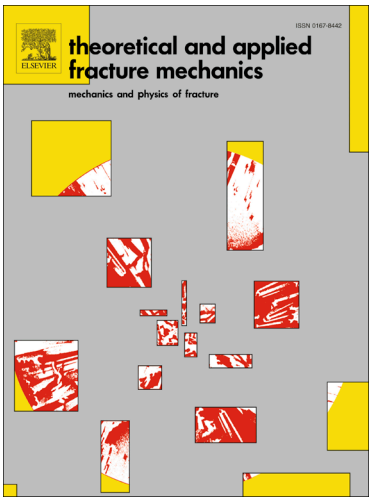
Accepted Manuscript



Hydrogen Embrittlement and Micro-Damage in Notched Specimens of Progressively Cold-Drawn Pearlitic Steel Wires

J. Toribio, D. Vergara, M. Lorenzo

PII: S0167-8442(17)30221-5
DOI: http://dx.doi.org/10.1016/j.tafmec.2017.06.014
Reference: TAFMEC 1896

To appear in: *Theoretical and Applied Fracture Mechanics*

Received Date: 1 May 2017
Revised Date: 14 June 2017
Accepted Date: 15 June 2017

Please cite this article as: J. Toribio, D. Vergara, M. Lorenzo, Hydrogen Embrittlement and Micro-Damage in Notched Specimens of Progressively Cold-Drawn Pearlitic Steel Wires, *Theoretical and Applied Fracture Mechanics* (2017), doi: http://dx.doi.org/10.1016/j.tafmec.2017.06.014

Hydrogen Embrittlement and Micro-Damage in Notched Specimens of Progressively Cold-Drawn Pearlitic Steel Wires

J. Toribio, D. Vergara and M. Lorenzo
* Fracture & Structural Integrity Research Group, University of Salamanca
E.P.S., Campus Viriato, Avda. Requejo 33, 49022 Zamora, Spain
Tel: +34 980 545 000; Fax: +34 980 545 002, E-mail: toribio@usal.es

ABSTRACT

Cold-drawn pearlitic steel wires are highly susceptible to hydrogen assisted fracture (HAF) related phenomena in the presence of hydrogenating environments. A widely spread test method for estimating such a phenomenon is the constant extension rate tensile (CERT) test using notched samples under cathodic electrochemical conditions. In this paper, a global study of the fracture process of progressively cold-drawn wires subjected to CERT testing is carried out by analysing diverse parameters: (i) *triaxiality* in terms of the samples notch geometry, varying the parameters that define a circumferentially round notched wire (notch radius and notch depth); (ii) the CERT test *loading rate*; (iii) the level of *microstructural damage and anisotropy* caused during a commercial cold drawing. The obtained results allow one to determining the influence of each factor on the HAF of cold-drawn pearlitic steel wires and, in addition, defining four micromechanical models in terms of diverse *micro fracture maps* representing the fracture events.

KEYWORDS:

Cold-drawn pearlitic steel, notch, stress triaxiality, hydrogen embrittlement, hydrogen-assisted micro-damage, tearing topography surface.

NOMENCLATURE

***A*:** Notch depth
C: Cleavage
CERT: Constant extension rate tensile
d_i**:** Diameter of the steel obtained after the *i*-th step of cold drawing
ε_p^i**:** Cumulative plastic strain of the steel obtained after the *i*-th step of cold drawing
FPZ: Fracture process zone
HAMD: Hydrogen-assisted micro-damage
HAF: Hydrogen assisted fracture
HDT: Hydrogen damage topography
HE: Hydrogen embrittlement
L: Longitudinal
LAD: Localized anodic dissolution

- Corresponding author: Prof. J. Toribio, Fracture & Structural Integrity Research Group, University of Salamanca, E.P.S., Campus Viriato, Avda. Requejo 33, 49022 Zamora, Spain
Tel: +34 677 566 723; Fax: +34 980 545 002, E-mail: toribio@usal.es