Isaac Valls

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Isaac Valls, director of the R&D Department of Rovalma, S.A.. Mr. Valls graduated as mechanical engineer and metallurgist from the Polytechnic University of Catalonia, Spain, and obtained his MSc in Materials Science and Engineering at Stanford University, U.S.A.. During the last decade, Mr. Valls has become a renowned specialist for tool steels and special alloys due to his vast experience in high technology applications and the development and employment of innovative tool material. His works have resulted in the development of several high performance materials; in particular very high thermal conductivity hot work steels and high performance cold work tool materials, along with an integrated tooling and tool management approach. Mr. Valls is the author of several international publications in these areas.
Werkzeugstähle mit hoher Wärmleitfähigkeit für den Aluminiumdruckguss (Tool steels with high thermal conductivity for aluminium die casting)

Nowadays, the performance of the die is one of the important focus and challenge for the foundry industries because of the role that it has in determining the final cost and the quality of the produced parts. Since several decades, many improvements have been introduced into the die material focusing mainly on the die mechanical properties and surface treatments. Surprisingly very little attention has been given to the die thermal properties despite the important contribution of these features of the die in determining the efficiency of the process. In fact, the thermal conductivities of most of the hot work tool steels applied for die casting, have remained between 20-35 W/m.K. The die thermal properties have a direct influence on the heat extraction rate from the part to the die and from the die to the internal and external cooling media. The heat extraction rate determine the cycle time on which the productivity is based and the thermal loading cycles on which the durability of dies is mainly based.

In the years 2005 and 2006, taking advantage of some lately developed technologies and understanding, a family of hot work tool steels with thermal conductivity between 44-70 W/m.K, were developed by ROVALMA, S. A. These grades which is known as High Thermal Conductivity tool Steel (HTCS® grades) were developed initially for Hot Stamping of Ultrahigh High Strength Steels. Three years later the HTCS® have been optimised for die casting also and have been successfully applied on short and long series production dies.

The present presentation deals with the HTCS® hot work tool steel for die casting, in a comparison point of view to the conventional 1.2343 (AISI H11) tools steels, in terms of properties and application features. Tow identical production dies built respectively of HTCS® and 1.2343 (AISI H11) hot work tool steels and a prototype die built of mixed HTCS® and 1.2343 were compared. The dies were instrumented by high performance heat transfer gauges that allow for measuring the temperature profiles of the melt and of the die during casting cycles without intrusion into the part and halting the production. Using HTCS® tool steel for the investigated production die allowed to reduce the cycle time by around 16-18% and to delay considerably the initiation of the thermal fatigue cracks compared to a
similar die built of 1.2343. A prototype die with a half built of HTCS® and other half built of 1.2343 tool steels were also investigated. The solidification rate and the yield strength of the cast parts was found to be higher respectively by around 20% and 11% in the half where the molten alloy was in contact with HTCS® material compared to the half where the molten alloy was in contact with 1.2343 material.