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FABRICATION AND TESTING OF NATURAL FIBER REINFORCED COMPOSITE MATERIAL

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ABSTARCT

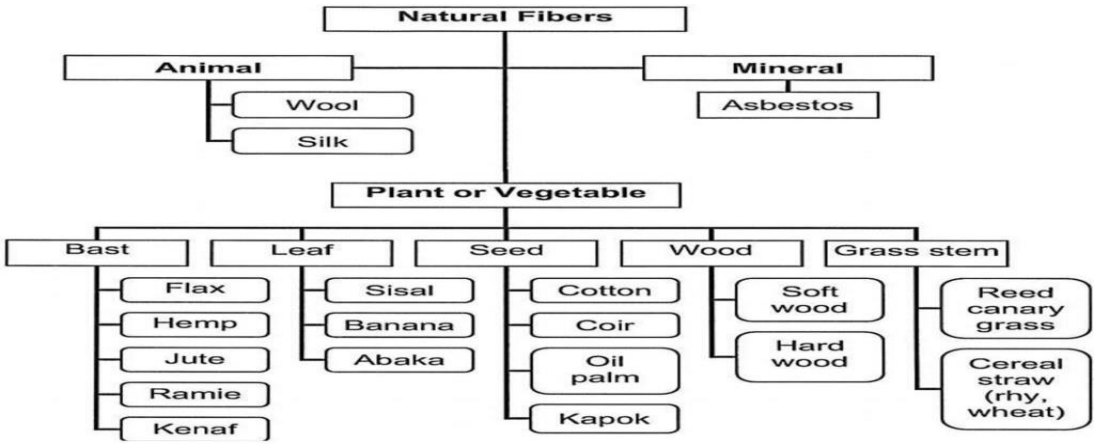
Nowadays material technologies are playing major role for the development of products in various fields. Many researchers are searching for structural materials of high strength, less weight and low cost. In generally strong materials are relatively dense and light materials have less strength. In order to achieve high strength and less weight, we go for composite materials. In composite material we used coconut fiber as a base material. In addition to that we used natural fiber and micro powder for improving the mechanical properties. For determining the effect of additives in composite we go for preparing four different specimens with coconut fiber, palm fiber, groundnut peals and wood powder respectively. Epoxy resin is used as bonding material. Then the tensile strength and impact strength of specimens is determined using ultimate testing machine and impact testing machine. The final result of the various composite specimens is then compared and optimized.

Keywords: impact testing machine, composite specimens and composite materials.

1. INTRODUCTION

1.NATURAL FIBERS

Natural fibers are renewable, cheap, completely or partially recyclable, biodegradable, and environment friendly materials. This is a new generation of reinforcements and supplements for polymer based materials. Fibers from plants such as cotton, hemp, jute, sisal, pineapple, ramie, bamboo, banana, coconut coir, palm fiber etc., as well as wood and seeds of flax are used as the reinforcement in polymer matrix composites. Their availability, low density and price as well as satisfactory mechanical properties, make them attractive alternative reinforcements to glass, carbon and other manmade fibers.



Classification Of Natural Fiber

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2.MATERIAL USED

1. Wood Flour
2. Coconut Fiber
3. Palm Fiber
4. Epoxy Resin with Hardener

MECHANICAL TESTING

A mechanical test shows whether a material or part is suitable for its intended application by measuring properties such as elasticity, tensile strength, elongation, hardness, fracture toughness, impact resistance, stress rupture and the fatigue limit.

TYPES OF MECHANICAL TEST

1. Hardness Test
   i.Shore D hardness test
2. Impact Test
   i. Izod Test
3. Tensile Strength Test
4. Flexural Test

EXPERIMENTAL DETAILS

Fiber composite

⇩

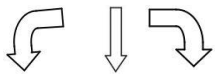
Fabrication by hand lay up method

⇩

Testing of fabricated composite

⇩

Mechanical properties



Impact Strength | hardness property | flexural property

FABRICATION PROCESS

HAND LAY- UP TECHNIQUE

As per our requirement solid pattern is used to mould the composite material. These types of patterns are made of single solid piece without joints, partings or loose piece. Therefore ,it is called solid or one piece pattern. It is made exactly into desired casting to be produced with some allowances. It is used for making a few large size simple casting . Removal of pattern from the material is easy.

