Fabrication and Machinability Behaviour of Banana and Coconut Sheath Fiber Based Composite

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***Abstract*- Natural fiber composites are now a days being used in various engineering applications to increase the strength and to optimize the weight and the cost of the product. In this project banana fiber and coconut sheath fiber are taken for the development of the composite material. The sodium hydroxide treated banana fiber and coconut sheath fiber is used as reinforcing material for Vinyl ester resin matrix. Composites are formed by combining materials together to form an overall structure that is better than the individual components. The two materials work together to give the composite unique properties. Banana plant not only gives the delicious fruit, but it also provides textile fiber, the banana fiber. It grows easily as it sets out young shoots and is most commonly found in hot tropical climates. All varieties of banana plants have fibers in abundance. These fibers are obtained after the fruit is harvested and fall in the group of bast fibers. Machinability properties of fabricated composite is evaluated by using lathe milling machine and also measured surface finish of the machined components.**

Index terms- Banana fiber, coconut sheath fiber, sodium hydroxide, vinyl ester resin, composites and machinability

I. INTRODUCTION

Composite Material is outlined as a mix of two or further materials that finally end up in higher properties than those of the individual elements used alone. These natural composites have superior mechanical efficiency in quality, inflexibility and robustness compared to many non-natural composite materials. These biological composites show stratified structures at several levels of hierarchy with length scales that modify from micro to Nanometers.

In distinction to metallic alloys, every material keeps its separate chemical, physical, and mechanical properties. The two constituents space augmentation and a matrix. The most blessings of composite materials square measure their high strength and stiffness, combined with density, in comparison with bulk materials, letting a weight reduction within the finished half.

The reinforcing section provides the strength and stiffness. In determined, the reinforcement solider, and stiffer than the matrix. The strengthening is commonly a fiber or a particulate.

Enhanced desired properties such as

- Strength
- Stiffness
- Toughness
- Corrosion resistance
- Wear resistance
- Reduced weight
- Fatigue life

Thermal/Electrical insulation and conductivity

- Acoustic insulation
- Energy dissipation

1.2 Classifications of Composite Materials:

1.2.1 Metal Matrix Composites (MMC)

Metals have abundant, higher strength and stiffness compared to chemical compound materials like Epoxy that is employed as matrix in chemical compound material shows in Fig:1.1. The planning of composite laminate, whereas reinforcements improve the mechanical properties in the longitudinal direction, the matrix mechanical properties contribute principally within the cross direction.

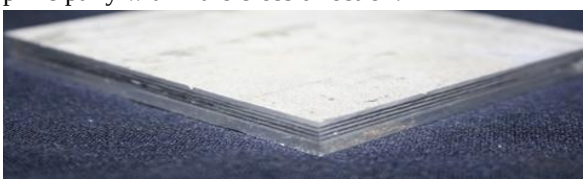

Fig:1.1 Metal Matrix Composites

1.2.2 Ceramic Matrix Composites (CMC)

Ceramic matrix composites showin Fig:1.2, conjointly referred to as fibre strengthened ceramics are becoming standard in material choice since Eighties. High modulus of elasticity of ceramics combined with superior toughness and strength contributed by the fibres have created CMCs a viable choice in material selection.

Due to the crispness and presence of flaws, ceramic materials are susceptible to injury because of shock and impact loading. it's ascertained that the reinforcement of fibre will increase the fracture energy by order of magnitude leading to high fracture toughness.

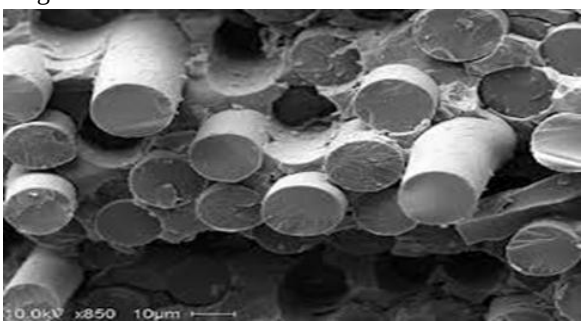

Fig:1.2 Ceramic matrix composites

Types of Natural Fibers:

(a) Hemp Fiber:

The fiber is that the most significant components of the hemp plant. it's ordinarily referred to as bast, that refers to the fibers that grow on the surface of the plant's stalk. Bast fibers offer the plants strength. Supported the process accustomed take away the fiber from the stem, the hemp might naturally be creamy white, brown, gray, black or inexperienced. a mix of covering material, hemp fiber is shows in Fig:

1.4, kenaf, and flax has been accustomed build composite panels for vehicles.

