White paper on Heat dissipation in Rheocast components

Background

The microstructure of a RheoMetal processed material is different from that processed through conventional high pressure die casting. These differences can be summarized as

1. Presence of larger globular particles
2. A change segregation pattern in both the transverse and longitudinal directions relative the die cavity filling

The matter changes the thermal transport properties in a component and in particular so for long thin product commonly used in the electronics industry including casings and products with cooling fins.

Heat dissipation

Thermal conductivity of StenalRheo1 was measured for a conventionally cast electronics casing and for the same part but using RheoMetal processed material. The thermal conductivity shows that the RheoMetal processed material has higher thermal conductivity than the conventionally cast material using a fully liquid state during casting. The improvement at room temperature is as large as 17W/mK or an improvement of 12%. Due to the nature of the rheological behavior of RheoMetal process material there is commonly a minor longitudinal segregation. This behavior originates from the fact that the RheoMetal processed material displays a yield point in the slurry state. This yield point must first be exceeded before melt can enter the die cavity. During this initial compression, the liquid metal portion of the slurry is squeezed out like water from a sponge causing a small amount of enriched melt to enter the die cavity. This results in that the amounts of the highly conducting globular particles are higher in the material entering the die cavity at the end of fill and therefore the material close to the gate will always display better thermal conductivity than the material first entering the die cavity ending up near the vents and overflows of the component. It should here be noted that even though the enriched metal liquid is present, the RheoMetal processed material shows a tendency towards higher thermal conductivity than for conventionally processed material and is as such superior to high pressure diecast material.

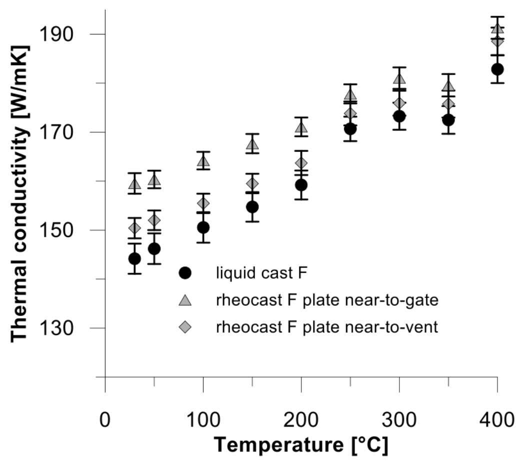

Figure 1.Thermal conductivity of StenalRheo1 in conventionally liquid process state and in RheoMetal

Ability to cast other types of materials

The selected alloying elements have profound influence on thermal conductivity. Elements such as Mn, Cr, Zr, V and Ti are highly detrimental to thermal conductivity. The Rheometal process allows foundries to venture outside the traditional boundaries of cast alloys. It is possible to cast wrought materials such as for instance AA6082 which is a common extrusion alloy.

The concentrations of dissolved Si in the matrix for AA6082 was 0.5±0.09 wt%. In an alloy that was developed for the purpose of improved castability, Alloy X, the dissolved Si concentration was 0.45±0.08 wt%. The main difference between these two materials was the the concentration of Mn. For AA6082 the amount of Mn in the matrix was 0.41±0.06 wt% while it was only 0.17±0.03 wt% for Alloy X. This reduced Mn concentration together resulted in improved thermal conductivity, figure 2

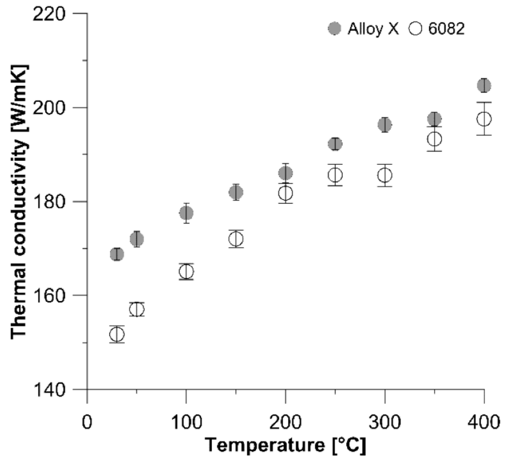

Figure 2. Thermal conductivity of RheoMetal processed Alloy X and 6082.

Source of this information

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