Characterization of A390 Aluminum Alloy Produced at Different Slow Shot Speeds Using Assisted Vacuum High-Pressure Die Casting

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Abstract : Under different slow shot speeds in vacuum assisted high pressure die casting (VHPDC) process, plate-shaped specimens of hypereutectic A390 aluminum alloy were produced. According to the results, the vacuum pressure inside the die cavity increased linearly with the increasing slow shot speed at the beginning of mold filling. Meanwhile, it was found that the tensile properties of vacuum die castings were deteriorated by the porosity content. In addition, the average primary Si size varies between 14μm to 23μm, which has a binary functional relationship with the slow shot speeds. Due to the vacuum effect, the castings were treated by T6 heat treatment. After heat treatment, microstructural morphologies revealed that needle-shaped and thin-flaked eutectic Si particles became rounded while Al2Cu dissolved into α-Al matrix. For the as-received sample in-situ tensile test, microcracks firstly initiate at the primary Si particles and propagated along Al matrix with a transgranular fracture mode. In contrast, for the treated sample, the crack initiated at the Al2Cu particles and propagated along Al grain boundaries with an intergranular fracture mode. In-situ three bending test, microcracks firstly formed in the primary Si particles for both samples. Subsequently, the cracks between primary Si linked along Al grain boundaries in as received sample. In contrast, the cracks in primary Si linked through the solid lines in Al matrix. Furthermore, the fractography revealed that the fracture mechanism has evolved from brittle transgranular fracture to a fracture mode with many dimples after heat treatment.

Keywords : A390 aluminum, vacuum assisted high pressure die casting, heat treatment, mechanical properties
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