

Investigation on the gating system:
Reoxidation in the mould

Rafał Dojka

Silesian University of Technology
Faculty of Mechanical Engineering

Gliwice 2020

Abstract

Investigation on the gating system: Reoxidation in the mould

The dissertation was focused on the reoxidation and entrainment phenomena occurring during the mould filling and their impact on the quality and properties of castings. Work began with a literature review on theoretical properties of metals and how they are affected by the presence of inclusions, additionally, the origins of casting defects were discussed. Importance of stream velocity control was underlined and selected case studies concerning gating system components were discussed.

The second part of the work contained experimental studies which were preceded by the formulation of dissertation theses. Studies can be divided into two parts, simulation analysis and manufacturing of experimental castings in foundry conditions. In the first part performance of selected solutions in the field of sprue, runner, ingate as well as complete gating systems design was examined. The simulation allowed for both qualitative and quantitative analysis of flow which facilitated the improvement of gating system design practices. The second part started with the presentation of a new fluidity test especially useful for flow analysis in slim naturally pressurised gating systems. In the experiment two groups of test castings were manufactured, one with a gating system resulting in the more turbulent filling, the other with the system minimizing turbulence. All test castings presented the same pouring temperature, chemical composition as well as the same phase composition. Test castings were subjected to NDT examination based on VT, PT and RT analysis which proved the negative influence of turbulence on the quality of the casting. Tensile and impact tests carried on the samples extracted from test casting proved that minimisation of turbulence can increase metal's plasticity as well as Weibull modulus. SEM analysis proved that the presence of turbulence caused the more brittle character of the fracture surface, bifilms and collapsed bubbles were not present in samples manufactured with the system minimising the turbulence.

Performed analyses allowed to prove that turbulent filling of the mould results in entrainment of oxide bifilms which negatively influence the plasticity of the casting as well as that proper design of gating system components can minimise air entrainment in the initial phase of mould filling process.