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# To study of mechanical testing's for walnut shell and polyester resin with fiber glass composites

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**Abstract:** A composite consists of two or more combined constituents in macroscopic level and is not soluble with each other. Currently worldwide interest in manufacturing composite materials from west industrial and agricultural materials due to increasing demands for environmental friendly material. The walnut is enclosed by the shell called as walnut shell. Walnut shell is treated as waste but because of its good mechanical strength, chemical property and abrasive nature so it is helpful for improving property and it used as reinforcement. Fabricate the specimens by varying % of weight of 0%, 5%, 10%, 20%, 30% and 40% walnut shell flour used in polyester resin and applying resin with E-Glass fiber by using hand lay-up method. The test is carried out to determine compression test, charpy test, tensile test and wear test is conducted.

**Keywords**: Walnut shell flour, polyester resin,compression test, charpy test, tensile test and wear test.

## I. INTRODUCTION

A composite material (also called a composition material or shortened to composite, which is the common name) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials. More recently, researchers have also begun to actively include sensing, actuation, computation and communication into composites,[1] which are known as robotic material.

There is increasing demand for advanced materials with improved properties, aiming to meet new requirements or to replace existing materials such as metals-based ones. This quest has significantly contributed to the advent of new polymer-matrix composite materials that allowed major design improvements and found extensive application in the manufacture of a variety of products, including automobile and aircraft components, structural components, sporting goods and biomedical devices. The high performance of continuous fiber reinforced polymeric matrix composites is thoroughly known and documented. However these composites present disadvantages regarding the matrix-dominated properties, which often limit their applicability range (Yasmin et al. 2004). The development of newer composite materials addressing these issues is thus of great significance for several engineering applications, broadening the potential structural applications of composites.

## II. OBJECTIVES

### 1.10 Objective of the Project

The objectives of the proposed research are:-

1. To prepare the Particulate composite with Walnut particulates as a filler with resin matrix
2. To prepare the Specimens of walnut shell composites with varying the weight of walnut shell particle as a filler material by 5%,10%,20%,30% and 40% by weight.
   a) To Study the specimens under tensile loading with D638 ASTM standards
   b) To study the specimens under Compressive loading with D695 ASTM standards
3. To study the specimens under Impact loading with D6110 ASTM standards.
4. TO study the specimen under Wear test with D99 ASTM standards.

## III. MATERIALS FOR SPECIMEN PREPARATION

### Walnut shell flour

The mainly walnut shell is biodegradable material, treated as waste. The dry walnut shells are powered by crushing action. The macroscopic structure is about < 0.25 macron. The walnut shell flour is in the form of flour. It is having good mechanical and chemical property about various applications.

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Fig 1.Walnut shell flour

**Gelcoat**

Glecoat is acted as high quality surface finish. This is mainly of thermosetting polymer .it is used for appliying primary process of fabricating in FRP composites. the composition of gelcoat is

Preparation of gelcoat per kg

Pigment mixing 2% to 3%

Accelerator mixing strilling (MAKP) 2%

Fig 2.Gel coat

**Polyester resin**

The polyester resin is used in industries because it is having low cost and having good mechanical, chemical properties. This is the thermosetting plastic resins. This polyester resin helps to gives good strength for composite material. Polyester resin is of two types they are General Purpose (GP) and Fire Resistance (FR). This is the most commonly used polyester resin because of its availability and lower price but it gives good strength while fabrication.

Fig 3.Polyester Resins

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**Hardener**

The hardener is the like curing agent for the resin in the specimen preparation. In the specimen preparation the hardener is used as MEKP (Methyl Ethyl Ketone Peroxide).

Fig 4.Hardener MEKP

**E-Glass fiber mats**

. The E-Glass fiber made with different type of GSM (glass surface mat) like surface mat 30GSM, 300GSM, 450GSM will be using. These fibres are of mainly using for electrical purpose with resisting characteristic. By combined emulsion of different resins to give high stiffness to the fibre.

Fig 5.Cutting mat for required size

The basically E-Glass mats are in the form of rounded bundle and that bundle is to cut as per the required shape and size for users.

## IV. PROCEDURE FOR SPECIMEN PREPARATION

The preparation of samples is fabricated by using hand lay-up method. The specimens preparation is consist of different stages.

