FATIGUE CHARACTERIZATION OF GLASS FIBER REINFORCED VINYL ESTER AND POLYESTER COMPOSITES CONTAINING CORE SHELL RUBBER PARTICLES

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ABSTRACT

Glass fiber reinforced polymer matrix composites have experienced tremendous growth in wind energy, construction, marine and automotive industries. This is because of the superior mechanical strength, chemical and fire-resistant properties of fiber reinforced composites. However, polymer resins are very brittle in nature because of the large amount of cross linking that occurs during composite curing. This results in composites with low toughness. This limits the use of glass fiber reinforced composites in applications where components are subjected to cyclic loading conditions such as wind turbine rotor blades and propeller shaft of automobiles.

This research focusses on characterization of core shell rubber particles (CSRP) modified glass fiber reinforced vinyl ester and polyester composites. Composites containing 2 wt%, 5 wt% and 10 wt% core shell rubber particles were manufactured using Vacuum Assisted Resin Transfer Molding (VARTM). Composite samples were tested for tensile, compressive, shear, flexural and short beam properties according to appropriate ASTM standards.

5 wt% core shell rubber particle modified composites performed the best with higher toughness. Control composite containing no core shell rubber particles were compared with 5 wt% core shell modified composites in tension compression fatigue testing at 5Hz to compare their load bearing capacity under cyclic loading condition. The 5 wt% core shell rubber particle modified vinyl ester composite retained 92.5% of its modulus compared to the control composite which retained only 75% of its modulus at the end of the test. The 5 wt% core shell rubber particle modified polyester composite retained 20% of its modulus compared to the control composite which retained only 45% of its modulus at the end of the test.

Optical microscopy revealed that composite damage occurred during fatigue due to matrix cracking followed by localized delamination and final failure. Differential scanning calorimetry and thermogravimetric analysis revealed that addition of core shell rubber particles had no effect on the glass transition temperature and mass loss rate of the manufactured composites respectively.