NUMERICAL AND THEORETICAL MODELS TO PREDICT FATIGUE LIFE IN AGGRESSIVE ENVIRONMENTS FROM EXPERIMENTAL DATA

Sergio Baragetti, Department of Management, Information and Production Engineering, and GITT- Centre on Innovation Management and Technology Transfer, University of Bergamo
sergio.baragetti@unibg.it
Francesco Villa, Department of Management, Information and Production Engineering, University of Bergamo

Key Words: FCGR, Environment Assisted Cracking, Corrosion Fatigue, Ti-6Al-4V

Corrosion fatigue produce sensible effects in the fracture mechanics of structural materials. Aggressive environments in presence of dynamic fatigue load are indeed responsible of multiple effects, regarding crack nucleation and propagation rates. Considering Ti-6Al-4V in air, inert paraffin oil and 3.5 wt.% NaCl mixture, environmental effects are sensible in terms of acceleration of Fatigue Crack Growth Rate – i.e. d*a*/d*N* vs. stress intensity factor Δ*K*. Several literature studies dealt with the topic in the past years. However, research has been focused mainly on the FCGR description, and the prediction of number of cycles to failure in aggressive environments is not addressed. In the presented poster, a methodology to obtain a numeric model which reconstruct d*a*/d*N* vs Δ*K* from experimental results, including crack length and applied stress, is presented and compared against literature data. Results are related to *R* = 0.1 axial test involving smooth and notched flat dogbone specimens, with varying notch radius. The proposed model is used to reconstruct the number of cycles to failure of the tested specimens, resulting in a satisfactory correlation with experimental data. Comparison with other literature models highlights the necessity to develop a proper numerical model with each test case.

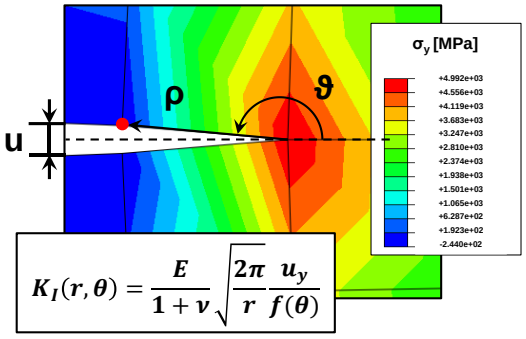

Fig. 1: FE numerical model and reconstruction of the stress intensity factor from crack tip opening.

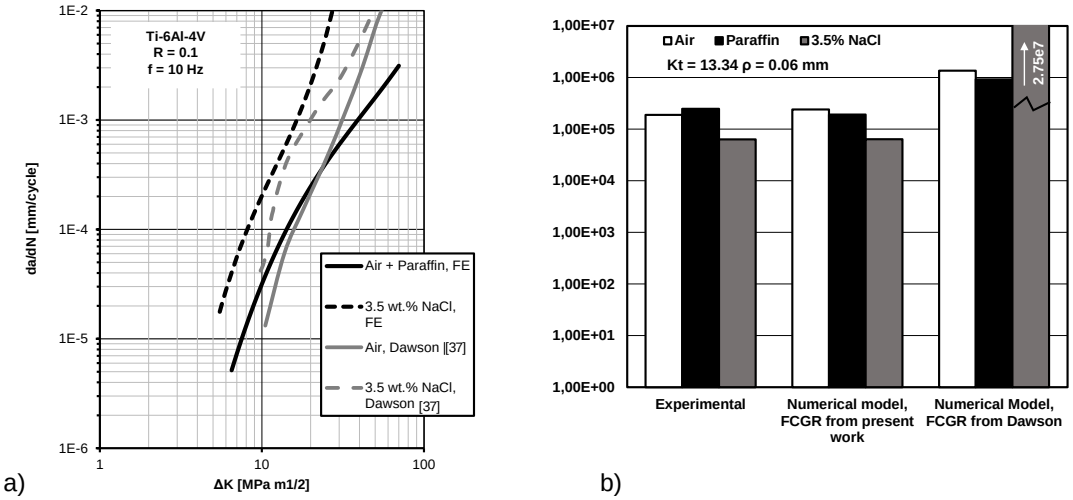

Fig. 2: FCGR obtained from numerical reconstruction of actual experiments vs. literature data (a); predictions in terms of number of cycles obtained from present numerical reconstruction, vs. prediction based on literature FCGR data.