Investigation of Precision-Determing Factors for the Minimization of Distortion in Molding and Die Casting

GI –CHAIR OF FOUNDRY SCIENCE AND TECHNOLOGY AND FOUNDRY INSTITUTE

Subproject B08

SUBPROJECT LEADER: UNIV. PROF. DR.-ING. ANDREAS BÜHRIG-POLACZEK

Executed and planned work

RESEARCH OBJECTIVE

The aim of the subproject is to increase manufacturing precision in the permanent mold casting of metallic cast materials. In particular, the focus is on minimizing distortion and hot cracking in aluminum permanent mold and high pressure die casting, as well as on creating the necessary improved understanding of the fundamentals of materials science. Therefore, the systematic determination of the relationships between heat balance, microstructure formation and residual stresses during solidification, combined with the control of distortion and hot tearing tendency, is the overriding ultimate goal.

Part-related input parameters

- Geometry
- Alloy

Process-related input parameters

- Temperature control
- Time of demolding
- Mold material
- Mold coating

Process values and product properties

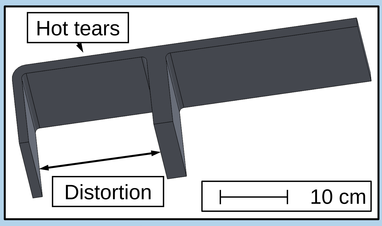
- Temperatures
- Shrinkage
- Displacement
- Contact pressure
- Microstructure
- Internal stresses

Target variables

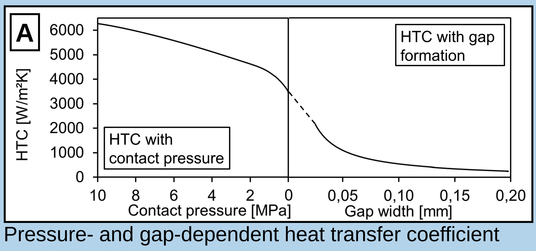
- Distortion
- Hot tears

RESULTS

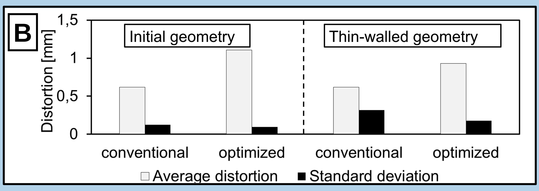
- The investigation of the influencing variables and process conditions affecting the heat balance in permanent mold casting (A) provided their proportional influences
- The magnitude of the component distortion and its dispersion within a series (B) could be influenced - in cooperation with SP B01
- In-situ investigations of hot tears formed during the casting process and their morphology (C) provided more detailed information on their formation - in cooperation with SP A02



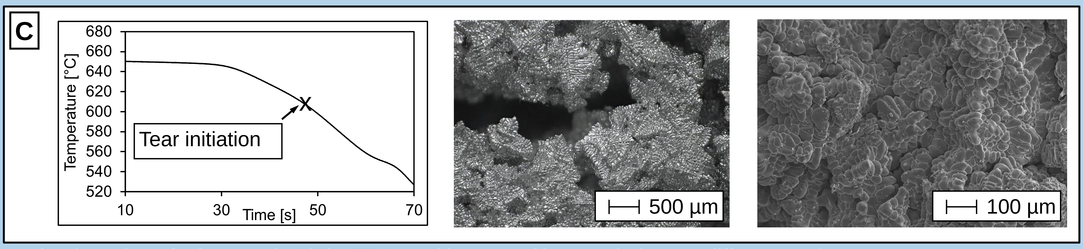
Cast test specimen



Pressure- and gap-dependent heat transfer coefficient as solid-solid contact



Mean component distortion and standard deviation for conventional mold modules and those with optimized cooling for different component geometries



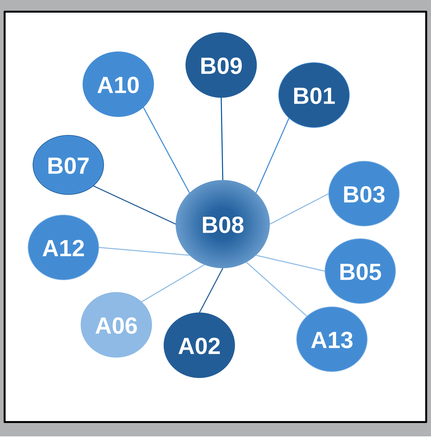
In-situ detection of a hot tear in AlSi1.75Mg and images of its morphology at different scales

FURTHER PROCEDURE

- Investigation of the combinability of geometric and thermal distortion and hot tear compensation in the test component and their interactions
- Consideration of the transferability of the developed methodology to other aluminum alloys
- Transfer of the control concepts demonstrated on a laboratory scale to highly complex real components of permanent mold casting
- Application of the compensation strategies developed in permanent mold casting in the high pressure die casting process
- Development of an evaluation parameter for quantitative assessment of the compensation achieved with weighting of the two target variables (distortion and hot cracking tendency)

In each case in cooperation with methodologically related or thematically complementary subprojects (see right side)

COOPERATIONS



Precision Melt Engineering

RWTH AACHEN UNIVERSITY