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CHEMICAL TREATMENT FOR DISSOLUTION OF AMINE-CURED EPOXIES AT ATMOSPHERIC PRESSURE

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Abstract

Carbon fiber/epoxy composites have largely resisted attempts to recycle because the crosslinked polymer matrices cannot be easily separated from the fiber reinforcements. In this study, two chemical treatment methods - depolymerization and acid digestion (both at atmospheric pressure) - were employed to dissolve amine-cured epoxy formulations. Both depolymerization and acid digestion were shown to be effective dissolution processes for all amine/epoxy samples that encompassed variations in amine/epoxy stoichiometric ratio (A/E ratio), epoxy monomer functionality, and amine curing agent type. The relationship between epoxy properties and dissolution rate was determined, and the key parameters affecting thermoset matrix dissolution were identified. The dissolution rate was controlled by both the chemical reaction and diffusion rates. The components of the chemical solutions after epoxy dissolution were analyzed and identified, and protocols to quantitatively track the products after dissolution were developed. The two major cleavable sites during epoxy dissolution were the C-N and C-O bonds, and the aromatic structures of the epoxies were preserved.

Keywords:

Recycling; Composites; Carbon fiber; Epoxy; Chemical treatment; Atmospheric pressure