Lehrstuhl für Umformtechnik und Gießereiwesen
TUM School of Engineering and Design
Technische Universität München

Flat rolling of continuously cast Al-Cu compound strips with structured interface

Motivation

By combining two different materials, the product properties of the compound can be optimized in terms of cost and material properties such as weight or electrical conductivity. The current process route for the production of aluminum copper semi-finished products by cold roll cladding requires several process steps to achieve the necessary compound strength. The reduction of the process route to a continuous compound casting process with subsequent finish rolling enables the production of aluminum and copper semi-finished products close to final dimensions and at low cost. The formation of intermetallic phases in the compound zone in the continuous compound casting process begins with the first contact of the liquid aluminum with the copper strand. The elevated temperatures in the process further promote the formation. For a successful rolling process, a high surface enlargement is necessary, that the brittle phases can tear open and the base materials can come into contact for a material bond. Until now, delamination has occurred between the bonding partners because high shear stresses occur in the bonding zone due to the difference in strength of the base materials.

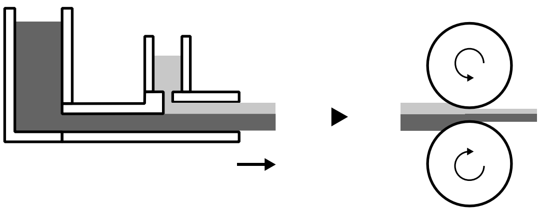

Figure 1: Horizontal Continuous Compound Casting and Rolling

Solution approach

The research project, funded by the German Research Foundation (DFG) - 457434681, focuses on the continuous compound casting process route with subsequent finish rolling. Together with the ibf at RWTH Aachen University, utg is conducting research into the realization of this process route. Due to the pronounced intermetallic phase formation in the compound zone and the resulting delamination in the rolling process, this process has not yet been used industrially. In order to realize the economically interesting process route of continuous compound casting and subsequent flat rolling despite pronounced intermetallic phase formation, a geometrically pronounced boundary surface is to be introduced into the compound zone by means of a structured interface. This geometric constraint can prevent relative movements between the compound partners and thus reduce undesirable shear stresses. The increase in surface area during rolling can thus be achieved without shearing of the compound partners.

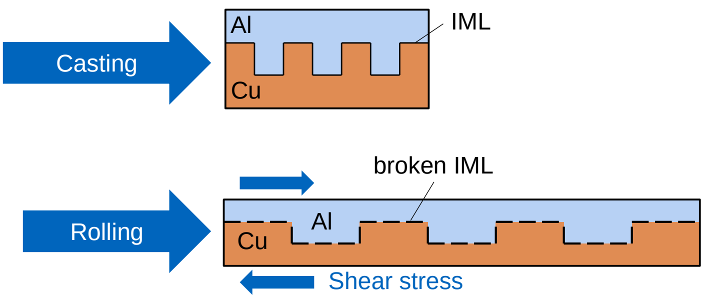

Figure 2: Strucutured Interface of the compound

Outlook

In order to investigate the solidification conditions at the interface, different mold geometries are investigated experimentally and simulatively. The geometric design of the interface influences both the process stability and the effectiveness in avoiding shear stresses and thus the bond strength of the final product. Due to the pronounced solidification shrinkage during casting, shrinkage effects on the mold profiles must be taken into account. The geometry in the compound zone also influences the ability to compensate for shear stresses occurring during the rolling process. Finally, the results will be used to expand the portfolio of geometries produced by continuous casting to include profiled surfaces and to enable the production of aluminum copper semifinished products.

Julika Hoyer, M.Sc.
Walther-Meißner-Straße 4
85748 Garching
julika.hoyer@tum.de
Tel. +49 89 289 13 988

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