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EVALUATING THE HEAT ENERGY DISSIPATED IN A SMALL VOLUME SURROUNDING THE TIP OF A FATIGUE CRACK

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ABSTRACT

Fatigue crack initiation and propagation involve plastic strains that require some work to be done on the material. Most part of this irreversible energy is dissipated as heat and consequently the material temperature increases. The heat being an indicator of the intense plastic strains occurring at the tip of a propagating fatigue crack, the hypothesis is formed that it can be used to assess the fatigue damage accumulation rate of cracked components. Moreover, the heat energy at the crack tip is averaged according to Neuber's finite particle concept. The aim of the present paper is to present the theoretical framework and the corresponding experimental technique to evaluate the heat energy dissipated in a structural volume surrounding the crack tip. The shape and size of the structural volume have been assumed according to the literature, even though the definition of the structural volume size of the analysed material in a fatigue sense is not the scope of the present paper. , The proposed experimental technique to evaluate the averaged heat energy is based on the radial temperature profiles measured around the crack tip by means of an infrared camera. The temperature fields measured within few millimetres from the crack tip have been compared successfully with existing analytical solutions.

KEYWORDS: crack tip, crack propagation, energy approaches, AISI 304L, averaging approaches, critical distance mechanics, fatigue assessment.