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## Measurement and Analysis of Thrust Force and Delamination in Drilling of Natural Fibre Reinforced Polymer Composites

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**ABSTRACT:** The composite materials is a well known and recently developed and widely useful in engineering, aerospace, military and other fields. When compared to the metal, the composite materials have very much tensile strength, hardness and flexible in nature. During machining it is much easier than the metal. In a recent research found that the effect of drilling parameter by drilling the holes on combined sisal and coir reinforced polymer composites. The main focus is to drilling the composite materials and to measure and analysis the thrust force and delamination. The drilling experiments are done on a CNC vertical machining centre. With the help of this experiments to analyse the performance in machining process and drilling studies are carried out using a 6,8 and 10mm diameter drill of High Speed Steel. In drilling a spindle speed and feed rate are found , these are considered as a input process parameters. In addition to this Taguchi method very useful to understand and make more composite materials , due to this method. This type of process is more reliable and more accurate. Dill bit of High Speed Steel (HSS) is alone to done this experiments.

**KEYWORDS:** sisal, coir, drill bit, thrust force, taguchi, delamination, dynamometer.

### I. INTRODUCTION

The natural fibre reinforced polymer composites is overtake the synthetic fibre reinforced polymer composites. Because of natural fibre composite materils having high tensile strength, toughness, hardness and flexible when compared to synthetic fibre. The hybrid natural fibre having good results to achieve the target. Due to they have more mechanical and physical properties. The single natural fibre does not attain the high properties , so choosen the hybrid natural fibre. The composite materials are widely used in many fields due to its properties. Based on hybrid composite materials having long life, strength, reliable and cheap when compared to the metal. Now the target is to achieve the thrust force and delamination.

### II. MATERIALS PURCHASE

The coir was purchased from nagarcoil, tamilnadu. The sisal was purchased from the coimbatore. The sodium hydroxide was purchased from nambi chemicals tirunelveli. The epoxy resin was purchased from Leo chemicals Nagarcoil. The extraction of coir and sisal fibre is below. The mechanical and physical properties are shown in table 1 below.

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Fig 1. coir



Fig 2 sisal

Table 1

Properties	Coir	Sisal
Density (g/cm <sup>3</sup> )	1.2	1.42
Diameter (µm)	100-450	145-440
Tensile strength (Mpa)	131-715	126-860
Cellulose (%)	36-43	41.6-62.6
Hemicellulose (%)	10-20	9.2-14.6
Lignin (%)	41-45	11.4-19.5

## 2.1 Resin

Typically, modified orsynthetic resins are used for manufacturing they can be produced from natural components with additives. The main use of resin is to be a glue to transfer stress between the fibres, clasp them together and protect from outside factors. There are number resin are used in many fields. Now the popular resins are listed in below.

- Polyester resins
- Phenolic resins
- Alkyd resins
- Epoxy resins
- Polyethylene resins
- Acrylic resins
- Polystyrene resins
- Polypropylene resins
- Silicone resins etc..,

There are most commonly used resins are,

- Polyester resins
- Epoxy resins

## 2.10 Polyester resins

Polyester resins are formed from the reaction of dibasic organic acids and polyhydric alcohols. They are very flexible and have excellent resistance to heat, chemicals, and flame.

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## 2.11 Uses

They are used for construction, laminate, auto repair of filler, skis, coatings decorative accessories, and bottles.

## 2.12 Epoxy resins

Epoxy resins are also called polyepoxides, are a type of reactive prepolymers and polymers which contain epoxide groups. They have excellent chemical and heat resistance and strong adhesion properties.

## 2.13 Uses

They are used for laminates, adhesives, flooring, linings, propellers, and surface coatings.

In these experiments, we are choosing the epoxy resin because of more stronger than all resins. Also the hardner plays an impotrtrant roles in this experiments. The hardner used to achieve more stronger.

Therefore the hardner need to fix the composite materiils to make more stronger without any crack in the materials.



Fig. 3 Resin

## 2.2Chemical treatment purpose

The hybrid coir and sisal fibres are following under chemical preparation taken down because of chemical treatment to attain the coir and sisal fibres are make smooth in nature and cutting process is so simple. The name of chemical is sodium hydroxide (NaOH). At first, the coir and sisal fibres was initially washed with distilled water to remove any dirt and mud present in the fibre and then driedfor 48hr. after, then these fibres are soaked in 10% NaOH concentration with maintaining liquor ratio of 1:30 for 2h at room temperature. The treated natural fibres are then washed with distilled water to removethe sodium hydroxide present in the natural fibre and then dried for 26hr.

## 2.3 Preparation of composite materials

The treated coir and sisal fibres are cut into a length of 5mm. And then a steel mould of length of 300mm, width 300mm, and thickness 3mm. The percentage of composite materials is to make with the help of weighting machine. With the help of procedure , there are only three rectangular plates to make with the various combination and resins.

