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G. Gürer, C.H. Gür

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Failure analysis of fretting fatigue initiation and growth on railway axle press-fits

G. Gürer[a,*], C. H. Gür[a]

[a]*Middle East Technical University, Department of Metallurgical and Materials Engineering, 06800 Ankara, Turkey*

Abstract

Fretting fatigue failure of press fitted railway axle-wheel assembly was presented. Size, distribution and propagation profile of the circumferential fretting cracks on the full-scale axles were determined by magnetic particle and metallographic slicing methods. The distribution of multiaxial stress cycle along the press-fit seat was obtained by finite element analysis (FEA). The obtained stress path was used for interpretation of fractographic evidence collected at crack initiation sites and the crack propagation plane. Metallurgical and mechanical characterization of the axle material (34CrMo4) was made on the specimens sampled from the broken axles. The threshold conditions for propagation of small fretting cracks were determined by Kitagawa analysis and El-Haddad correction method. The results of the experimental study were compared with EA1N grade steel which is given as the reference axle material in the EN standards. The metallurgical factors affecting the fretting fatigue crack initiation and propagation were investigated mainly. The causes of the examined axle failures were associated with the deteriorated mechanical properties of the axle material.

Keywords: Fretting, multiaxial fatigue, multi-site damage, short cracks

*Corresponding author
Email address: goksu.gurer@metu.edu.tr (G. Gürer)