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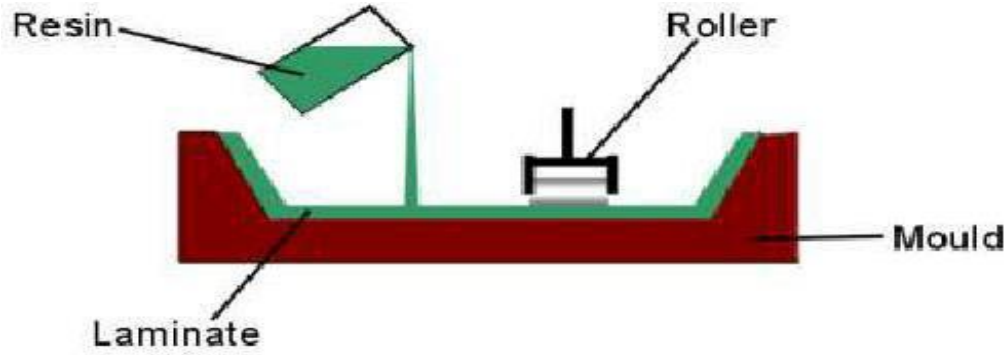
Select the suitable work table, which should be smooth and clean. The required amount fiber material was taken. Then the fiber mat was cut according to the required size. The required amount of the epoxy resin was taken. The hardener was used for the quick drying of the mixture. The process at which the base was spray coated with little bit amount of epoxy resin .then the wood powder was applied the first layer and above the surface resin was applied .Then second layer was formed with help of coconut fiber then the above surface resin was applied. Then third layer was formed with help of Palm fiber again the resin was applied. Thus the same manner will be followed another side of fabricated material.The fabricated material was dried in the presence of sun light and atmosphere



Hand lay- up Technique

CURING

The part can be cured at elevated temperatures using an oven (usually somewhere around 160 degrees F) or at room temperature. Generally, the proper curing time of each type of resin-hardener, as well as the working time, is given by the supplier on the back of the containers. If the part is left on plastic sheeting be sure to use properplastic sheet that will survive the elevated temperature. Most plastic sheet available from hardware stores (polyethylene) may melt. If planning the layup part is going to be moved to a curing oven.

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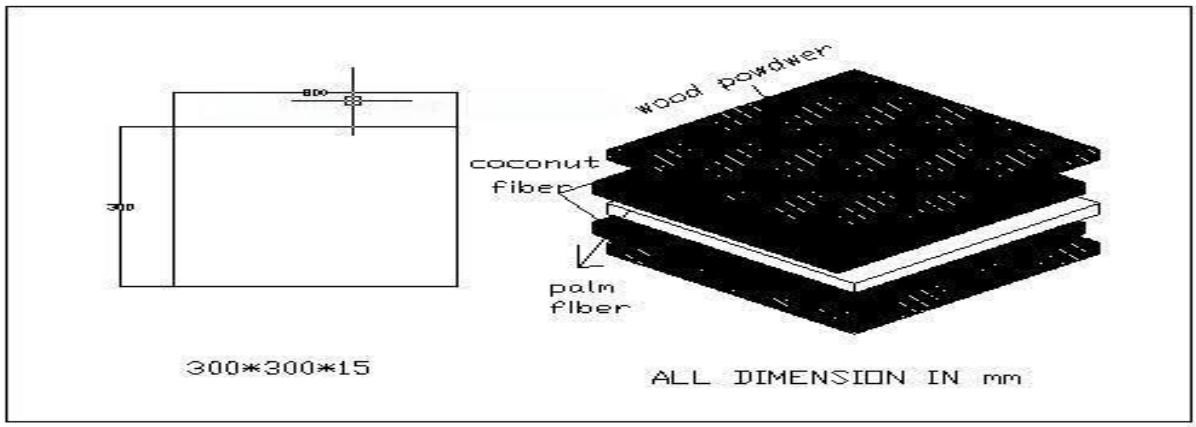
AN HYBRID LAMINATE OF NATURAL FIBERS WITH HELP OF AUTO CAD



Natural fibers laminate

MIXING RATIO

1) Wood powder - 10%
2) Coconut fiber - 15%
3) Palm fiber - 15%
4) Epoxy resin - 60%

MECHANICAL TEST OF OUR MATERIAL

1.SHORE HARDNESS MEASUREMENT

Scale: Shore Hardness D scale.

