Comparison of solidification properties in plain sand cup versus test castings with different modules using thermal analysis

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Abstract

The demands for defect free castings today are very high, therefore many foundries rely on in-situ thermal analysis (TA) with a plain sand cup with a thermal module of 0,8 cm for correction/adjustment of compacted or flake graphite base and final iron. This method results in a reliable and stable control of the process. Normally TA gives a good correlation between acquired thermal properties and one of the most important properties is "ACEL" (Active Carbon Equivalent evaluated from Liquidus temperature). If the castings have approximately the same thermal modules (M~0,8 cm) as plain sand cups, the ACEL in the poured casting are equal to results from TA. However, for many applications, castings have a variety of wall thicknesses and different thermal modules (different cooling rates). There is need for better understanding concerning the results from a standard TA method and the relation to the real solidification and cooling conditions in a commercial casting. In the investigation, ATAS MetStar (a system for process control based on TA) is used for the comparison between different thermal modules and thermal properties. To describe different cooling and solidification rates, cylindrical-shaped castings with different radiuses were poured. The molds are produced using 3D printing technology (furan resin sand). To determine thermal modules in our investigated cylindrical-shaped castings, we have used the simulation package system (NovaFlow&Solid), with which we have accurately calculated thermal modules and their cooling rates for investigated testing probes.

Key words: thermal properties, thermal module, compacted graphite iron, flake graphite iron, thermal analysis.