CHAPTER 57

TECHNOLOGY
MANUFACTURING PROCESSES
&
AUTOMATION ENGINEERING

Doctoral Thesis

01. CHAUDHARY (Vijay)
Development and Characterization of Natural Fiber Reinforced Polymer Composites.
Supervisors : Prof. Sachin Maheshwari and Dr. Pramendra Kumar Bajpai
Th 24195

Abstract
(Not Verified)

The present research initiative aims at highlighting the issues and challenges associated with processing of plant based thermoset composites. In this work, three different types of natural fibers (jute, hemp, and flax) were reinforced with epoxy matrix to fabricate natural fiber reinforced polymer composites (NFRP) and their hybrid composites (jute/hemp/Epoxy, hemp/flax/epoxy and jute/hemp/flax/epoxy). Developed composite were characterized for their physical properties, mechanical properties, tribological properties and dynamic mechanical analysis. All the experiments were conducted before and after one year water immersion of all the developed composites. Physical properties (density, moisture absorption), chemical characterization (FTIR spectroscopy and XRay Diffraction) and thermal analysis (TGA and DTA) of jute/epoxy, hemp/epoxy, flax/epoxy, jute/hemp/epoxy, hemp/flax/epoxy and jute/hemp/flax/epoxy composites were performed. Incorporation of jute, hemp and flax fibers with epoxy matrix influenced the transmittance peaks in FTIR spectroscopy analyses. Mechanical properties (hardness, tensile, flexural, and impact strength) before and after one year water immersion of all the developed composites were evaluated. The effect of water absorption on mechanical properties of the developed composites were investigated. SEM micrographs of fractured surfaces after mechanical characterization were analysed to reveal the surface condition and possible mechanism of failure. Dynamic mechanical analysis (DMA) was also carried out before and after one year of water immersion to evaluate the viscoelastic behaviour (damping capability (tanδ), storage modulus and loss modulus) of the developed composites. Tribological performance of the developed bio-composites were evaluated before and after one year of water immersion in terms of frictional characteristics and sliding wear under dry contact condition at different process parameters, such as applied load (10-50N), sliding speed (1-5m/s) and sliding distance (1000-2000m). The surface morphology of samples after wear test was examined by scanning electron microscopy to investigate and propose the possible wear mechanism of the developed composites.

Contents

1. Introduction 2. Literature review 3. Material and methods 4. Physical, chemical and thermal characterization of natural fiber reinforced epoxy composites 5. Mechanical characterization of natural fiber reinforced epoxy composites before and after one year of water immersion. 6. Dynamics mechanical analysis of natural fiber reinforced copy fiber reinforced epoxy composites before and after one year of water immersion 7. Tribological analysis of natural fiber reinforced epoxy composites before and after one year of water immersion. 8. Summary, conclusion and scope for future work. References and list of publication.

02. HIMANSHU PAYAL
Some Studies on Electric Discharge Machining of Nickel Based Super Alloy
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Abstract
(Not Verified)

Electric discharge machining (EDM) has established itself as one of the most versatile non-conventional material removal process suitable for difficult-to-cut materials such as composites, super alloys (Inconel 825), ceramics, hastelloys, carbides, tool steels etc. EDM is basically a thermo-electric process in which material is removed with the help of spark energy formed between the tool electrode and work piece submerged in a dielectric medium. A detailed experimental investigation has been undertaken on die-sinking EDM by taking Inconel 825 as work piece and copper, copper-tungsten, graphite as tool electrode. Inconel 825, a nickel-based super alloy, is a precipitation-hardenable nickel-chromium-iron alloy containing significant amount of nickel, chromium, iron, and molybdenum. The input parameters considered for experimentation are dielectric fluid (DF), pulse-on-time (Ton), discharge current (ID), duty cycle (ζ), gap voltage (Vg), tool electrode lift time (TL), tool electrode material (TM) and performance measures are Material removal rate (MRR), Tool wear rate (TWR) and Surface roughness (SR). In this work, experiments have been designed by Taguchi's design of experiment (DOE) and experimental runs have been conducted as per Taguchi's L36 (21x36) orthogonal array. Beside this, surface characterization, material transfer and compound formation are found out by scanning electron microscopy (SEM), Energy dispersive x-ray spectroscopy (EDXS) and X-ray diffraction (XRD). To do the modeling of the process artificial neural networks (ANN) have also been employed. The optimal combination(s) of input parameters are obtained by applying various optimization and hybrid techniques such as single objective by taguchi's method, Multi-response signal-to-noise ratio (MRSN), Grey relational analysis (GRA), Principal component analysis (PCA), Taguchi- fuzzy logic (FL). It can be concluded from this research work that machining of nickel based super alloy by EDM is technically feasible and simple modifications in the existing set-ups can lead to substantial improvement in the performance measures.

Contents

1. Introduction 2. Literature review 3. Design and experiments 4.Experimentation 5.Experimental investigations 6.Single Objective optimization by Taguchi's method 7.Process modeling of electric discharge machining of inconel 825 using artificial neural network 8. Parametric optimization of EDM using multi response signal to noise ration technique 9. Multi objective optimization using GRA and PCA approach 10. Conclusions and future scope of the work. References, appendices, List of publications and bio data of author.