Layout of the roller levelling process via controlled Finite Element simulations

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ABSTRACT

Modern strip processing lines require homogeneous conditions regarding the material state to ensure an interference-free production. Residual stresses and flatness defects are introduced due to coiling or guiding the strip around small guide rolls [1]. Therefore, roller levelling machines are placed at the initial sage of the processing line to ensure flatness and set an appropriate level of residual stresses. The correct setting of the roller levelling machine, which is defined by the relative roll positions – called the roll intermesh – is crucial for the strip's flatness and residual stress distribution. Furthermore, it is necessary to adapt the machine settings if changes of the material characteristics occur along the strip length as previous works have shown [2, 3].

In this work a method for the precise determination of the settings for roller levelling machines is presented. The concept is based on a Finite Element (FE) modell of the roller levelling process including a closed-loop control. Using this model, it is possible to calculate the ideal roll intermeshes leading to a flat sheet after the levelling process for a given combination of process parameters in a single simulation run. Thus, it is possible to calculate parameter sets enabling a feed-forward control that can be implemented to the roller levelling process.

For an investigation of the potential of such a feed-forward control, changes in the yield strength as well as a change in the strip's initial curvature are considered. The later includes a look on the influence of cyclic material behaviour on the roller levelling process by means of the respective parameter sets. Finally, a numerical validation of the proposed feed-forward control algorithm is presented by implementing a user-subroutine to a commercial FE code.

REFERENCES

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