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ABSTRACT

Dependence of Interfacial Heat Transfer in Squeeze Casting of Wrought Mg Alloy AZ31 on Casting Section Thicknesses and Applied Pressures

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Three hydraulic pressures 30, 60, and 90 MPa were applied during the indirect squeeze casting of the wrought magnesium alloy AZ31 using a 75-ton hydraulic press. A P20 steel die was used in the process, which featured five different section thicknesses: 2, 4, 8, 12, and 20 mm, referred to as steps 1 through 5, respectively. Temperature measurements were taken simultaneously on the casting surface and at three different points within the die using K-type thermocouples. To determine the IHTCs for each of the five casting steps, an inverse method was employed based on the recorded temperature data. The resulting IHTC values for each step showed varying peak values depending on the applied pressure. The IHTC curves initially exhibited an upward slope, peaked, and then gradually declined over time. For a constant pressure of 90 MPa, the peak IHTC values increased from 4499 to 10602 (W/m^2 K) as the section thickness expanded from 2 to 20 mm. As the applied pressure increased from 30 MPa to 90 MPa, the peak IHTC value for step 5 rose from 7524 to 10602 (W/m^2 K). Multivariate linear and polynomial regression techniques were utilized to develop empirical equations for IHTC, incorporating factors such as pressure, casting section thickness, and solidification temperature at the casting/mould interface. A comparison of the predicted cooling temperatures with experimental results showed that the cooling curves forecasted by the IHTC values obtained in this study closely matched the experimental data.