- At first the combination of coir is 30% and sisal is 20% then the resin is 50% with hardner.
- Now the second combination of coir is 20% and sisal is 30% then the resin range is 50% with hardner.
- At last the combination of coir is 35% and sisal is 25% then the resin range is 40% with hardner.

The combination percentage of coir and sisal fibres are tabulated in below.

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Table 2

Materials	Combination 1 (%)	Combination 2 (%)	Combination 3 (%)
Coir	30	20	50
Sisal	20	30	50
Epoxy resin	35	25	40

### 2.4 Wax

Waxes are a diverse class of organic compounds that are lipophilic, malleable solids near ambient temperatures. They include higher alkanes and lipids, typically with melting points above about 40°C melting to give low viscosity liquids. There are so many wax present in it. The best wax for prepare the composite materials is Mansion wax polish.

#### 2.41 Mansion wax polish

It is used as polishing abrasives. It gives an instant shine to the surface. Mansion wax polish is also used for providing protection to the wood and other materials.



Fig. 4 Wax

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## III. DRILLING EXPERIMENT

In drilling procedure, the specimen of composite materials is to be cut in a rectangular shape of size 100 x 70 x 3 mm<sup>3</sup> respectively. And then the High Speed Steel of drill bit is used to produce a holes in a rectangular plate. The various size of drill bit is used, then the size of drill bit is 6mm, 8mm and 10mm respectively. The purpose of High Speed Steel are since the coir and sisal fibres are soft in nature so the HSS are used to do the procedure. The thrust force is measured by Kistler Dynamometer. The experiment setup of the drilling is to place the dynamometer in below the workpiece. And then the dynamometer is connected to the data acquisition system and connected to a computer to monitor the following tests. At last the output levels received from the dynamometer.

### 3.1 Drill bit

The drill bits are cutting tools used to remove the materials to create holes, always of circular cross section. Drill bits come in many sizes and shapes then can create different kinds of holes in many different materials.

Drill bits are often classified by the materials from which they are manufactured and coatings applied to them.

- **High Speed Steel drill bits** are used for drilling wood, light metals and PVC.
- **Titanium coated drill bits** have reduced friction, less effort and last longer than black oxide coated bits.
- **Cobalt drill bits** are used for drilling hard metal and steel. They dissipate heat quickly and highly resistant to abrasion
- **Carbide tipped drill bits** is very sharp over long periods of use and used for mainly concrete and tile.
- In these experiments, chosen the High Speed Steel drill bits and used to done the process.

## IV. TAGUCHI METHOD

The procedure of these method are to reduces the cost, time and waste of the product. From the software of Minitab version 2019, to find out the taguchi method. Then go to the minitab software and then DOE ( design of experiments) to taguchi method the levels of design is placed to create a number of components that is ( L9, L12, L16,L32) are to be found and go to the custom design to select the columns and design at last to attain the results and graph.

Table 3  
L 9 (3<sup>4</sup>) Orthogonal array

S.No	Spindle speed (rpm)	Feed rate (mm/min)	Combination (%)	Diameter (mm)
1	600	25	C 1 (15)	D 1 (6)
2	600	50	C 2	D 2
3	600	75	C 3	D 3
4	1200	25	C 2 (20)	D 3
5	1200	50	C 3	D 1
6	1200	75	C 1	D 2 (8)
7	1800	25	C 3 (30)	D 2
8	1800	50	C 1	D 3 (10)
9	1800	75	C 2	D 1

### 4.1 Delamination analyse

Delamination is one of the failure process in composite materials. Due to the action of various machining forces. There are only study the two procedure, one is peel up and another one is push down. Push down is occurs at the

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end side of the workpiece, whereas the peel up is occurs at the starting side of the work piece. The tool maker microscope is used to measure the delamination. The delamination is calculated under one formula is shown in below.

$$F_d = D_{max} / D$$

Where,

$D_{max}$  as a damaged part diameter

D as a actual diameter



Fig 5.  
Combination of coir is 15%



Fig 6.  
Combination of coir is 30%



Fig 7.  
Combination of coir is 20%

### V. ADVANTAGES

- Fabrication is cheaper.
- It is durable in nature.
- Corrosion and oxidation resistance.
- It is light in weight.
- The cost of operation is low.
- It is used to mould complex shapes.



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## VI. APPLICATION

- Used in aircrafts.
- Used in marine industry.
- Used in automobile industry.
- Used in wind mills for wind blades.

## VII. CONCLUSION

From the result, the hybrid sisal and coir fibre reinforced polymer composites values is to be analysed. The high speed steel is used to drill the composite materials and the drill bit sizes are 6,8 and 10mm respectively. The taguchi method, orthogonal array helpful to analyse then the parameters are spindle speed, feed rate,drill bit diameter are used. The above table are used to analyse the drilling and then the thrust force and torque. From the above delamination, the figure shows that the combination of coir (15%) has the 10mm diameter drill bit shows that the delamination is occurred. At finally the above combination, 30% of coir has more stronger than the other combination. So the combination of 30% of coir has good strength, durable and reliable one.

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