ABSTRACT

This study aims to investigate the effect of rice husk ash (RHA) weight fraction variation on the microstructure, mechanical properties, and thermal characteristics of epoxy resin composites as candidates for high-voltage insulating materials. The composites were synthesized using DGEBA epoxy resin with RHA weight fractions of 0%, 4%, 8%, 12%, 16%, and 20%. Characterization was conducted through tensile testing to evaluate mechanical strength, Scanning Electron Microscopy (SEM) to observe surface morphology, and Simultaneous Thermal Analysis (STA), including Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC), to assess thermal degradation behavior. The results indicate that RHA fraction significantly influences composite properties. The highest tensile strength was obtained in the low-fraction sample (sample B) at 21.273 MPa, while the lowest was observed in the high-fraction sample (sample F) at 14.975 MPa. SEM observations revealed increased agglomeration and reduced microstructural homogeneity at higher RHA fractions. TGA analysis showed increase in final residue up to 16.80% for high RHA content compared to 0.68% for low fraction, although the onset degradation temperature was not much shifted. Moreover, the exothermic peak intensity in the DSC curve increased with higher RHA content. Overall, increasing RHA fraction enhances thermal residue stability but reduces mechanical performance, indicating the need for an optimal composition balance for high-voltage insulating applications.

Keywords: *Epoxy–RHA composite; rice husk ash; mechanical properties; thermal characteristics; high-voltage insulator; SEM and STA.*