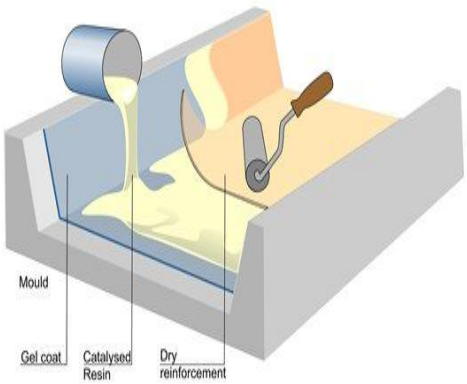


Fig 6.Hand lay-up technique

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## V. METHODOLOGY

**Methodology for specimen preparation (Tensile Test)**

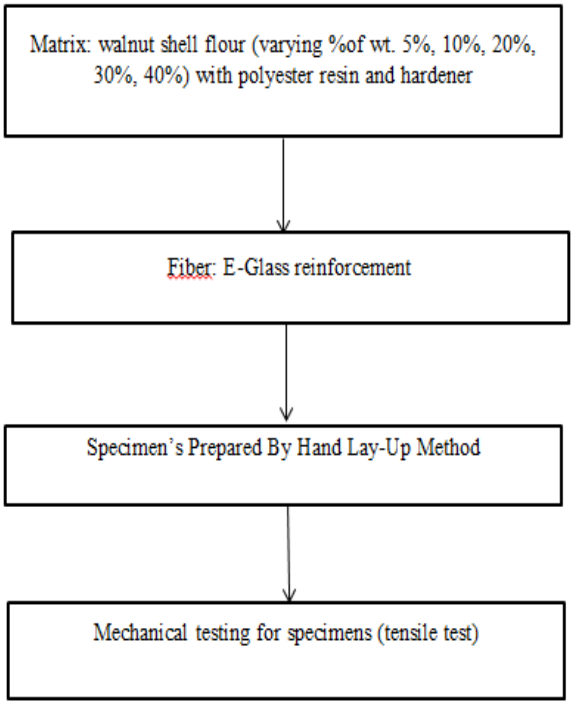


Fig 7: flow chart for specimen preparation

**Methodology for specimen preparation (Compression Test, Charpy Test, Wear Test)**

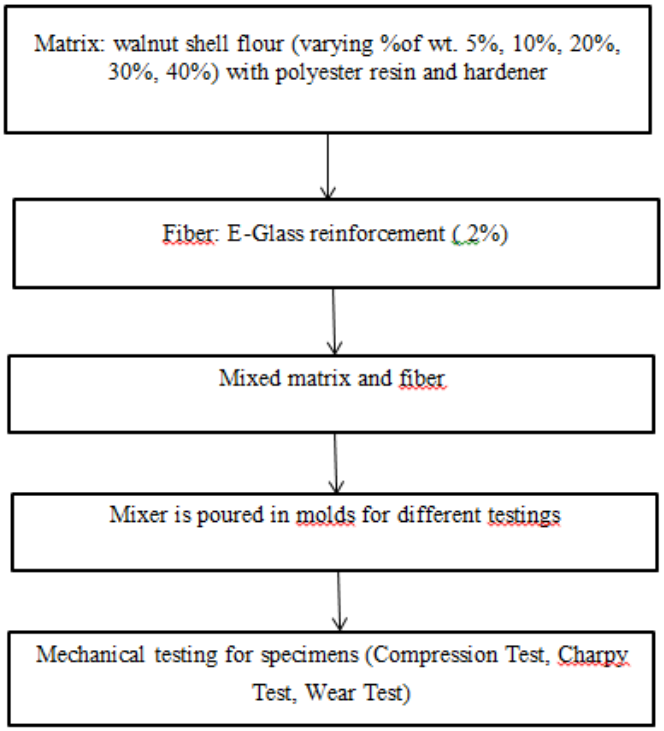


Fig 8: flow chart for specimen preparation

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## V. SPECIMEN PREPARATION FOR MECHANICAL TESTINGS

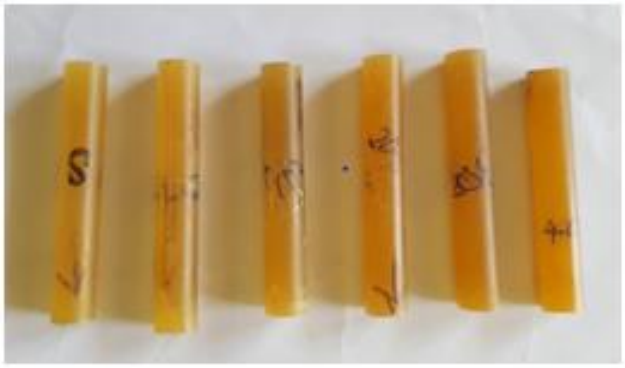

Fig 9: For Wear Test

Fig 10: For Charpy Test Test

Fig 11: For Tensile Test

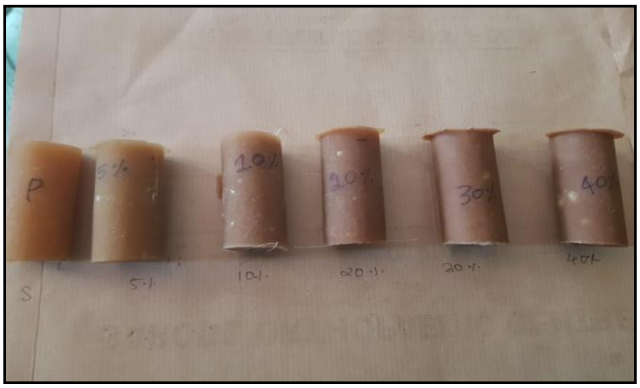

Fig 12: For Compression Test

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## VI.RESULTS AND DISCUSSION

**1) For wear test**

Table 1, wear rate for specimens

| specimens | Wear rate ($N/m^2$) |
|---|---|
| sample | $3.44\times10^{-5}$ |
| 5% | $6.36\times10^{-6}$ |
| 10% | $7.95\times10^{-6}$ |
| 20% | $6.895\times10^{-6}$ |
| 30% | $9.017\times10^{-6}$ |
| 40% | $7.42\times10^{-6}$ |

The microscopic testing is conducted after completing wear testing of specimens to know the wear behaviour in specimens for different composition of specimens. The all wear testing specimens are tested in stereo zoom microscopic testing with having 30-magnification.