Fig: 1.4: Hemp Fiber Plant and Hemp fiber

(b) Banana Fiber:

Fibers square measure the cells with heavily hard cell walls having a slender lumen in cross section.

Natural fibers possess many blessings over artificial fibers like tenuity Banana fiber show in Fig:1.5 could be a fiber with high strength, which might be intermingled simply with cotton fiber or alternative artificial fibers to supply intermingled material & textiles. Banana Fiber additionally finds use in first-class security/currency paper, packing artifact for agriculture turn out, wet drilling cables etc.

Banana fiber, a lingo cellulosic fiber, gained from the pseudo-stem of banana plant, could be a natural fiber with comparatively sensible mechanical properties. Applicable stiffness and mechanical properties and additionally high disposability and renewability. Also, they're reusable and perishable.

Fig:1.5 Banana Fiber Plant and Banana Fiber

Banana fibers shown in Fig:1.5 are often used for numerous functions like in textile, paper or handicrafts business. Banana paper is flexible because it is waterproof and stronger than wood-pulp paper that means it are often utilized in packaging and while a basis for building materials.

1.3.1 Characteristic of Banana Fibers:

Presence the banana fibre is like that of bamboo fibre and ramie fibre, but its quality and rotation capability is well than the both.

The chemical arrangement of banana fibre is cellulose, hemicellulose, and lignin.

It is highly durable fiber.

It has less elongation.

It has rather glossy appearance depending upon the removal& rotating method.

It is light weight.

It has strong moisture absorption quality. It captivates as well as releases moisture very quickly.

(c) Coconut Sheath Fiber:

Many fibers are obtainable in numerous elements of the Cocous nucifera. The sheath is created from AN inner mat that is sandwiched among two layers of coarse fibers. Solely preliminary studies of coconut leaf sheath fibre were reportable within the literature. Although the fibers from several elements of the coconut trees are place to use, the sheath fibers are left as immense waste. Within the gift work, we tend to discrete the coarse fibers from the outer layers and also the fine fibers from the inner mat to review their properties. The impact of alkali treatment on the properties of those fibers was studied mistreatment chemical, FTIR, WAXRD and TG analyses. Their tensile properties and morphology were conjointly studied to evaluate their quality as reinforcements. The palm is shown in Fig:1.6 a member of liliopsid family. Coconut leaf sheath fibers occur in mat type. The leaf sheaths collected from the trees were unfit in water for one week, totally washed with water followed by water, and dried within the sun for every week. Cleansed leaf sheath stood divided to inner sheath mat and also the outer layer fibers. The fibers of the inner mat and outer layers were on an individual basis unbroken in hot air kitchen appliance for twenty-four h at 105−110ºC to get rid of the wetness. a number of these fibers were treated with five-hitter binary compound caustic soda (NaOH) resolution for one hour at temperature, maintaining a liquor magnitude relation of 25:1 to get waive of the hemicellulose and alternative greasy materials. These fibers were cleaned with water repeatedly and treated with dilute ethnic acid to neutralize them. Finally, the fibers were washed with water before drying in hot air kitchen utilization for an amount of 24 hours.

Fig:1.6 Coconut Sheath Fiber Plant and Coconut Sheath Fibers

(d) Jute Fiber:

Jute (Fig:1.7) may be a lengthy, lax, glossy plant fiber which will spun into coarse, robust threads. It's made primarily from plants within the genus Corchorus that was once divided with the family Tiliaceae, and additional recently with mallow family his fiber.

