Criterion 1: Curricular Aspects

1.3 Curriculum Enrichment

1.3.4.1: Number of students undertaking field projects / internships / student projects

Programme Name: M.E Manufacturing Engineering.

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Criterion 1: Curricular Aspects

1.3 Curriculum Enrichment

1.3.4.1: Number of students undertaking field projects / internships / student projects

Programme Name: M.E Manufacturing Engineering.

Field Projects/Student Projects Proof

EXAMINATION OF STATIC AND DYNAMIC MECHANICAL PROPERTIES OF PALYMRA PALM LEAF STALK FIBER (PPLSF) REINFORCED POLYMER COMPOSITE

A PROJECT REPORT

Submitted by

DHIYANESWARI J M (927621MME001)

in partial fulfillment for the award of the degree of

MASTER OF ENGINEERING

in

MANUFACTURING ENGINEERING

M. KUMARASAMY COLLEGE OF ENGINEERING,KARUR.

ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2023

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BONAFIDE CERTIFICATE

Certified that this Report titled **"EXAMINATION OF STATIC AND DYNAMIC MECHANICAL PROPERTIES OF PALYMRA PALM LEAF STALK FIBER (PPLSF) REINFORCED POLYMER COMPOSITE"** is the bonafide work of **"DHIYANESWARI JM (927621MME001),"** who carried out the project work during the academic year 2022-2023 under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

The research work is focused toward determining the static and dynamic mechanical properties of the composites made by reinforcing untreated and alkali-treated short *palmyra palm leaf stalk fibers (PPLSF)* of length 20mm, 30mm and 40mm in the polymer matrix. The short *palmyra palm leaf stalk fiber* reinforced polymer matrix composites are prepared by a compression molding method. The result illustrates that the 40mm alkali-treated short *PPLSF* composite exhibited the maximum tensile strength of 26.14 MPa, the flexural strength of 79.81 MPa and impact strength 9.796 kJ/m2. The dynamic mechanical analysis shows that the 40mm alkali-treated short *PPLSF* composite has improved the storage and loss modulus compared to 20 mm and 30 mm short untreated and alkali-treated fiber composites.Then, optimization of the results was performed based on taguchi using Qualitek 4. L4 lattice was used for yarn lengths 20 and 30mm. The optimized values showed the fiber with maximum length in the mix polymers for better results.

KEYWORDS: Palmyra palm leaf stalk; Tensile strength; Dynamic mechanical analysis

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CHAPTER 1

INTRODUCTION

1.1POLYMER COMPOSITES

A composite material is one made up of two or more chemically and physically distinct phases that are separated by specific interfaces. Different systems are carefully combined to produce systems with more useful structural or functional properties than either component could achieve on its own. Composites, a wonder material, are becoming an essential part of today's home building equipment and spacecraft materials due to benefits such as light weight, corrosion resistance, high fatigue strength, and reduced assembly time. The primary distinction between blends and composites is that in composites, the two main components are visible while in blends, they may not be. Wood, concrete, and ceramics are the most commonly used materials in our daily lives. Surprisingly, the most significant polymeric composites occur naturally and are referred to as natural composites. Mammalian connective tissue is one of the most complex polymer composites known to man, with the fibrous protein collagen acting as reinforcement. It has both soft and hard connective tissue functions. A composite material is a mixture of materials of various compositions in which the individual components retain their distinct identities. These individual components work together to provide the mechanical strength or stiffness that composite parts require. Composites are materials made up of two or more distinct phases (matrix and dispersed) that have bulk properties that differ significantly from their constituents. Matrix phases are primary phases that have continuous characteristics. The matrix is usually the softer, more ductile phase. The load is distributed while the dispersed phase is held. The dispersed (reinforced) phase is discontinuously embedded in the matrix. The dispersed phase is the name

CHAPTER 7
RESULT AND DISCUSSION

7.1 TENSILE TEST

Figures 7.1 and Figure 7.2 depict the stress-strain properties of a unidirectional, tightly blended, alkali treated, random oriented palm leaf fiber-reinforced polyester composite. From the result by Up to a certain point, increasing the fibre length increases the mechanical properties. The mechanical properties of tensile strength and tensile modulus are 16.39 MPa and 1.47 GPa for the pure plastic sample. By increasing about 30% of the yarn length for 20 mm of reinforcement, the tensile strength and modulus values are obtained 22.21 MPa and 1.82 GPa. For a fiber length of 30 mm reinforced about 30%, the obtained tensile and modulus values are 24.06 MPa and 1.84 GPa. For a fiber length of 40 mm reinforced at approximately 30%, the obtained tensile and modulus values are 26.14 MPa and 1.89 GPa.

