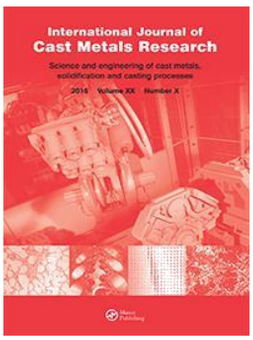

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Effect of casting practice on the reliability of Al cast alloys

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The properties of aluminium castings are strongly affected by their inclusion content, particularly entrained surface alumina films. These form due to the surface turbulence associated with mould filling, which causes the oxidised surface of a liquid metal to fold-over onto itself and be submerged into the bulk liquid with a thin layer of air entrapped within it. This is known as entrainment action. These flaws have been reported to increase the variability of the fracture strengths of Al alloy castings. This means that shape castings in light alloys can have inconsistent properties, which makes designing structures employing shape castings more difficult. Entrained surface layers can cause premature failure, but also have been associated with other defects, such as hydrogen porosity, shrinkage porosity, intermetallic compounds and hot tearing. Recent research has suggested that the air inside the defect would react with the surrounding melt leading to its consumption, which may enhance the mechanical properties of the casting. In this work, liquid aluminium was poured into three identical ceramic moulds which were immediately placed in a furnace to preserve the molten metal at 800°C, for different periods of time prior to freezing. The Weibull moduli of the plate castings were determined under tensile conditions, and their fracture surfaces examined using SEM. Investigation of the fracture surfaces of the specimens detected many alumina layers at different locations. Many of which were found inside pores, reflecting the role of entrained defects in the formation of porosity. The results also suggested that opposite phenomena may take place during the holding treatment. The consumption of air inside the entrained defects due to reaction with the surrounding molten metal may lead to improvements in mechanical properties, but this may be accompanied by hydrogen passing into the defects, which has a deleterious effect on properties.

Keywords: Entrained inclusions, Aluminium casting, Porosity, Mechanical properties