Accepted Manuscript

Quantitative calorimetric analysis of the fretting damage: Construction of the elastic shakedown boundary

A.R. Moustafa, B. Berthel, S. Fouvry, E. Charkaluk

PII: S0142-1123(16)30339-5
DOI: http://dx.doi.org/10.1016/j.ijfatigue.2016.10.018
Reference: JIJF 4102

To appear in: *International Journal of Fatigue*

Received Date: 22 June 2016
Revised Date: 19 September 2016
Accepted Date: 17 October 2016

Please cite this article as: Moustafa, A.R., Berthel, B., Fouvry, S., Charkaluk, E., Quantitative calorimetric analysis of the fretting damage: Construction of the elastic shakedown boundary, *International Journal of Fatigue* (2016), doi: http://dx.doi.org/10.1016/j.ijfatigue.2016.10.018

QUANTITATIVE CALORIMETRIC ANALYSIS OF THE FRETTING DAMAGE: CONSTRUCTION OF THE ELASTIC SHAKEDOWN BOUNDARY

A.R. Moustafa[1], B. Berthel[1], S. Fouvry[1] and E. Charkaluk[2]

[1]LTDS, Ecole Centrale de Lyon, 36 Avenue Guy de Collongue, Ecully 69134 Cedex, France. abdel-rahman.moustafa@ec-lyon.fr, bruno.berthel@ec-lyon.fr, siegfried.fouvry@ec-lyon.fr
[2]LML, Ecole Centrale de Lille, Boulevard Paul Langevin, 59655 Villeneuve d'Ascq Cedex, France. eric.charkaluk@ec-lille.fr

Corresponding author: A. R. Moustafa (Tel: +33 (0)4 72 18 60 44; E-mail: abdel.moustaf@gmail.com; bruno.berthel@ec-lyon.fr)

ABSTRACT. *The paper aims to illustrate the relevant use of infrared thermography and energy based approaches to study the plastic behavior and the crack initiation under plain fretting loadings. A well known 35Ni Cr Mo 16 low-alloyed steel was studied under various plain fretting partial slip conditions. The experimental results showed that the proposed 2D image processing method is able to estimate thermoelastic amplitude fields in a good agreement with the theory of linear thermoelasticity, and mean intrinsic dissipation per cycle fields reflecting localized microplastic deformation. The maximal local evolution of the intrinsic dissipation as function of the shear stress amplitude, underlined the presence of a non-dissipative regime, where the specimen mainly undergoes elastic deformation and a dissipative regime where plastic deformation take place. The transition between these two regimes was then coupled with the local elastic shakedown boundary.*

KEYWORDS. *Fretting; Crack nucleation; Thermography; Heat sources; Thermoelasticity; Dissipation; Plasticity; Damage.*

NOMENCLATURE

R	Cylinder radius
P	Static normal force
$p(x)$	Hertz contact pressure distribution
p_{max}	Maximal Hertzian pressure
a	Hertzian contact half size
a_m	Measured contact half size
c_m	Measured stick zone half size
b	Projected crack length
δ	Cyclic relative displacement
δ^*	Cyclic relative displacement amplitude
Q	Macroscopic tangential force
Q^*	Macroscopic tangential force amplitude
$q(x)$	Classical shear stress distribution