Damage Evolution in Compacted Graphite Iron during Thermo-Mechanical Fatigue Testing

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Thermo-mechanical fatigue (TMF) properties of a compacted graphite iron (CGI) in an out-of-phase (OP) configuration are investigated for different maximum temperatures and mechanical strain ranges. Furthermore, the stress-strain hysteresis loops are analysed and in particular the unloading modulus, i.e. the elastic modulus measured during specimen unloading, is obtained from each cycle. This material parameter has earlier been explicitly related to the amount of microcracking in cast irons. The results show that the unloading modulus linearly declines with the numbers of cycles in all tests performed. In addition, the rate of change of the unloading modulus is closely related to the number of cycles to failure. Accordingly, it is concluded that microcracks are independently propagated by fatigue until a point of rapid crack-linking resulting in the ultimate failure. This is supported by microstructural analyses consisting of optical microscope images taken at different stages throughout the life of a specimen.

Keywords: Thermo-mechanical fatigue, compacted graphite iron, microcracking, damage, unloading elastic modulus

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