SUCCESS STORY

InTribology1
Excellence Centre of Tribology

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre K2

Type of project:
Friction optimization
04/2020 – 03/2024
multi-firm

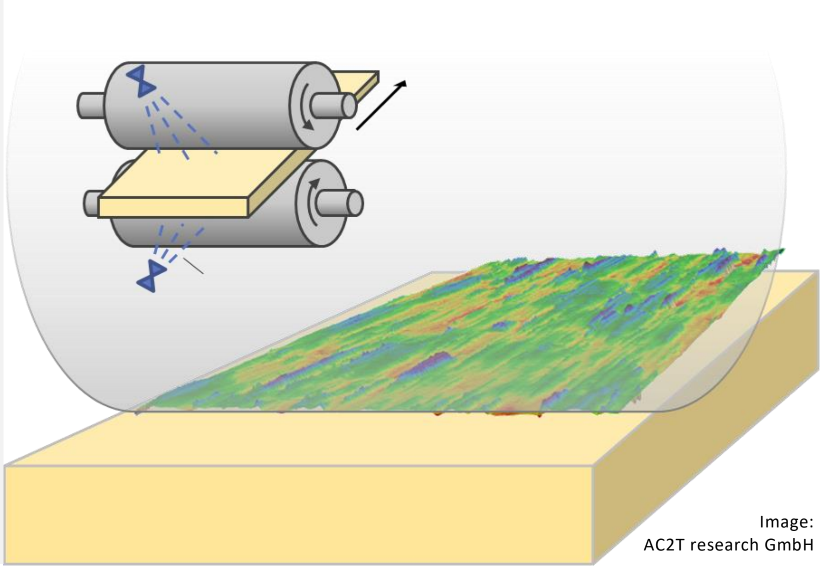

Image:
AC2T research GmbH

OPTIMIZING INDUSTRIAL ROLLING PROCESSES

AC2T DEVELOPS A DETAILLED MODEL OF THE MICROSCOPIC CONTACT SITUATION TO OPTIMIZE INDUSTRIAL ROLLING PROCESSES

The goal of this work was to develop a new friction model, which serves as a predictive tool in the context of tribology in metalworking, for example, the hot rolling process of aluminium sheets. A reliable friction model in metalworking processes ultimately contributes to increase accuracy, efficiency, and thus decreasing costs and energy of the process.

Hot rolling – the role of friction in an energy intensive process

The friction forces in the contact of a metal hot rolling processes are crucial for to the quality of the rolled workpiece, both for the smoothness of the rolled surface and for the produced material properties due to deformation. During the deformation process, friction has to ascertain the constant transport of the metal through the contact whereas too high friction leads to deterioration of the rolled surface as well as unproportional energy consumption.

Studying the friction on the roughness level

Common simplifications, such as the use of a constant Coulomb friction coefficient, hinder the optimization of the process in terms of energy and costs. In this work, a model for friction prediction along the contact of a hot rolling pass was developed, including thermo-viscoplastic material properties of the aluminium alloy (macroscopic model), topography of the roll and representation of the contact region in contact patches (microscopic model), analytical models, and tribometer experiments.

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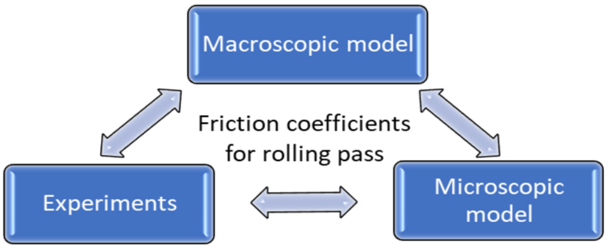
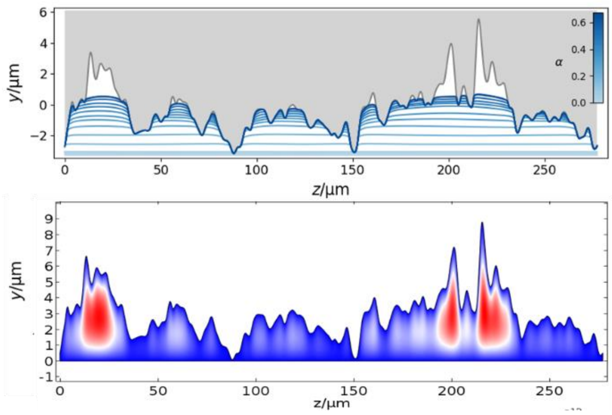


Impact of entrapped lubricant

Friction depends on evolving physics and chemistry of the contact zone during the forming process. Such components may include, for example, the formation of lubricant pockets, micro-plastohydrodynamic lubrication regions, tribofilm formation and metal contact spots. Plastic contacts involving high fractional contact area are greatly affected by the bulk deformation: as the number of asperities in contact increases, the stress fields acting on them begin to interact, triggering plastic flow in the substrate. With the modelled surfaces and an established flattening contact model, lubricant entrapment and its effect on the real contact area can be quantified, making it possible to provide rheological properties of the lubricants.



Top: Microscopic deformation of the soft material due to the micro-topography of the rigid roll; Bottom: Hydrodynamic-pressure distribution of the lubricant flow in the topography (Photo: AC2T research GmbH)

With this friction model, the project partner is now able to optimize the surface topography of the rolls considering the lubrication conditions in order to establish a stable and efficient rolling process for high-quality products.

Project coordination (Story)
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Project partner

- AMAG rolling GmbH, Austria
- AC2T research GmbH, Austria

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