RESEARCH ARTICLE

Industrial cutting waste granite dust reinforced cardanol benzoxazine/epoxy resin hybrid composites for high-voltage electrical insulation applications

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Abstract

An attempt has been made to develop hybrid composites from benzoxazine monomer (C-ddm) hybridized with DGEBA epoxy resin (EP) and reinforced with varying weight percentages (20 wt%, 40 wt%, 60 wt%, 80 wt% and 100 wt%) of glycidoxypropyltrimethoxy- silane (GPTMS) functionalized granite dust (GD) obtained from industrial granite cutting and polishing process in order to utilize them for electrical insulation applications. The thermal stability of granite dust reinforced poly(EP-co-C-ddm) composites was studied by TGA analysis. Among the composites samples studied, 100 wt% GD reinforced poly(EP-co-C-ddm) composites possess better thermal stability than that of other neat matrices and composites. Among the composites prepared using varying weight percentages of functionalized GD reinforcement, it was observed that 80 wt% GD reinforced poly(EP-co-C-ddm) composites possesses better hydrophobic character than that of other neat matrices and composites. The value of LOI calculated for neat matrix (poly[EP-co-C-ddm]) and 20 wt%, 40 wt%, 60 wt%, 80 wt% and 100 wt% GD reinforced composites was found to be 22, 28, 34, 40, 43 and 45 respectively. The 80 wt% GD reinforced poly(EP-co-C-ddm) composites possess the higher values of tensile strength and flexural strength of 47 MPa and 140 MPa, respectively than those of their samples. The values of electrical surface resistivity and electrical volume resistivity of all the neat matrices and GD reinforced polybenzoxazine composites were found to be in the order of 10^{12} and 10^{13} respectively. The values of dielectric strength obtained from break down voltage (BDV) for neat matrix [poly(EP-co-C-ddm)] and 20 wt%, 40 wt%, 60 wt%, 80 wt% and 100 wt% of GD reinforced poly(EP-co-C-ddm) composites are 15.0, 15.5, 16.5, 17.0, 17.0 and 17.0 kV/mm, respectively. Data obtained from thermal stability, hydrophobic behavior and dielectric studies it was inferred that the hybrid polymer composites developed in the present work can be conveniently used in the form insulators, sealants, adhesives and matrices where application demands at high-performance industrial and engineering applications.

CONFLICT OF INTEREST

The authors declare that they no conflict of interest.

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DATA AVAILABILITY STATEMENT

The data that supports the finding of this study are available on request from the corresponding authors.

Supporting Information