Fig:1.7 Jute Fiber Plant and Jute Fiber

(e) Sisal Fiber:

Sisal Fiber is one in all the foremost wide utilized natural fiberand is incredibly simply cultivated. It's get from sisal plant. The plant, noted formally as century plant. These plants manufacture rosettes of UNsubdivided leaves that begin out toothed, and step by step lose their teeth with maturity. Every leaf contains variety of long, straight fibers is shown in Fig:1.8 which may be removed in an exceedingly method referred to as surgical operation. Throughout surgical operation, the leaves square measure crushed to get rid of the pulp and material, departure the robust fibers behind. The fibers are often spun into thread for twine and textile manufacture, to create paper product.

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Fig:1.8 Sisal Fiber Plant and Sisal Fiber

II. LITERATURE SURVEY

Murali Mohan Rao, et al.[1], variety of investigations are created in predicting the assorted mechanical properties like lastingness, flexure strength, etc., of banana fiber and banana fiber strengthened with polymers. All the results show the superb mechanical properties exhibited by the banana fibers. The tensile check was conducted in keeping with the ASTM-D 3379-75. The plot of stress vs. proportion strain of assorted fibers is around linear; with banana having a stress worth of around 560 MPa once the proportion of strain is three.5%. Conjointly it absolutely was foreseen that banana fibers area unit stiffer and stronger than sisal fibers.

K. Senthil Kumar, et al. [2], 2 completely different fibers, particularly short banana (B) and naturally plain-woven coconut sheath (C), were hybridized in polyester matrix composites victimization compression mouldings. Numerous composites were created with a similar general fiber wt.% and variable the relative wt.% of the separate fibers. Banana and coconut sheath fibresin surface treated victimization 1N alkali resolution to reinforce surface adhesion. Static mechanical, dynamic features like natural regularity and damping were studied in impulse hammer method was utilized to review the dynamic characteristics of the composites.

Mechanical performance was maximized the best relative quantity of banana fiber within the composites. The mechanical properties were conjointly to get the differ with the layering design. Regardless of the relative weight % of fibers and layering design used, alkali treatment displayed a positive impact on the estimated properties. The blood count layering pattern exhibited the best damping, indicating higher energy absorption

capability brought by the porous structure of the coconut sheath fiber.

Naveen J, et al. [3], the goal of this analysis is incomplete replacement of woven Kevlar 29(K) with naturally plain-woven cocous nucifera sheath excess. Laminated K/CS bolstered epoxy hybrid composites were unreal by hand lay-up methodology followed by hot compression moulding with105? C temperatures at 275 bar pressure for one h. the entire fiber loading of the hybrid composite was maintained 45 wt.% and the magnitude relation of Kevlar and Cocous sheath differs in weight portion of 100/0, 75/25, 50/50, 25/75, and 0/100. Mechanical wet distribution and morphological reaction of the coated composites were evaluated.

Ayyasamy Elayaperumal, et al. [4], among the assorted artificial materials that are explored as Associate in nursing alternate to iron and steel for the employment in automotive, plastics claim a serious share. Throughout the last decade, the study of stuffed plastic composites has simulated huge attention in meeting the lack of plastic materials. Plastics area unit used for nearly everything from the articles of daily use to difficult structures, machine elements etc. Plastics notice an in depth application as they need less weight, low tide absorption, high stiffness and strength.

If truth be told artificial fibers like nylon, rayon, aramid, glass, polyester, and carbon area unit extensively used as a reinforcement of plastics. At present, thanks to unsure conditions within the shortage and therefore the price of crude, and it's by merchandise, there's a requirement to go looking for its alternate that is nothing however natural. In recent years the vegetableproves itself as an alternate fiber to its artificial counterpart. Natural fibers area unit cheaper, bio-degradable and haven't any hazard. Moreover natural fibre bolstered fibers area unit seen to own smart potential within the future as a substitute.

