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NOTE

A Study on the Mechanical Properties of Zinc Oxide Reinforced Epoxy Composites

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This study involves the comparison of the mechanical properties of different proportion of ZnO (1, 3, 5 and 7 %) reinforced epoxy composites fabricated by the light compression moulding technique. The mechanical properties such as tensile, flexural and impact strength have been investigated and found that there was an increase in the mechanical properties from 1 to 5 % and there after starts decreasing. This negative trend may be due to the clustering of particles in the polymer matrix.

Key Words: Zinc oxide, Metal oxide, Polymer composite, Mechanical properties.

Composites are materials consisting of two or more chemically distinct constituents, on a macro-scale, having a distinct interface separating them. One or more discontinuous phases are therefore embedded in a continuous phase to form a composite[1,2]. The discontinuous phase is usually harder and stronger than the continuous phase and is called the reinforcement, whereas the continuous phase is termed the matrix. Inorganic particles reinforced composites reveal enormous potential in producing materials with low friction, high wear resistance *etc*. Wetzel *et al.*[3] have investigated the friction and wear of low nanometre Si_3N_4 filled epoxy composites. Epoxy resins are extensively used in various industries such as coatings, insulating and substrate materials due to their superior mechanical and electrical, excellent moisture and chemical resistance low shrinkages, *etc.*[4].

In present work, various percentages of ZnO (1, 3, 5 and 7 %) reinforced epoxy resins are prepared to get the respective composites. The mechanical properties of these composites are evaluated and compared. Flexural and impact strength increases up to 5 % and there after a negative trend appeared. This negative trend may be due to the clustering of ZnO particles in the polymer matrix resulting from non-uniform dispersion at higher concentration[5].

Zinc oxide were procured from Merck and used as received. The epoxy resin (DGEBP-A) and curing agent (poly amido phenol) were purchased from Javanthee Enterprises Private Limited, Chennai, India.

Fabrication of composites: Zinc oxide was well dispersed in epoxy matrices and the corresponding hardener (HY951) was mixed in a ratio of 10:1 by weight. The composites sheets were prepared by moulding technique using a standard steel mould having dimensions 210 mm × 210 mm × 40 mm. The steel moulds were sprayed by releasing agent (silicon spray) to facilitate easy removal of the composites from the mould after curing[6].

Mechanical tests: The tensile, flexural and impact strength of the plain epoxy matrix as well as the ZnO loaded epoxy composites were measured by using Universal Testing machine. These tests were conducted as per the ASTM E8/E8M (Physical Testing standards and Mechanical Testing standards) specification[7]. In each case, five specimens were tested and the average value is tabulated.

The results obtained for mechanical properties of virgin epoxy, 1, 3, 5 and 7 % of the zinc oxide reinforced composite were tabulated in Table-1. The ZnO reinforcement imparts considerable increase in the tensile, flexural and impact up to 5 % and there after it decreases. This could be due to cluster of fillers in the polymer matrix and non-uniformity in dispersion at higher concentrations.

Conclusion

The present study, tensile, flexural and impact strength of various percentages (1, 3, 5 and 7 %) of the ZnO filler reinforced epoxy composites were investigated. The mechanical

TABLE-1
MECHANICAL PROPERTIES OF PURE EPOXY AND ZINC OXIDE REINFORCED COMPOSITE

System	Tensile strength (MPa)	Tensile modulus (GPa)	Flexural strength (MPa)	Flexural modulus (GPa)	Impact strength (KJ/m^2)
Epoxy	320	3.8	402	8.5	12.3
Epoxy + 1 % zinc oxide	401	4.9	467	10.2	14.1
Epoxy + 3 % zinc oxide	440	5.8	512	11.5	18.2
Epoxy + 5 % zinc oxide	465	6.4	548	12.3	19.9
Epoxy + 7 % zinc oxide	448	5.7	523	11.2	17.4

properties enhanced obviously up to 5 % and later decreased. The decrease in trend may be related to the clustering of ZnO particles in the polymer matrix.

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