlate well with experimental data for first order residual stresses.

Keywords: rotary friction welding, residual stresses, material modeling, hardening, structural simulation

1. Introduction

Rotary friction welding allows joining of two or more parts by the use of frictional heat and pressure. Therefore, one part is set in rotary motion and is axially pressed against a second part. In case of direct drive rotary friction

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