Natural fibers are extracted from varied plant elements and classified consequently. it's fascinating to notice that natural fibers like jute, coir, banana, sisal, etc., are copiously out there in developing countries like Republic of India, Sri Lanka, and a few of the African countries however don't seem to be optimally utilised. At the moment these fibers are employed in a standard manner for the assembly of yarns, ropes, mats, and matting still as in creating articles like wall hangings, table mats, handbags, and purses. Fibers like cotton, banana, and pineapple also are employed in creating material additionally to getting used within the paper business. Several of the plant fibers like sisal, coir, banana, longer palm etc. notice applications as are supply for industrial materials.

J. Santhosh, et al. [5], fiber composites are today getting used in varied engineering applications to extend the strength and to optimize the load and also the value of the merchandise. Varied natural fibers like fibre, sisal, jute, fibre and banana are used as reinforcement materials. During this paper each treated and unprocessed banana fiber are taken for the event of the hybrid stuff. The unprocessed banana fiber is treated in hydrated oxide to extend the wettability. The untreated banana fiber and hydrated oxide treated banana fiber are used as reinforcing material for each rosin epoxy glue synthetic resin} matrix and Vinyl organic compound resin matrix. Coconut shell powder is employed beside each untreated and treated banana fiber as a reinforcing material.

During this method the banana fiber is treated with five-hitter of hydrated oxide for one hour and also the specimen is fictitious by hand moulding method. The mould used for fabricating the hybrid stuff is created from Al with a deboning agent applied on the inner facet. The banana fiber content is unbroken constant to half-hour of weight fraction of entire stuff. The variation in mechanical properties are studied and analysed. Here, the enduringness has evaluated by universal testing machine, impact strength has evaluated by setup impact checker and flexural strength has evaluated by universal testing machine also with flexural test arrangement of the specimen. Then the treated and untreated specimens areanalysed and compared through Scanning microscope to check concerning its adhesion between fiber and rosin matrix and surface morphology.

Pongsathorn Kongkaew, et al. [6], this analysis the mechanical properties. Of epoxy glue by exploitation random orientation discontinuous banana fiber and coconut fiber as reinforcement were studied. The each fibers square measure in turn treated by AL calescent treatment in hydroxide resolution (NaOH) at temperature. The composites were ready with numerous fiber content (3, 5, 10, 15, twenty and half-hour by weight) of banana and coconut fibers in

epoxy compound matrix. The mechanical properties (tensile and impact strength) tests were administrated exploitation composites specimen. And examine the microstructure of the composites by scanning microscope (SEM).

The results from the tensile tests of banana and coconut fiber bolstered epoxy composites square measure that the fifteen WTC banana fiber showed the very best price is seventy three.23 MPa for optimum durability. The impact strength highest values for ten WTC of coconut fiber bolstered epoxy composites is 363.66 kJ/m2 that over banana fiber bolstered epoxy composites. this can be according to the results for determinative the microstructure of composite materials with the upper fiber content attended have void within. That a hole can leads to a brittle material strength because the durability and impact strength attenuated.

V.Vignesh, et al. [7], The tensile, flexural and impact properties of arbitrarily familiarised short Hybrid Pineapple /Coconut Sheath Fibre/polyester (PCSFP) composites square measure represented for the primary time during this work. Composites were invented exploitation Hybrid Pineapple/Coconut Sheath Fibre /polyester (PCSFP) with variable wt% of fibre. PCSFP composites showed a daily trend of a rise in properties with fibre weight % till (100 pc|100%|100 %) and later on a decrease in properties for composites with bigger fibre weight percent. Tensile tests disclosed that the durability was regarding 11MPa, the tensile modulus was 0.7 criterion and therefore the elongation at break was between one.26% and 100%. The flexural strength and modulus were calculable to be around 76 MPa and 7.9 GPa, severally. Effect tests showed a strength of roughly 7.86 kJ/m2.

