World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:14, No:08, 2020

Critical Study on the Sensitivity of Corrosion Fatigue Crack Growth Rate to Cyclic Waveform and Microstructure in Marine Steel

Authors : V. C. Igwemezie, A. N. Mehmanparast

Abstract : The primary focus of this work is to understand how variations in the microstructure and cyclic waveform affect the corrosion fatigue crack growth (CFCG) in steel, especially in the Paris region of the da/dN vs. ΔK curve. This work is important because it provides fundamental information on the modelling, design, selection, and use of steels for various engineering applications in the marine environment. The corrosion fatigue tests data on normalized and thermomechanical control process (TMCP) ferritic-pearlitic steels by the authors were compared with several studies on different microstructures in the literature. The microstructures of these steels are radically different and general comparative fatigue crack growth resistance performance study on the effect of microstructure in these materials are very scarce and where available are limited to few studies. The results, for purposes of engineering application, in this study show less dependency of fatigue crack growth rate (FCGR) on yield strength, tensile strength, ductility, frequency and stress ratio in the range 0.1 – 0.7. The nature of the steel microstructure appears to be a major factor in determining the rate at which fatigue cracks propagate in the entire da/dN vs. ΔK sigmoidal curve. The study also shows that the sine wave shape is the most damaging fatigue waveform for ferritic-pearlitic steels. This tends to suggest that the test under sine waveform would be a conservative approach, regardless of the waveform for design of engineering structures.

Keywords : BS7910, corrosion-fatigue crack growth rate, cyclic waveform, microstructure, steel
Conference Title : ICMSI 2020 : International Conference on Materials and Structural Integrity
Conference Location : Vancouver, Canada
Conference Dates : August 06-07, 2020