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Analysis of Fractures and Microstructures on Different Injection Speeds in High-Pressure Die-Casting Magnesium Alloy

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Abstract: In this study, to clarify the unknown physical properties of the Mg-Al-Th-RE alloy, the relationship between the injection conditions and the internal porosities, and the mechanical properties exerted by the solidification microstructure was investigated. The obtained cast samples were investigated using X-ray CT internal measurements, tensile tests, Vickers hardness tests, and solidification microstructure observations. The tensile strength and the elongation at the injection speed of 5.0 m/s were higher than at 2.0 m/s. The number of porosities affected the tensile strength and the elongation even at the same fracture position. In addition, it was confirmed that segregation affected the destruction smaller the porosity size and the greater the variability of porosity. As the injection speed increased, the amount of heat transferred between the molten metal and the wall surface also increased, resulting in quick freezing and solidification. The tensile strength increased at the injection speed of 5.0 m/s because the interface between the scattered primary crystals and eutectic systems was narrow. On the other hand, at the injection speed of 2.0 m/s, the tensile strength decreased because the molten metal was delayed in solidification and dendrite growth became remarkable.

Keywords: Tensile strength, elongation, injection speed, porosity

1. Introduction

High-Pressure Die Casting (HPDC) is a technology that is indispensable to produce magnesium parts. HPDC is a casting method that injects molten metal into a mold at high speed and high pressure, thereby shortening the manufacturing cycle as much as possible. For this reason, die casting has been established as a system capable of mass-producing products with excellent casting surfaces in a short time. However, characteristic porosities such as porosity and inclusion of solidified fragments occur in die-cast products. In particular, the cavities caused by air entrainment and solidification shrinkage cause not only deterioration of mechanical properties but also leakage of pressure-resistant members. Therefore, there is a need to elucidate the mechanism of porosity generation and optimization of the injection speed has been performed with CFD [1], [2], [3]. Research related to quantitative measurements is also being

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