AN ANISOTROPIC FATIGUE DAMAGE MODEL FOR FIBERGLASS COMPOSITE

Movaghghar A., Lvov G. I.
National technical university
«Kharkov polytechnic institute», Ukraine

Investigation of fatigue behavior of fiber-reinforced composite materials and in particular identification of characteristics of their resistance to deformation and destruction are of great scientific and practical interest due to continuous growth in production volumes and increased application of composite materials in the growing fields of modern technology [1].

Priority acquired researches aimed to establish patterns of occurrence and development of various mechanical fatigue damage which their accumulation in time may lead not only to reduce the durability characteristics of structures and elements, but also cause premature exhaustion of load bearing capacity and fracture.

Mathematical modeling of anisotropic fatigue damage in materials and in particular composites was the subject of intense research in the last decades. This paper presents an energy based model for fatigue life prediction and evaluation of progressive anisotropic damage in composite materials. It is based on the assumption that the damage growth rate in composite depends on the value of elastic strain energy per cycle W_e, the cycle parameter R, the current level of stress and damage:

$$\frac{dD_{ij}}{dN} = f(W_e, R, D_{ij}, s_{ij}). \qquad (1)$$

Here assumed that there exists a power relation between the damage growth rate and elastic strain energy of the composite, then the model is represented as:

$$\frac{dD_{ij}}{dN} = k(R)\cdot(W_e)^n \cdot M_{ijkl}\cdot s_{kl}\ . \qquad (2)$$

To identify the parameters of this model used experimental results obtained by fatigue tests of specimens cut along the warp, weft and 45º directions from a single sheet of fiberglass composite mark STEF-1. It is shown that the proposed theory reflects well the process of anisotropic fatigue damage accumulation and fracture of fiberglass composite specimens.

[1] Composite materials in 8 Vol. / edited by L. Broutman, R. Krock. Vol 5. “Fracture and fatigue”, Academic press: New york and London, 1978. -483p.