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Grain Size Distribution and Interfacial Heat Transfer Coefficient during Solidification of Magnesium Alloys Using High Pressure Die Casting Process

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The objective of this study is to predict grain size and heat transfer coefficient at the metal–die interface during high pressure die casting process and solidification of the magnesium alloy AM60. Multiple runs of the commercial casting simulation package, ProCAST™, were used to model the mold filling and solidification events employing a range of interfacial heat transfer coefficient values. The simulation results were used to estimate the centreline cooling curve at various locations through the casting. The centreline cooling curves, together with the die temperature and the thermodynamic properties of the alloy were then used as inputs to compute the solution to the Stefan problem of a moving phase boundary, thereby providing the through-thickness cooling curves at each chosen location of the casting. Finally, the local cooling rate was used to calculate the resulting grain size via previously established relationships. The effects of die temperature, filling time and heat transfer coefficient on the grain structure in skin region and core region were quantitatively characterized. It was observed that the grain size of skin region strongly depends on above three factors whereas the grain size of core region shows dependence on the interfacial heat transfer coefficient and thickness of the samples. The grain size distribution from surface to center was estimated from the relationship between grain size