P.C. Abhemanyu, et al, [8],this paper explores the mechanical properties of compound composites bolstered with natural fibers - banana, coconut sheath and jute. Natural fibers that area unit sometimes discarded away as agricultural waste have an honest potential of getting used as reinforcements. Epoxy glue is employed because the matrix. The fibers area unit treated in alkali answer and also the composites area unit fictitious by hand lay-up methodology. The fictitious specimen's area unit tested for his or her mechanical properties in step with ASTM standards. The potential to use these fibre composites in varied automobile applications is analysed. These fibre composites is wont to create varied automobile accessories. The employment of such inexperienced materials involves lesser price and energy needs fibre composites. Being less dense, is wont to manufacture light-weight elements.

I Siva, et al. [9], this work reports the tensile, effect, and free shaking assets of sisal/coconut sheath fibre hybrid-reinforced unsaturated polyester composites. The hybrid composites area unit fictitious employing a compression moulding technique with varied stacking sequences below as-received or with chemicals treated conditions. The chemical actions have shown higher circumstances than untreated composites.

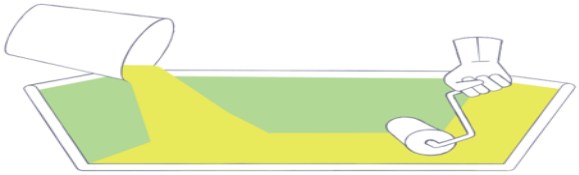
What is more, the silane-treated composite illustration increased stationary mechanical and free shaking assets for all stacking system virtual to the opposite two cases. After the trial results, the silane-treated coconut sheath/sisal/coconut sheath hybrid stack is found to be AN finest system sequence for higher properties. Further, AN encouraging damping issue price is additionally determined for the optimum stacking system. The disaster mechanism of surface de-bonding between the fibres and also the matrix is analysed with the help of scanning microscopy.

III. EXPERIMENTAL WORK

Method (Hand Layup Method):

In this project is hand lay-up methodology. Hand lay-up is shown in Fig:4.1the commonest and least costly open moulding as a result of it needs quantity amount of apparatus. Fiber reinforcement's square measure placed by hand during a mould and organic compound is applied with a brush or roller. This method is employed to form each giant and little things, as well as boats, storage tanks, tubes and showers.

During this project fibres taken in seventieth and chemical vinyl organic compound half-hour. Powders already born-again and placed on bottom in wastage oil applied glass.



Fi: 4.1 Hand layup method

Mixed the powders and chemicals in fastly.it forms stuff to place on high oil applied glass and to push the highest frame of glass. Weights placed on glass plates. Its hardening on most 4hours.

Table:4.1. Resign specification

S no:	Material	Specifications
1	Vinyl ester	Density: 1.05g/cm3 Heat distortion temperature: 125˚C. Gel time: 13˝00” at 25˚C. Shell life: 45 days.
2	Promoter (10% Di-methylaniline)	Density: 0.94g/cm3
3	Accelerator (3 % Cobalt Octoate)	Density: 0.98 g/cm3
4	Catalyst (Methyl ethyl ketone peroxide)	Density: 1.17 g/cm3

4.2 Materials:

Banana fiber powder = 250g
Coconut sheath fiber powder = 250g
Vinyl ester = 1kg
Promotor = 20g
Accelerator = 20g
Catalyst = 20g

4.3 Dimensionsof Composite Material:

In this project to ready stuff in dimensions of 250×250×10mm and shaft diameter 30 mm length 30cm. Fig:4.2 shows in Glass prime surface to applied in wastage oil.

Fig: 4.2 Oil applied glass

4.4 Composite Material Making Process:

Hand lay-up methodology to employ in this project to creating material. i used to be taken in banana powder 250g and coconut powders 250g shown in Fig:4.3 to mixed in each and brought a bowl.

Fig: 4.3 Weighting machine and mixing powder

Vinyl organic compound and promoter to mixed on 100:2. Mixed Powder taken in 500g and rosin to mixture on bowl. Mixed the powders and chemicals in fastly.it forms material to place on high oil applied glass and to push the highest frame of glass. Weights placed (Fig:4.4) on glass plates. Its solidification on most 4hours shown in Fig: 4.5.

