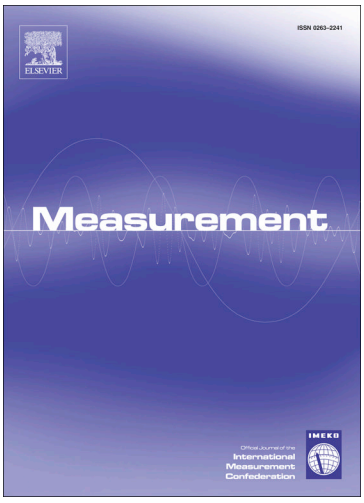

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Minimization of Cutting Force, Temperature and Surface Roughness through GRA, TOPSIS and Taguchi techniques in End Milling of Mg Hybrid MMC

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Abstract

Present study investigates the effect of material and machining parameters on cutting force, surface roughness and temperature in end milling of Magnesium (Mg) Metal Matrix Composite (MMC) using carbide tool. Mg hybrid composite was fabricated by reinforcing Cathode Ray Tube (CRT) panel glass, an intensifying E-waste and Boron Nitride (BN) particles through powder metallurgy method. The milling experiments were conducted based on L27 orthogonal array designed by considering CRT glass particle size and weight percentage, tool diameter, speed, feed and depth of cut as input process parameters. Multi objective optimization was done through Grey Relational Analysis (GRA) and Techniques for Order Preferences by Similarity to Ideal Solution (TOPSIS). Both of the techniques provided a similar optimum parameter condition i.e. 10µm particle size, 5% reinforcement, 8mm diameter tool, 710rpm speed, 20mm/min feed and 0.5mm depth of cut that outcomes in 139.48N in-feed force, 63.92N cross-feed force, 42.6N thrust force, 68.96^{o}C temperature and 0.198µm surface roughness. ANOVA is performed to identify significance and also the effect of each process variables on response parameters. Though all the parameters were found to be significant, reinforcement weight % and particle size affects the response parameters as that of machining parameters whereas speed turned to be the least significant factor.

Keywords: Magnesium; Composite; Milling; Cutting Force; Temperature; GRA; TOPSIS.

1. Introduction

Magnesium, one amongst the lightest materials with a density of 1.76 g/cc has numerous applications in various sectors viz. computer parts, airframes, aircraft engines, helicopter components, light trucks and automotive parts [1]. Even though Mg has some encouraging basic properties such as high strength to weight ratio, lower density (that is only two third of aluminium) its performance is poor in terms of accomplishing the need of functional properties like that of wear resistance. Later, Mg based composites introduced with improvised functional properties displaced conventional hard materials used in many applications just for their extensive and well improved properties. On the other hand, rapid emergence of LCD and LED