Location	Shore D Hardness
1	601
2	590
3	577
4	587
5	578

Shore hardness test result

The above table shows the effect on shore hardness for the five samples made up of our natural fibers. From the shore test conducted on the samples, it is inferred that the maximum amount of energy the samples can be withstand is around is 601

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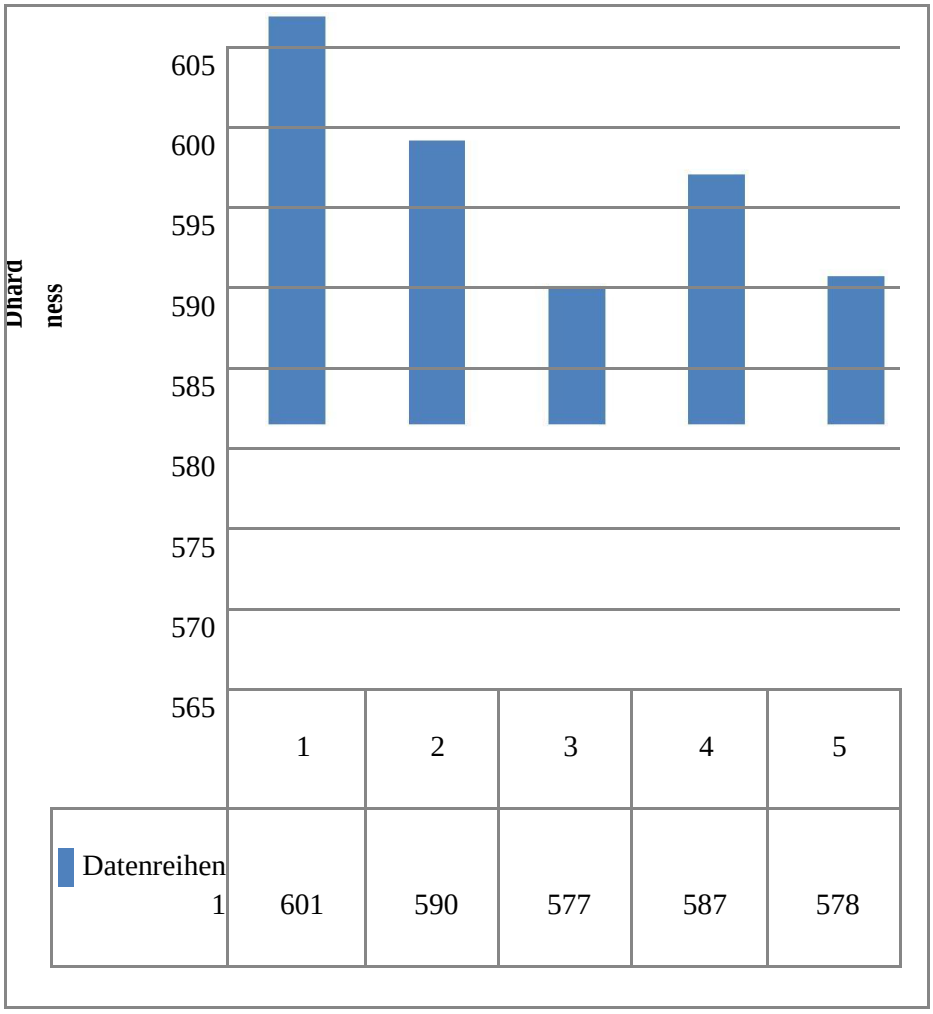

2. IZOD IMPACT TEST

Sample	Energy(j/mm^2)
1	0.42
2	0.43

izod impact test result

The above table shows the effect on impact load for the two samples made up of our natural fibers. From the impact test conducted on the samples, it is inferred that the maximum amount of energy the samples can be withstand is around 0.43joules/mm^2