Fig:4.4 Powders with resin and composite material

Fig:4.5 After curing composite materials

4.5 CNC Machine:

It's easier to know what the CNC machine is. CNC is that the short type for pc Numerical management. we've seen that the American state machine works as per the program of directions fed into the controller unit of the machine. The CNC machine contains of the mini pc or the PC that acts because the controller unit of the machine. whereas within the American state machine the program is fed into the punch cards, in CNC machines the program of directions is fed directly into the pc via atiny low board kind of like the standard keyboard.

In CNC machine the program is keep within the memory of the pc. The coder will simply write the codes, and edit the programs as per the wants. These programs may be used for various elements, and that they don't have to be compelled to be perennial once more and once more.

Fig:4.6 Cnc lathe machine

Fig: 4.6 shows in CNClathe machining came upon its operating in programme based mostly and manually additionally operating. Fig:4.7 shows the turning operationand shows the work pieces after machining.

4.5.1 LATHE PROGRAM:

G21 G98;
G28 U0 W0;
M03 S700;
G00 X11Z1.0;
G90 X10 Z-15 F70;
X9;
X8;
G28 U0 W0;
M05;
M30:

Figure: 4.7 CNC machining and after machining material

4.5.2 CNC MILLING MACHINE:

Milling is a process which is used to cut the material and also used to make the holes in it.Digital technologies and CNC milling machines Fig 4.8 give the resolution of the many issues that cannot be simply solved mistreatment previous ways. The technology approaches the operating method in an exceedingly means that's each more practical and additional economical.After machining specimens shown in Fig: 4.9 rectangular form specimens. Work piece dimension is 90×90cm.

Fig 4.8 CNC milling machine

IV. NUMERICAL RESULTS

The following table 5.1 shows the various level of factors considered the experimental work

Table 5.1 Factors information

FACTOR	LEVEL 1	LEVEL 2	LEVEL 3
Speed (Rpm)	600	700	800
Feed (mm/min)	60	70	80
DOC (mm)	0.5	1	1.5

5.1 Surface Roughness Testing:

Roughness is a very important parameter once making an attempt to seek out whether or not a surface is appropriate for an explicit purpose. Rough surfaces typically wear out a lot of quickly than sander surfaces. Rougher surfaces area unit usually a lot of liable to corrosion and cracks, however they will conjointly aid in adhesion. A roughness test is employed to rapidly and exactly verify thesurface roughness of a cloth.

A roughness tester shows the measured roughness depth (Rz) furthermore because the mean roughness worth (Ra) in micro meters or microns (µm). Measure the roughness of a surface includes applying a roughness filter. Completely different international standards and surface texture or surface end specifications advocate the employment of various roughness filters for instance, a mathematician filter typically is suggested in ISO standards.

These specimens are used for testing any surface end quality and have long well-tried their worth in follow used for bit andsight comparisons against the surface of labour items that are made victimisation constant producing method. The assessment of the extent to that the surface end of each is alike will solely be subjective. Sight comparison needs optimum light angle. for little surfaces, the employment of a simple microscope with up to 8x magnification is suggested. bit comparison is formed victimisation the fingertip or a little copper piece like a coin.

5.2 DOE Graphs Forturning process:

Table 5.2Surface roughness of turning process.

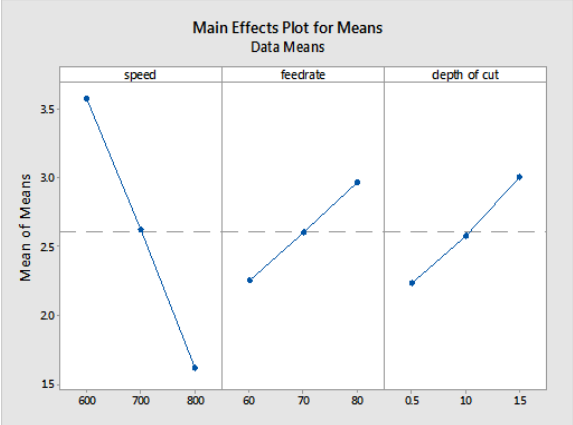


Fig:5.1 effects of speed, feed rate, depth of cut on turning

In this turning operation to remove metal in different depth of cuts and feed rates L27 orthogonal array below shown in surface roughness of turning operation, as give Table:5.2

Increasing surface mm per minute reduces settled edge. can this maythis can prolong tool life and scale back the possibility that harmful tool failure will damage a finished half.

