Lehrstuhl für Umformtechnik und Gießereiwesen
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Design of Multilayer Sand Cores for High-Pressure Die Casting

Motivation

High-pressure die casting (HPDC) is a casting technique in which liquid metal is pressed into a permanent metal mold under high pressure and at high speed. Typical mold filling times are in the range of 30 ms, solidification times in the range of seconds. With a share of over 60 %, HPDC is the most important casting process for aluminum alloys.

Cavities in the component can be realized by slide bar technology, less frequently by the use of lost cores. Due to the necessary hydraulic and cooling units, slide bar technology is costly in terms of equipment, maintenance-intensive, prone to failure and therefore expensive overall. Increasing functional integration in die cast parts and shrinking assembly spaces, particularly in the automotive sector, are leading to increasingly complex die casting molds with numerous core pulls. Conventional sand cores cannot withstand the high casting pressures of up to 1200 bar and have not yet been used in HPDC.

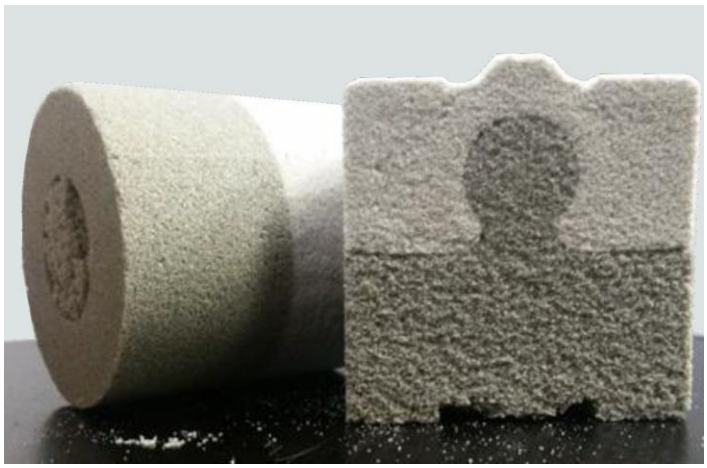

Figure 1: Multilayer core made of two different sand-binder systems, produced in two steps on a core shooting machine.

Solution Approach

The aim of the research project is the production of sand cores for use in the HPDC process. Therefore, the process is to be characterized and simulated using novel measuring approaches in such a way that the specified requirements on the sand cores can be precisely quantified. This knowledge will be used to develop a new type of core material system consisting of two layers. The outer layer of the cores is particularly fine-grained and hard in order to prevent the melt penetration shown in the preliminary tests and to withstand the high stresses during the casting process. The interior of the core consists of a significantly coarser and less solid sand-binder mixture, which maintains gas permeability and facilitates the challenging core removal observed in the preliminary tests. In the end, a multi-scale simulation methodology should be available that both predicts the stresses during the casting process for specific component geometries and assists in the selection of the grain-size distribution of the molding material at the microstructure level. Furthermore, a die casting tool should be available which is optically accessible through a glass panel and enables the validation of simulations.

Outlook

The use of lost cores in high-pressure die casting is largely limited by their strength. A further challenge lies within the core removability. Two-layer cores made of different sand-binder mixtures allow these conflicting objectives to be optimized separately. The use of lost cores can simplify the die technology in the die casting process and increase process stability.

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