Numerical and experimental study on mechanical joining by a hybrid rolling process

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ABSTRACT

The focus of this paper is the numerical and experimental analysis of the joining mechanisms for the mechanical joining using a hybrid rolling process. A schematic of the rolling process as well as two specimen with and without joined gear wheel are shown in Fig. 1. Two pairs of actively driven work rolls follow an axial and radial tool path to form circumferential groves while pushing excess material in the direction of the joining partner thereby forming a closed joint. Each set of work rolls simultaneously functions as a counter bearing for the other. The workpiece is not actively driven, but forced into rotation by the frictional forces.

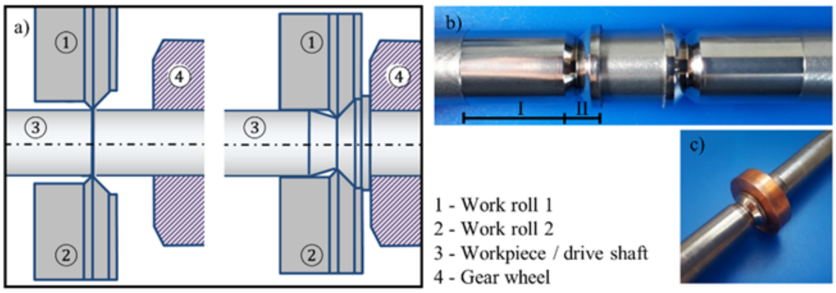

Figure 1: (a) Schematic of hybrid rolling process stage; (b) rolled specimen without and (c) with joined gear wheel [1].

In preliminary experimental investigations, this connection has been shown to be able transmit a significant torque [2]. Here, a more detailed study of the joining mechanisms and their dependency on process parameters as well as material combinations is presented. Two borehole geometries for the hub as well as different work roll paths are numerically analysed regarding the material flow during the rolling process and the resulting force- and form-closed joints. LS-Dyna is used to implement a full 3D-model of the process with an axial symmetry plane. Selected parameter sets are then compared to experimental investigations carried out on a Profiroll 2-PR-15e profile rolling machine in order to verify the numerical model. Strain gauges are applied to the hub before the rolling process in order to measure the resulting strains and compare them to the numerical results. The overall goal is to identify advantageous process parameters that lead to a strong shaft-hub connection and a high transmittable torque.

REFERENCES

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