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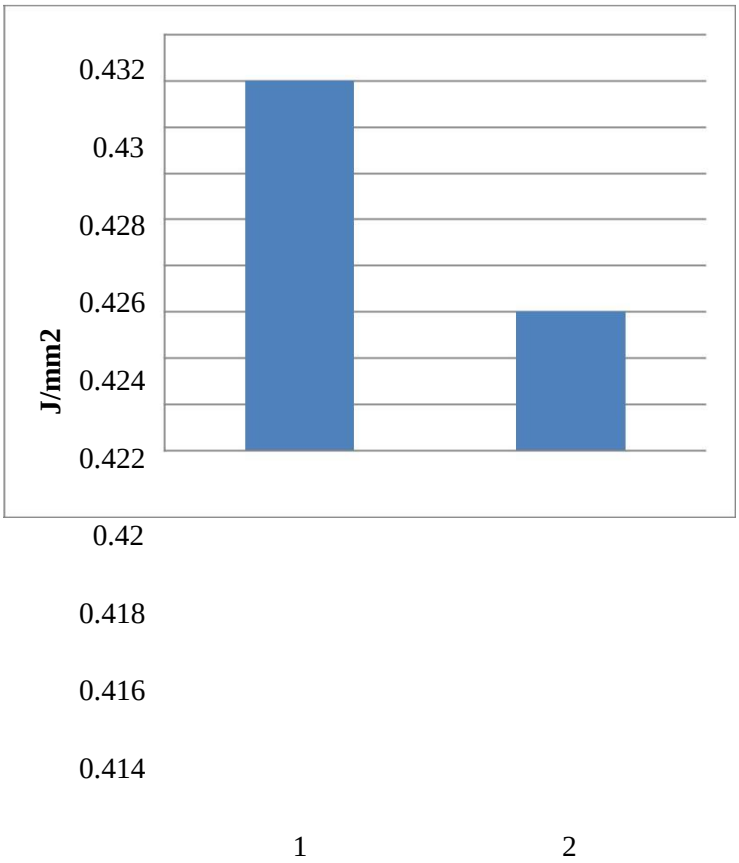

Energy Vs Sample

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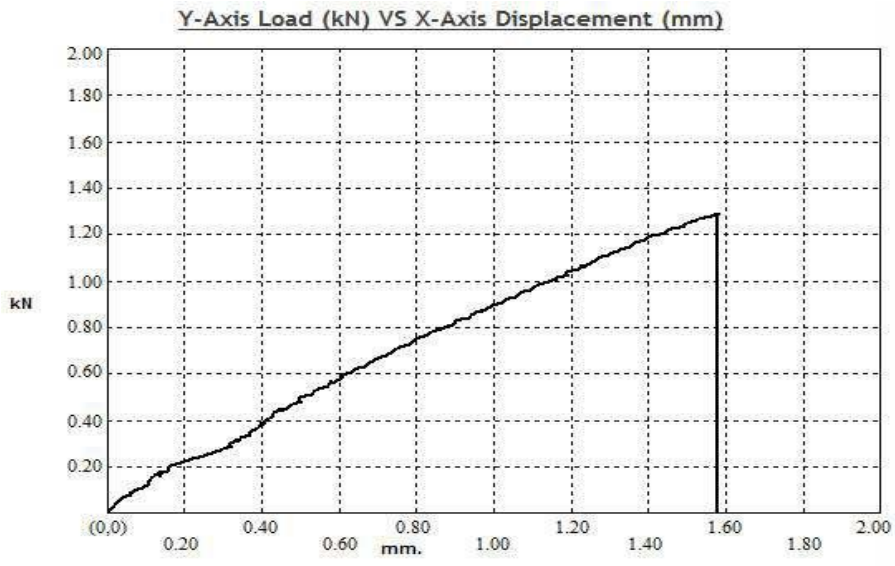
3.TENSILE TEST

Input parameters		**Output results**	
Sr .No	: SVVS	Ultimate load (KN)	:1.29
Specimen Width(mm)	: 12.70	Ult tensile strength(N/mm^2)	:6.772
Specimen Thickness(mm)	:15	Disp.at ult load(mm)	:1.58
Cross section area (mm^2)	:190.5	Breaking load (KN)	:1.29
Test temp	:1163	Breaking stress(N/mm^2)	:6.772
Test speed (mm/min)	:2.0	Maximum displacement(mm)	:1.59
Original gauge length(mm)	:60	%Elongation(%)	: 1.667
Final gauge length(mm)	:61	Yieald load (KN)	:0.00
		Yield stress (N/mm^2)	:0.00

