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A Review on Machinability of Carbon Fiber Reinforced Polymer (CFRP) and Glass Fiber Reinforced Polymer (GFRP) Composite Materials

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Abstract

Fiber reinforced polymer (FRP) composite materials are heterogeneous and anisotropic materials that do not exhibit plastic deformation. They have been used in a wide range of contemporary applications particularly in space and aviation, automotive, maritime and manufacturing of sports equipment. Carbon fiber reinforced polymer (CFRP) and glass fiber reinforced polymer (GFRP) composite materials, among other fiber reinforced materials, have been increasingly replacing conventional materials with their excellent strength and low specific weight properties. Their manufacturability in varying combinations with customized strength properties, also their high fatigue, toughness and high temperature wear and oxidation resistance capabilities render these materials an excellent choice in engineering applications. In the present review study, a literature survey was conducted on the machinability properties and related approaches for CFRP and GFRP composite materials. As in the machining of all anisotropic and heterogeneous materials, failure mechanisms were also reported in the machining of CFRP and GFRP materials with both conventional and modern manufacturing methods and the results of these studies were obtained by use of variance analysis (ANOVA), artificial neural networks (ANN) model, fuzzy inference system (FIS), harmony search (HS) algorithm, genetic algorithm (GA), Taguchi's optimization technique, multi-criteria optimization, analytical modeling, stress analysis, finite elements method (FEM), data analysis, and linear regression technique. Failure mechanisms and surface quality is discussed with the help of optical and scanning electron microscopy, and profilometry. ANOVA, GA, FEM, etc. are used to analyze and generate predictive models.

Keywords: Composite materials, fiber reinforced polymer composite materials, CFRP, GFRP, machining, wear, surface damage.