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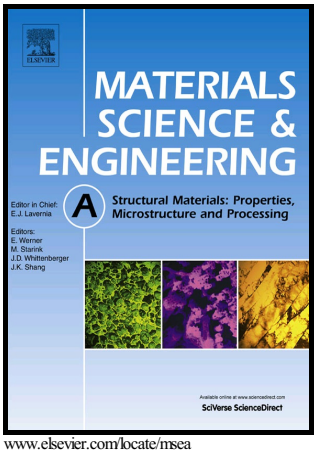

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Relationship between mechanical properties and high-cycle fatigue strength of medium-carbon steels

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Abstract

The relationship between the mechanical properties and the fatigue limit (FL) of medium-carbon steels with various microstructures and tensile properties was investigated through measurement of their hardness, tensile properties, and high-cycle fatigue resistance after subjecting them to heat treatment or prestraining. Carbon steels with 0.30 wt.% C and 0.55 wt.% C subjected to austempering and quenching-tempering treatments underwent microstructure variation from ferrite-pearlite to binate and to tempered martensite, respectively. Cold rolling of austenitic high-Mn steels with 0.57 wt.% C caused an increase in their tensile strength owing to strain hardening. Fatigue tests of these materials showed that the FL increased linearly with increasing hardness (HV) of the material irrespective of the microstructure; this relationship can be expressed as FL = 1.54·HV + 189. In addition, the relationship between the FL and the ultimate tensile strength (UTS) can be expressed as FL = 0.55·UTS + 134. Application of additional fatigue test results of high-carbon (0.86 wt.%) steel and 151 data points extracted from the Fatigue Data Handbook to these HV- or UTS-based FL prediction models confirmed the high reliability of these models, with good agreement between the experimental and predicted FL values.