

PROCEEDINGS

3D Analysis of Effect of Graphite Morphology on Thermomechanical Behaviour of CGI

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ABSTRACT

Compacted graphite iron (CGI) was attractive as an important material for the industry since its introduction in the last century. Thanks to its high strength, great wear resistance and thermal conductivity, CGI became extensively applied in the automotive industry as engine parts: brake drums, cylinder heads and exhaust manifolds. As a metal-matrix composite, CGI contains two microstructural phases: graphite inclusions and a metallic matrix. The main fracture mechanism of CGI under high-temperature service conditions at macroscale is linked to graphite-matrix (interfacial) debonding, formation of microcracks and their networks, and final failure of the material at microscale because of the mismatch in coefficients of thermal expansion of these phases. This graphite-matrix debonding phenomenon was studied in various research works with regard to mechanical or thermal loads for various compositions but is still required to be investigated for CGI with its complex microstructure [1,2]. To study the effect of graphite morphology on thermomechanical behaviours of CGI, a set of three-dimensional numerical models of unit cells was generated. Each unit cell includes metallic matrix containing a single graphite inclusion with complex morphology. In finite-element analysis, elastoplastic behaviour was applied to both phases. Pure thermal loads were considered in numerical simulations focusing on the thermomechanical response of CGI. The obtained results provide a fair correlation between microstructure and thermomechanical behaviour of CGI under high temperatures.

KEYWORDS

Compacted graphite iron; thermal load; fracture mechanism; numerical simulation

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