Table7.1 Tensile Strength

Fiber length variations in 30%PPLSFiber Composite plate	Neat resin	20mm Fiber	30mm Fiber	40mm Fiber
Tensile strength(MPa)	16.39	22.21	24.06	26.14

CHAPTER 9
CONCLUSION

Alkali-treated fibers have been used to prepare composite layers for different fiber lengths. Fibers are reinforced in resins for the preparation of polymer composite panels with a composition of 30:70. The length of the fibers is chosen between 20mm, 30mm and 40mm. A randomization orientation was applied to the above study. Tensile, bend and impact test specimens are cut from prepared polymer composite panels. The results show that the mechanical properties of the fibre increase to some extent as the fibre length increases. The 40mm yarn has the best strength in the polymer composite matrix compared to other fibers of shorter length. Then, optimization of the results was performed based on taguchi using Qualitek 4. L4 lattice was used for yarn lengths 20 and 30mm. The optimized values showed the fiber with maximum length in the mix polymers for better results.

Investigation on inclined Laser Hole Drilling of Carbon Fibre Reinforced Plastic using Nd: YAG laser

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ABSTRACT

This study investigates the process of laser percussion inclined hole drilling in CFRP using an Nd:YAG laser. Parametric analysis to analyse the effect of input parameters like laser power, cutting velocity and argon pressure on heat affected zone and kerf angle has been carried out for inclined hole drilling using Nd: YAG laser. Composite materials, advanced materials and that are shaped by the arrangement of two or more materials in order to get distinctive properties of materials, includes the Carbon Fiber Reinforced Polymer (CFRP) which an extremely strong and light fiber-reinforced polymer due to the presence carbon fibers. Among the different methods for drilling, Laser inclined drilling are considered for this study. In this work, two machine capability (Nd: YAG laser and CO_2) is studied by employing process capability index. Based on experimentally measured hole quality characteristics namely Heat Affected Zone (HAZ) and Circularity Error (CE), this comparison is made. The main purpose of this investigation is to find the most suitable process among Nd: YAG laser and CO_2 process based on process capability for drilling micro hole in the carbon fiber reinforced polymer composites.

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CHAPTER-1

INTRODUCTION

Composite materials are gradually applied in different sort of fields like engineering and science due to its distinctive and desirable properties. With the effect of these properties and prospective applications, there is well-built need to recognize the problems associated in machining of composite materials superior. The make use of composites is rising significantly, frequently leading to new applications materials in the past few decades. Initially the cost of these materials is very high, justified only for specialized, low volume applications such as aerospace and defence. The low volume application fields like aerospace and defence, initial cost of these materials is very high and only for specialized components. As these materials and its manufacturing methods are becoming cheaper, they are finding an increasing use in consumer-oriented applications.

The fabricating costs of materials are reduced, as result of increases the use of consumer-oriented and structural-oriented applications. As confidence level in composites technology grows up, the higher commercial aircraft and battle aircraft will be constructed with composites materials.

1.1 COMPOSITE MATERIALS

Composite material is shaped by the arrangement of two or more materials in order to get distinctive properties of materials. These materials are integrated and not

CHAPTER-4

RESULTS AND DISCUSSIONS

Table 4.1 and Table 4.4 show experimental data observed from Nd: YAG laser and CO_2. Figure 4.1 show the image of holes at entry of the CFRP by Nd: YAG. Figure 4.2 shows the image of holes at entry of the CFRP by CO_2. Table 4.2 and Table 4.3 shows the process capability index for HAZ and circularity error of Nd: YAG. Table 4.5 and Table 4.6 shows the process capability index for HAZ and circularity error of CO_2. Process capability is the quality tool used to assess whether process performance characteristics statistically capable to meet the design specifications. In order to achieve and assess the quality characteristics of process and/or machine are usually performed the process capability study. The process is said to be capable when the width of process is less than or equal to width of design specification, otherwise it is incapable. The following guideline procedure is employed to evaluate the process capability.

