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Effect of aluminizing and oxidation on the thermal fatigue damage of hot work tool steels for high pressure die casting applications.

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Abstract

The interaction between thermal fatigue and aluminizing and/or oxidation is investigated using an experimental approach based on decoupling of mechanisms.

Virgin and pre-aluminized steel specimens are tested in air and nitrogen between 100 and 650°C. Homogeneous uniaxial micro-crack network forms on the oxidised or pre-aluminized surface in air, with a better resistance to micro-cracking for the intermetallic coating. The propagation of the micro-cracks is delayed in nitrogen, whilst no evidence of micro-cracking is observed on the virgin specimen. The premature cracking of the steel depends on the formation of the superficial micro-crack network, and the crack propagation is assisted by oxidation.

Keywords: Thermal fatigue; Intermetallics; Corrosion; Cracks; Tool steel.

1. Introduction

In the High Pressure Die Casting (HPDC) process, molten aluminium is injected between 650 and 700°C in the cavities of the mould, at a speed higher than 30 m/s and under high pressure (up to 1300 bar) [1]. The surface of the mould is thus exposed to strong thermo-mechanical loadings and severe corrosive attacks. It is damaged by complex mechanisms

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