**For sample specimens**

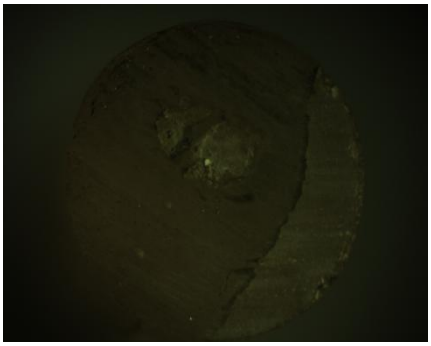

Fig 13: specimen sample

The image shows for sample specimen to know the after wear test behaviour of sample in microscopic is more wear is observed.

**For 40% WS Adding Sample**

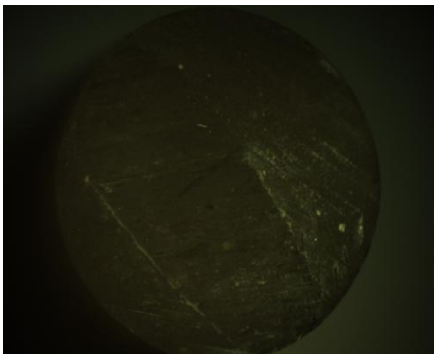

Fig 14: 40% specimen sample

The above image shows the image of 35-magnification of specimen sample. The wear is less compared to the specimens WS of specimen.

**Discussion on Wear Test**

For collecting all data from the wear test calculation is compared with each other for different compositions for sample, 5%, 10%, 20%, 30% and 40% is shows the readings of $3.44\times10^{-5}$ , $6.36\times10^{-6}$, $7.95\times10^{-6}$, $6.895\times10^{-6}$, $9.017\times10^{-6}$ and $7.42\times10^{-6}$ respectively. After wear test the samples are subjected for microscopic test. The test concluded the more wear in specimen sample and less wear in 40% of specimen.

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### 4.2 Charphy test

The charphy test has following readings

Table 2: charphy test readings for specimens

| Specimens | Energy (J) |
|---|---|
| Sample | 2 |
| 5% | 10 |
| 10% | 10 |
| 20% | 10 |
| 30% | 13 |
| 40% | 20 |

