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Seminar

Materials Science & Engineering

Presents:

Professor K. L. (Larry) DeVries

Distinguished Professor, Mechanical Engineering, University of Utah

"The Use of Fracture Mechanics and Finite Elements Methods in the Analysis, Testing, and Design of Adhesive Joints"

Since the advent of synthetic adhesives in the middle of the last century their growth in usage has been so phenomenal that, a handbook (the International Plastics Selector-Adhesives published by D.A.T.A. in 1991) lists some 5000 different adhesive formulation that are commercially available. Despite their wide usage much is not well understood about the mechanic of adhesives and adhesive joint failure. A few observations relevant to this discussion of Finite Elements Analysis in conjunction with Fracture Mechanics Analysis (FEA/FMA) of Adhesive Joints are: (a) The stress distribution in such joints is never as simple as often assumed and the usually reported "standard test results" often completely ignore the most important aspects of the stress distribution. (b) Crack growth does not always initiate at the point of apparent maximum stresses in an adhesive joint. (c) The locus of adhesive crack growth is often somewhat removed from the adhesive-substrate bond-line but there are instances where it closely follows this bond-line. (d) FEA/FMA can provide significant information on the resolution of questions raised in these observations. This presentation will endeavor to demonstrate that: (1) FEA/FMA can be used to quantitatively predict the strength of adhesive joints and more particularly to elucidate the effects of such factors as adherend thickness (and variation), amount of overlap, geometric, material discontinuities, etc. (2) Other factors being equal, crack growth tends to initiate at locations of maximum energy release rate irrespective of whether or not these are points of maximum stresses. And (3), the preferred locus of crack growth is along those paths for which energy release rate is a maximum. In each of these cases results of a fracture mechanics analysis will be presented along with experimental verification of the analyses. Finally, it will be shown that methods commonly used for joint design often yield extraneous results. The use of FEA/FMA as a design tool will be then discussed, e.g. demonstrating how it can provide insight into how slight changes in geometry can dramatically affect joint performance.

Wednesday November 18, 2009
4:10-5:00 p.m.
1230 WEB