Abstract:

One of the applications of glass fiber reinfoced polymers are in wind turbine blades. These blades are subjected to cyclical loading consequently suffering fatigue damage. In this study, the residual strength in E-glass fiber reinforced epoxy composite with the sequence of $[90/0/\pm45]_s$ made by vacuum infusion process (VIP) has been investigated. By determining the ultimate tensile strength and S-N curve, the residual strength test was performed at a maximum stress level of 163 MPa for three different ratios of nominal fatigue lifetime namely, 20, 50 and 80 percent of nominal fatigue lifetime. The statistical distribution of the ultimate tensile strength was determined by the two-parameter weibull distribution. According to the results, the shape and scale parameters were 19.9 and 389.70 MPa, respectively. In this research, fatigue data from the databases of the Sun Air Research Institute were used. The fatigue results of this research and data base were evaluated by t-test and the belonging of the two data groups to a statistical set with 95% reliability was confirmed. The experimental results of residual strength were analysed by linear (BR), nonlinear (REI) and modified (OM) proposed models. The reduction in the residual strength was observed in the experimental and predicted results of the OM model representing a preliminary loss of residual strength, a subsequent decrease with low slope and a sudden drop at later stages of its life. These changes may be attributed to the rapid accumulation of the damage in the first stage, damping at energy in the second stage and delamination in the third stage. The results represent the conservative function of the linear model (BR) and the adaptation of the modified model (OM) to the experimental results.

Keywords: GFRP composite, vacuum infusion process (VIP), fatigue, residual strength.