Tensile Test Result



Load Vs Displacement

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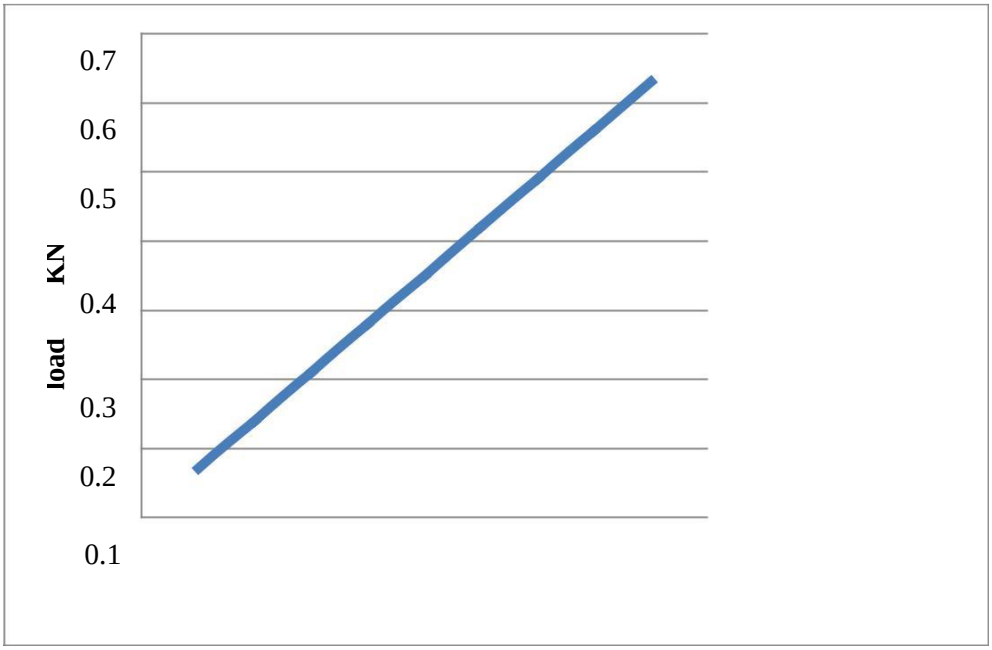
4. FLEXURAL TEST

Load KN	Displacement mm
0.071	0.1
0.140	0.2
0.210	0.3
0.280	0.4
0.350	0.5
0.420	0.6
0.490	0.7
0.560	0.8
0.630	0.9

Flexural Test



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COMPARING MATERIAL OF POLYPROPALENE

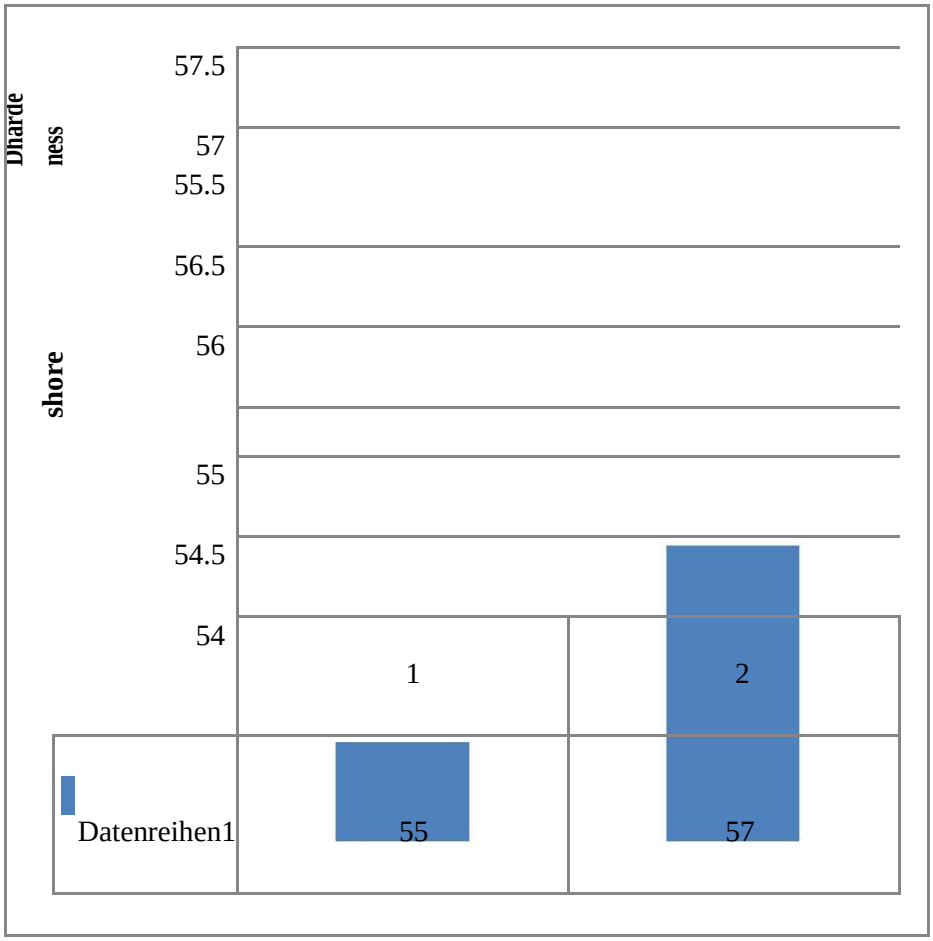
1. SHORE HARDNESS TEST

Scale: Shore Hardness D scale.

location	Shore D hardness
1	550
2	570

Shore Hardness Test Result

The above table shows the effect on shore hardness for the two samples made up of polypropalene. From the shore test conducted on the samples, it is inferred that the maximum amount of energy the samples can be withstand is around is 57.