Variation in Absorbing Energy by Specimens

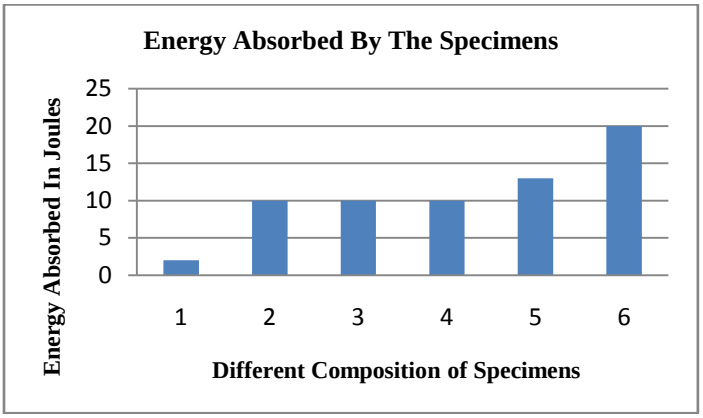


Fig 15: Charphy test readings

#### 4.2.1 Discussion about charpy test

The test readings gives that energy absorbed by the different compositional of specimens. For without walnut shell contained specimen Absorbed 2J whereas increasing in the composition of specimen gives the 5%, 10%, 20%, 30% and 40% specimens are resist the energy of 10J, 10J, 10J, 13J and 20J respectively. Hence the maximum energy absorbed by the specimen is 40% of walnut shell powdered specimen sample.

### Tensile Test calculations

Table 3: Average tensile test results

| Sl No. | Process done for | Tensile strength N/mm$^2$ | % Elongation | Tensile modulus N/mm$^2$ |
|---|---|---|---|---|
| 1 | Sample | 65.42 | 7.02 | 181722 |
| 2 | 5 % | 69.65 | 4.78 | 1477.02 |
| 3 | 10% | 70.57 | 3.82 | 1857.10 |
| 4 | 20% | 70.85 | 3.82 | 1854.71 |
| 5 | 30% | 74.57 | 4.26 | 1750.46 |
| 6 | 40% | 78.00 | 4.61 | 1130 |

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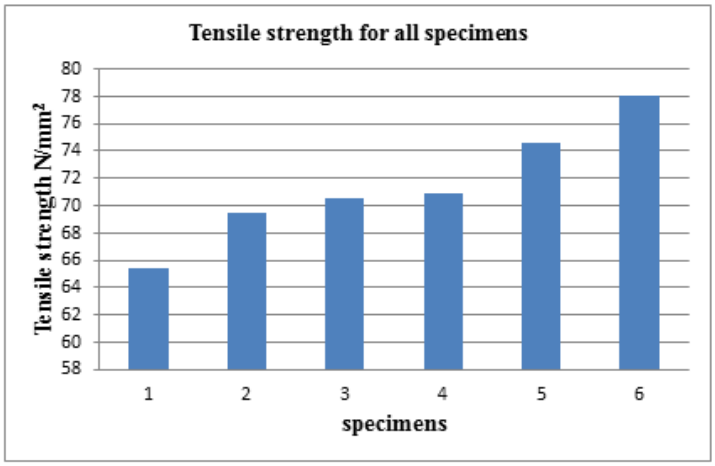


Fig 16: Comparison of Tensile strength

By observing above graph, it shows that maximum tensile strength is 78.00 N/mm$^2$ for 40% process and minimum is 65.42 N/mm$^2$ for 5% process.

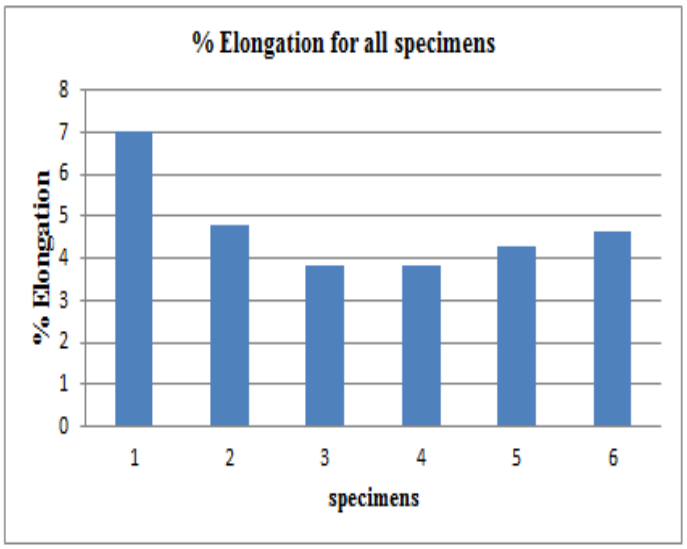


Fig 17: Comparison of % Elongation

By observing above graph, it shows that, maximum elongation is 7.02 for 10 % process and minimum elongation is 4.6 for 40 % process.

