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2D to 1D fatigue crack propagation transition

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A crack is considered one-dimensional when the trajectory can be represented by a curve, as in the case where a surface crack pierces the entire thickness of a piece. If the crack penetrates partially in the specimen, it is considered to be two dimensional. There are some empirical expressions for two-dimensional cracks provided in the literature that help describe the stress intensity factors. These equations are limited to various form factors that relate the stress intensity to the geometrical characteristics of the piece. An important question in calculating the total life of fatigue crack is describing the transition from a crack partially penetrating (two dimensional) for a one-dimensional (passing crack), because to calculate the total life of a fatigue crack is also necessary to model the transition. However, this process of transition has not for many geometries been described by analytical or experimental studies. This research was aimed at investigating the process of transition from the two-dimensional crack to a one-dimensional crack with the use of polycarbonate a transparent material. Experiments were conducted involving crack propagation in plates with a rectangular cross section. In each experiment, a crack was induced as a defect with a quarter-elliptical shape in one corner of the specimen. The propagation affected by the application of a low-frequency cyclic loading. Values of characteristic lengths of the two-dimensional shape of the crack (*a, c* and *c'*) were measured during the transition process, which allowed us to evaluate the rates of change of these parameters with the number of cycles N applied load and to evaluate the normalized stress intensity factors that control the transition. The experimental values are also used as input to a program for numerical analysis of crack propagation, the ViDA, which allows us to calculate the stress intensity factors along the front quarter-elliptical crack.

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