D Hardness Vs Location

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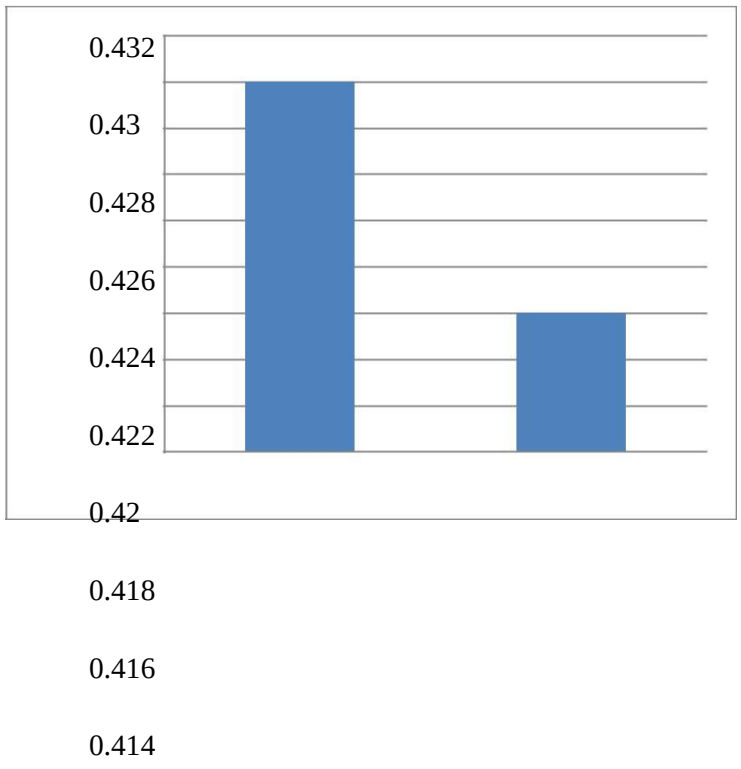
2. IZOD IMPACT TEST

Sample	Energy(j/mm^2)
1	0.40
2	0.41

Izod impact test result

The above table shows the effect on impact load for the two samples made up of polypropalene. From the impact test conducted on the samples, it is inferred that the maximum amount of energy the samples can be withstand is around 0.4joules/mm^2.



Energy Vs Sample

2. TENSILE TEST

There are many types of testing machines. The most common are tensile Testing machines, which test materials in tension, compression or bending. There are two classes of testing machines, electromechanical and hydraulic. The electromechanical machine uses an electric motor, gear reduction system and one, two or four screws to move the crosshead up or down. A range of crosshead speeds can be achieved by changing the speed of the motor through the software control. A

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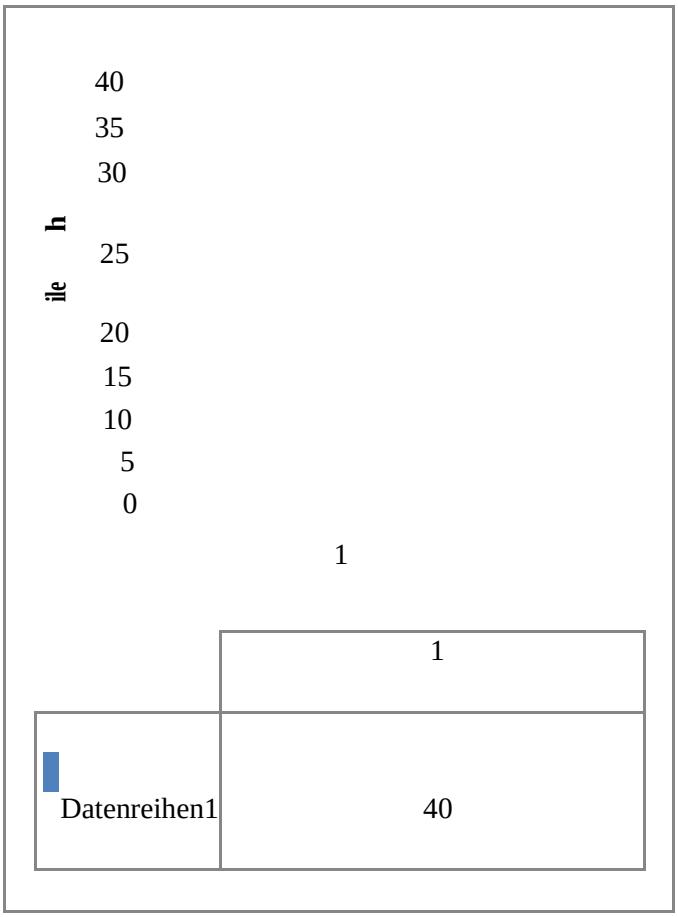
microprocessor based closed-loop servo system can be implemented to accurately control the speed of the crosshead.

