Chair of Metal Forming and Casting
TUM School of Engineering and Design
Technical University of Munich

Multi-Material-Injector-Casting

Motivation

Conventional sequential process chains in gravity, sand and permanent mold casting do not offer the possibility to adjust local part properties during the casting process. The desire for tailored properties, i.e. the right material at the right place in the part, has so far been met primarily in semi-finished product manufacturing. In order to utilize the far-reaching advantages of tailored properties in gravity casting processes, the innovative Injector Casting process is used. This solves both existing problems, such as oxide skin in the casting, and at the same time offers the necessary further development potential for reproducible production of multi-material castings with local material properties out of two melts.

Approach

The aim of the research project is the reproducible production of a part with tailored properties in a multi-material injector casting process. (MMIC). The interaction of the two melts allows free adjustability of the shape of the boundary layer between the materials. This makes it possible to provide the right material at the right place in the part to ensure material properties that are optimally adapted to the requirements. An example would be a combination of wear resistance in the working area and mechanical strength in the area of the connection points.

Especially the mixing oft he melts due to density differences and turbulence is a challenge and requires explicit modeling. For this purpose, extensive simulations are carried out in order to be able to estimate all relevant cause-effect chains. To validate the simulation results, a test rig for water model experiments will be set up. Here, a stereo camera system enables the reconstruction of flow conditions using tracer particles (see Figure 1). These results are incorporated into the design of both the casting process and the control system.

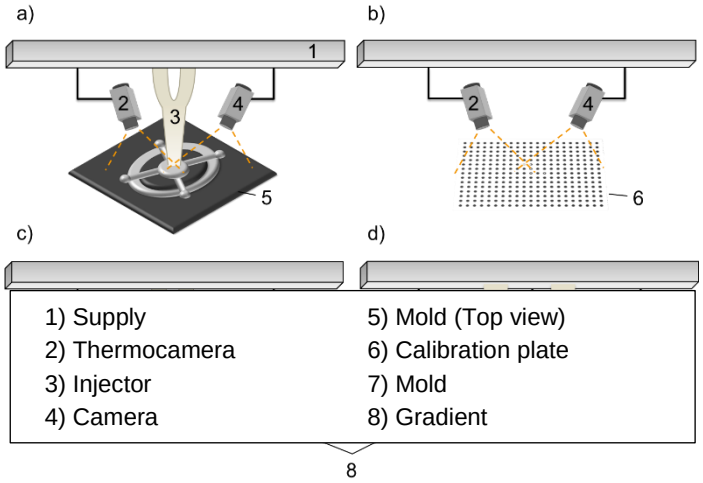

Figure 1: Schematic structure of the casting system with thermostereo camera system a) in the casting machine, b) for the calibration, c) Y-variant with horizontal and d) II-variant with vertical gradient

Outlook

By developing and analyzing a multi-material casting process based on injector casting, a local change in the material properties in the casting can be achieved with controlled mold filling and, in the best case, an adjustable mixing range of the two alloys, allowing optimization of the casting properties with the same material input.

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