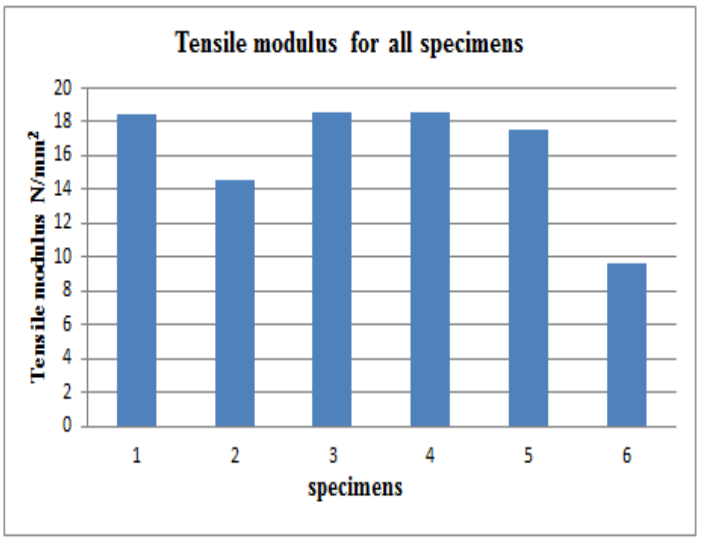


Fig 18: Comparison of Tensile modulus

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By observing above graph, it shows that, maximum tensile modulus id 1857.00 N/mm$^2$ for 10 % process and minimum is 1130 N/mm$^2$ for 40 % process.

**Discussion on tensile test**

By comparing the above results we observed that.

1) Maximum tensile strength is 78.00 N/mm$^2$ for 10% process and minimum is 65.42 N/mm$^2$ for 40% process. 10 % process is better in tensile strength. The 40 % process is having lowest tensile strength.
2) Maximum elongation is 7.02 for 10 % process and minimum elongation is 3.56 for 40 % process.
3) 10 % process is having high tensile modulus and 40 % process is having lowest tensile modulus.

**Compression Test**

Compression strength when the load is applied parallel to the grain of specimen for all composition are listed below

Table 4: Compression Test Readings

| Compositions | Stress in N/m$^2$ |
|---|---|
| Sample specimen | 62.7 |
| 5% WS | 64.97 |
| 10% WS | 69.68 |
| 20% WS | 72.71 |
| 30% WS | 73.12 |
| 40% WS | 90.23 |

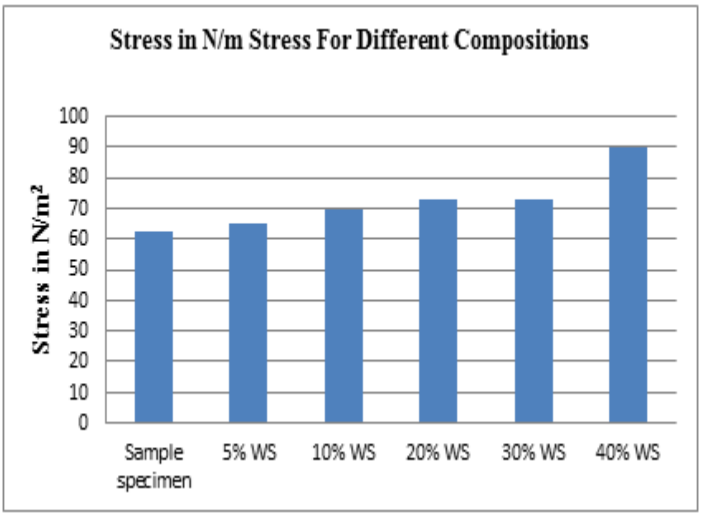


Fig 19: Stress for Different Compositions

**4.4.1 Discussion on Compression Test**

For completing compression test the specimens sample is having compression strength when the load is parallel to the grain of specimen is 62.7 N/m$^2$ and for 5% WS, 10% WS, 20% WS, 30% WS and 40% WS is getting 64.97N/m$^2$, 69.86 N/m$^2$, 72.71 N/m$^2$,73.12 N/m$^2$ and 90.23 N/m$^2$ respectively .

## VII. CONCLUSION

From the experimental results are concluded that

1. Pin on disc is concluded that as percentage of walnut shell powder in composite the wear will be getting low wear capacity. Wear is more while not adding walnut shell powder to the specimen. Percentagewise adding walnut shell powder to the specimen the wear capacity will improve up till 40%.
2. For charphy test is concluded for specimen is of without walnut shell sample is having to absorb the low energy stored and with walnut shell powder in specimens are gradually high energy resistance capacity with respect to different compositions. High energy absorbed specimen is 40%.

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3. For tensile test concluded that the tensile strength is maximum for 40% tensile strength and minimum for 10% process by calculating.
4. By compression test of specimens for compression strength when the load is parallel to the grain of specimens are gradually increases with increase in percentage of walnut shell powder of specimens.

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