Sample	Tensile Strength (Mpa)
1	40

Tensile test result



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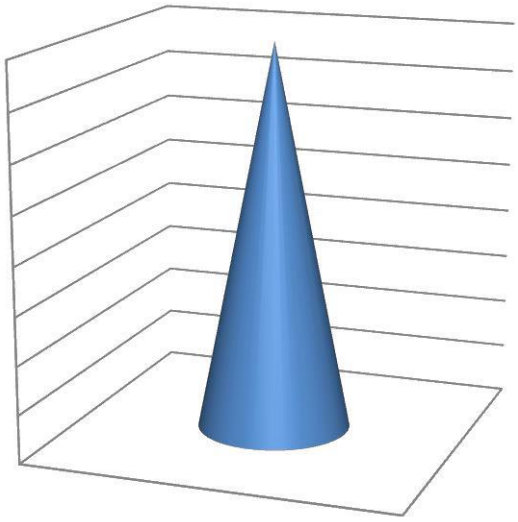

Tensile strength result

3. FLEXURAL TEST

The goal of a compression test is to determine the behavior or response of a material while it experiences a compressive load by measuring fundamental variables, such as, strain, stress, and deformation. By testing a material in compression the compressive strength, yield strength, ultimate strength, elastic limit, and the elastic modulus among other parameters may all be determined. With the understanding of these different parameters and the values associated with a specific material it may be determined whether or not the material is suited for specific applications or if it will fail under the specified stresses.

Load KN	Displacement mm
0.064	0.1
0.078	0.2
0.099	0.3
0.156	0.4
0.289	0.5
0.399	0.6
0.45	0.7
0.51	0.8

Flexural Test

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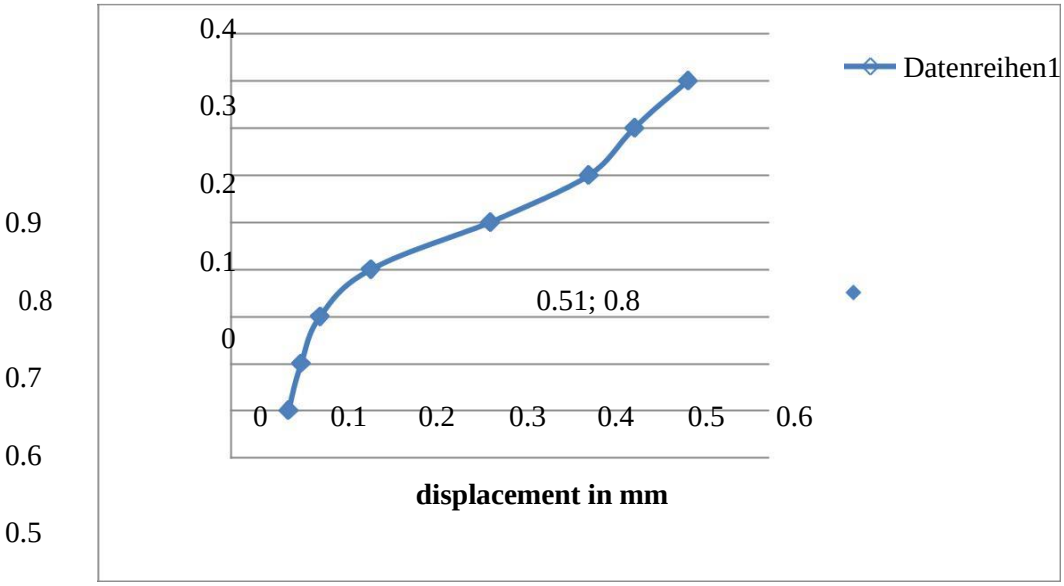