Reducing the surface roughness as per the speed, feed, depth of cut. While increasing the speed the flank wear also increases the above said the variables. Once roughing, it's best to use a tool capable of a high feed to get rid of material quickly. once finishing, it's typically best to possess a lightweight depth of cut and conservative feed rate. In the effect of cutting variable the surface roughness values(mean of means) shown in Fig 5.1 that cutting speed, feed and depth of cut increasing gradually.

Regression Equation:

Lathe = 2.6107 + 0.9689 speed_600 + 0.0183 speed_700 - 0.9872 speed_800 - 0.3547 feedrate_60

- 0.0048 feedrate_70 + 0.3594 feedrate_80 - 0.3726 depth of cut_0.5

- 0.0268 depth of cut_1.0 + 0.3993 depth of cut_1.5

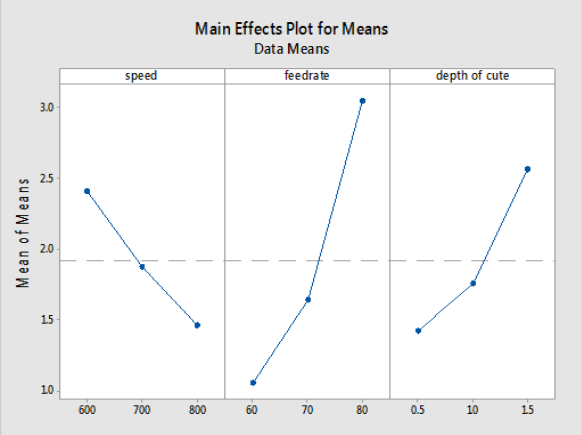


Fig: 5.2effects of speed, feed rate, depth of cut on milling

Fig: 5.2 as shows in optimum point in various speeds, feed rates, depth of cuts in milling operation. Optimum value is speed 800 rpm and feed rate 60 mm/min and depth of cut 0.5 mm.

Regression Equation:

Milling = 1.918 + 0.492 speed_600 - 0.040 speed_700 - 0.453 speed_800 - 0.856 feedrate_60

- 0.272 feedrate_70 + 1.128 feedrate_80 - 0.492 depth of cut_0.5

- 0.156 depth of cut_1.0 + 0.647 depth of cutting.

V.CONCLUSION

By using hand layup method and taguchi method various factors design is established to conduct experimental work.In turning operation of optimized point is which on in turning effects the surface finish in different variables like speed 800 rpm, feed rate 60 mm/min, depth of cut 0.5 mm.In milling operation Similar to the turning operation opted.

The present investigations were administered significantly to review the influence of constituents like industrial fillers like fossil fuel cokes etc. in numerous kind of particulate carbons and size of carbon fibers, short fibers or continuous fibers in carbon/carbon composites. The scope of the add future will be widened to incorporate differing types of alternative fillers like industrial wastes. In gift work, synthetic resin has been used as matrix precursor, however in future; composites with completely different chemical compound matrices like polyimides and high char yielding aromatic resins will be tried with varied reinforcing fillers.

Natural precursors like coconut fibers and pine wood are wont to create porous carbons. Work will be extended to alternative natural precursors like jute, bamboo, sisal etc. The natural precursors utilised during this analysis work may also be investigated with completely different composite materials for his or her numerous industrial also as business application.

The number of input machining parameters will be extended and thus the info base will be improved through an experiment to seek out correct results. The experiments will be performed with alternative tool and work piece material. During this work, ANN-DEA model has been applied for CNC-turning method. This experimental work will be extended to alternative machining operations like CNC-Milling, Micro-turning.

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