1. Checking the type of data is given for process capability analysis (e.g., Continuous data or attribute data)

2. Checking the normality of process by normal probability plot

CHAPTER-5

CONCLUSIONS

The process capability of Nd: YAG and CO_2 were successfully evaluated while micro-drilling CFRP composites. In order to evaluate the best hole making process normality test, control chart, evaluation of process capability were used. From the above analysis, the following conclusion were drawn

1. The blind micro-holes with diameter 0.5 mm were precisely drilled using Nd: YAG process.
2. The quality characteristics of Nd: YAG and CO_2 are normal and are in control. The HAZ and circularity error obtained in CO_2 are exceptional from the control chart.
3. Based on the experimentally obtained value, control chart in both Nd: YAG and CO_2, it can be concluded that the CO_2 process is inferior process.
4. Based on the selection of machining condition and specifications limit, the Nd: YAG is found to be the best process for processing CFRP composites.

RECAST LAYER THICKNESS AND DEBRIS ANALYSIS FOR WIRE EDM INCONEL 718 USING CRYOGENICALLY TREATED ZrSiO4 AND Sic

PROJECT REPORT

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ABSTRACT

The conventional kerosene and powder-added kerosene dielectric performances have been found in wire electrical discharge machining (wire EDM) efficiency owing to dielectric properties variation, high recast layer thickness (RLT) formation, low residual stress induced. The cryogenically treated zirconium silicate (ZrSiO4) and silicon carbide (Sic) added dielectric fluid on Inconel 718 have been carried to evaluate the RLT and Debris diameter. Hence, the square holes have been performed. The Taguchi design, ANOVA are employed in this work. Overall analysis found that silicon carbide (SiC) added dielectric fluid produced a better result compared with other two dielectric fluids.

KEYWORDS: Inconel 718, Machining, Recast Layer Thickness, Debris Diameter, Surface Roughness.

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CHAPTER 1

INTRODUCTION

1.1 ADVANCED MACHINING PROCESS

The Advanced machining process does not employ a traditional tool for metal removal; instead, they directly utilize some form of energy for metal machining. In this process there is no physical contact between the tool and work piece.

In machining process harder and difficult to machine materials such as carbides, stainless steel, nitro alloy, hast alloy and many other high strength temperature resistant alloys find wide application in aerospace and nuclear engineering industries, owing to their high strength to weight ratio, hardness and heat resisting qualities conventional machining is economical and the surface finish is poor. The non-traditional machining process has been developed to overcome these difficulties.

To remain competitive in a global market environment, manufacturers should enhance the quality of their products and reduce costs while meeting strict customer requirements. Thus, recent research in the machining community has been mainly focused on increasing efficiency by fully utilizing the resources. It has been shown that actual machining times are much shorter than the non-productive times spent on loading/unloading, transferring, etc. the parts. Therefore, if

CHAPTER 4
RESULTS AND DISCUSSION

The responses, RLT, DD and SR have been measured. The designs of experiments and measured values have been shown in Table 4.1. The best dielectric performance has been selected by a minimum of RLT, DD and SR. Hence, Minitab statistical software has been used to find the best dielectric performance. Interval plots have been drawn under 95 % confidence intervals based on the experimental values and found that cryogenically treated Sic powder produces better performance than that of kerosene and ZrSiO4 powder, which has shown in Fig. 4.1. Thereby, cryogenically treated Sic powder has been considered for further analysis.

4.1 RECAST LAYER THICKNESS

In wire EDM, the sparks melt the material's surface and then undergo rapid quenching, resulting in a thin layer formed on the machined surface after solidification. The carbon in the kerosene was the reason for forming a recast layer, resulting in increased hardness of the surface. The thickness of the recast layer was related to dielectric properties, flushing pressure, and direction and value of process parameters. Fig. 4.2 shows the effects of parameters over the recast layer thickness. The performance trends for kerosene, cryogenically treated Sic powder and ZrSiO4 powder found that the RLT increases with an increase in current and

CHAPTER 5
CONCLUSIONS

The purpose of this work is to reduce the recast layer thickness, debris diameter and surface roughness of Inconel 718 using conventional kerosene, cryogenically treated Sic powder-added kerosene and ZrSiO4 powder-added kerosene performance in electrical discharge machining. The following statements have been made based on the experimental result and analysis.

