Monitoring Acoustic Emission During Quasi-Static Loading/Unloading Cycles of Filament-Wound Graphite/Epoxy Laminate Coupons*

J. Awerbuch**, M.R. Gorman***, M. Madhukar**

ABSTRACT

The potential for determining damage severity in composites by monitoring acoustic emission during proof loading has been assessed. For this purpose graphite/epoxy laminates were loaded to a pre-determined load level and then unloaded. Loading/unloading cycles were repeated eight to twelve times, increasing the load incrementally up to failure. Tests were conducted with filament-wound $[\pm 24/90/0/\pm 45/0/90/\pm 24]_T$ laminate coupons. Notched and unnotched specimens (300 x 25 mm in dimensions) were tested, having five different notch length-to-width ratios.

The main objective of this work was to determine the validity of the Kaiser and Felicity effects and to assess the concept of the Felicity Ratio (as defined by the Committee on Acoustic Emission for Reinforced Plastics of the Society of Plastics Industry) as a measure for damage severity, material quality, and consequently as an indication of the loading history that the subject material or structure has experienced.

It has been determined for all tests conducted that, during loading, emission initiates prior to the previously applied load level, which is a deviation from or breakdown of the Kaiser effect, and that this early onset

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** Associate Professor and Graduate Student, respectively, Department of Mechanical Engineering and Mechanics, Drexel University, Philadelphia, PA 19104.

*** Assistant Professor, Department of Engineering Mechanics, University of Nebraska-Lincoln, Lincoln, Nebraska, 58488-03477.

of emission depends upon load level, load history and the subject material. The Felicity Ratio was recorded for each load cycle and the effect of applied stress was determined so that its applicability as a measure of damage severity could be established. Results indicate that for poor quality material the Felicity Ratio drops rapidly with increasing applied stress, and that it can therefore serve as an indicator of damage severity and/or material quality, and ultimately as an acceptance/rejection criterion.