- The influence of cryogenic processed Sic powder-added kerosene produces better performance than that of ZrSiO4 powder-added kerosene and conventional kerosene.
- The current and pulse duration are improvement percentages up to 55 % in recast layer thickness, 21 % in debris diameter and 30 % in surface roughness, respectively. The results were found based on the design of the experiment and cryogenic processed Sic powder-added in kerosene.
- The statistical indices of ANFIS modelling produces consistent results.
- The cryogenic processed Sic powder-added kerosene produces superior percentage improvement than that of the conventional kerosene.
- The laser surface treated Sic nano powder added EDM oil can be used further for improving the performance measures.

IMPROVEMENT IN THE FEED MARK LINE AND SURFACE CRACK OF MICRO TURNED AA 7075 THROUGH LASER HARDENING AND PLASMA NITRIDING

A PROJECT REPORT

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IMPROVEMENT IN THE FEED MARK LINE AND SURFACE CRACK OF MICROTURNED AA7075 THROUGH LASER HARDENING AND PLASMA NITRIDING.

Abstract

An Aluminium alloy has been observed to have limited applications based on the surface morphology and mechanical properties in the micro turning of AA7075. Hence, to reduce the feed mark line and surface crack of AA7075 surface belowthis level, the Laser Hardening (LH) and Plasma Nitriding (PN) on cermet inserts are proposed to reduce the feed mark line length and surface crack lengthof micro turned surface. In this work, the influences of spindly speed, feed rate and depth of cut on feed mark line length and surface crack length are investigated. The hardness in untreated cermet and treated cermet insert surfaces are also studied.

Keywords: Feed mark line length, Crack length, Plasma Nitriding, Laserhardening, AA7075, Cermet insert.

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CHAPTER 1

INTRODUCTION

Machining is an important process in any manufacturing Industry. Machining removes unwanted material from the workpiece to give the required size and shape of the component. Many kinds of machining processes have been developed in the manufacturing field to suit the requirement of industries and to satisfy the quality requirement of the components produced. The quality requirement includes the dimensional accuracy and surface finish of the components.

The machining processes are classified as conventional machining and unconventional machining processes. As a recent development in the machining, micromachining paves its way to produce micro features in the components or miniature of components. Micromachining is the basic technology for production of miniaturized parts and components, fabrication of miniature components in terms of micron range dimensions. Applications of micro component to enhance health care, quality of life and growth grabbed huge attention of the commercial industries. Madou (1987)

The micromachining is generally used to define the material removal process for parts having dimensions that lie between (1- 999) μm.

CHAPTER 6

Results and discussion

6.1.HARDNESS AND WEAR RESISTANCE OF UNTREATED AND TREATED CERMET SURFACE

The influence of LN and PN on hardness and wear resistance of cermet were studied. The hardness and scratch test results are shown in Table 6.1.

Table 6.1 Hardness of treated and untreated cermet

Sample	Hardening depth (mm)	Hardness (HK) (kgf/mm^2)	COF range	Scratch depth (mm)
Untreated	-	275	0.25-0.78	0.012-0.026
LH	0.135	656	0.14-0.56	0.003-0.023
PN	0.432	768	0.14-0.45	0.004-0.014

The PN on cermet surface produced a higher hardness compared with untreated and LH. The observed result was due to the high thickness layer formation on the cermet surface. The nitride layer was used to increase the resistance of the cermet surface. The scratching depth was also decreased in the PN processed cermet surface.

The result was due to the low plastic deformation on the nitride surface. On comparing the present hardness (768 $HK_{0.05}$) with other surface hardness (826–951 $HK_{0.05}$), a PN processed on cermet surface produced a slightly lesser hardness than that of duplex processed on compacted cermet.

Overall, a wear resistance of cermet was increased by increasing a layer formation thickness, decreasing a scratching depth and obtaining a low COF using a PN process. Hence, PN processed cermet was taken for further analysis.

6.2 FEED MARK LINE AND CRACK ANALYSIS

After conducting the turning process, as per the design of experiment, the

CHAPTER 7

Conclusions

The laser hardening and plasma nitriding, have been performed on Cermet inserts to reduce the feed mark line and crack length. The following conclusions have been made based on the experimental results.

- The laser hardening and plasma nitriding have improved 64% for hardness .
- The laser hardening and plasma nitriding have reduced 46 % for scratching depth compared with cermet hardness.
- In the present study of micro machining of cermet with PN the cutting is mostly restricted to nose portion with cutting edge radius playing a significant role on tool performance. Thus, feed rate proportional to edge radius (14 μm) have resulted in good machining performance.
- Finer feed facilitates plowing, resulting the higher order wear and with higher feed rate, reduced order of tool wear occurs.