Load Vs Displacement

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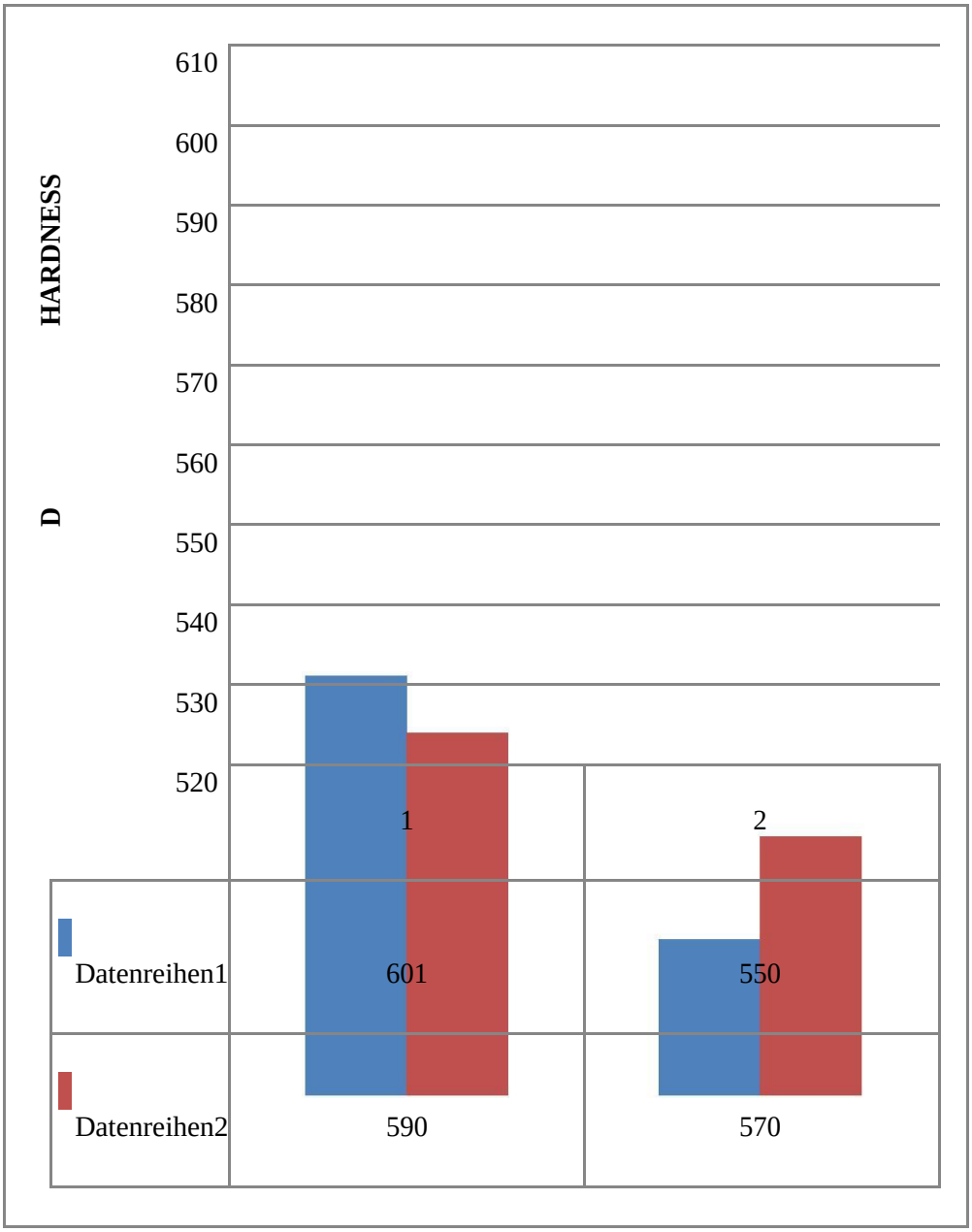
COMPARISON

Compare the our natural composite material and polypropalene in hardness test, impact test, tensile test and flexural test.

1.SHORE HAEDNESS TEST RESULT

The shore hardness of two materials are shown in graph in below



Comparison Shore Hardness Test Result

When compared to the two materials shore hardness test is more than the other two materials. The D hardness test is 601 j/mm$^{2.}$

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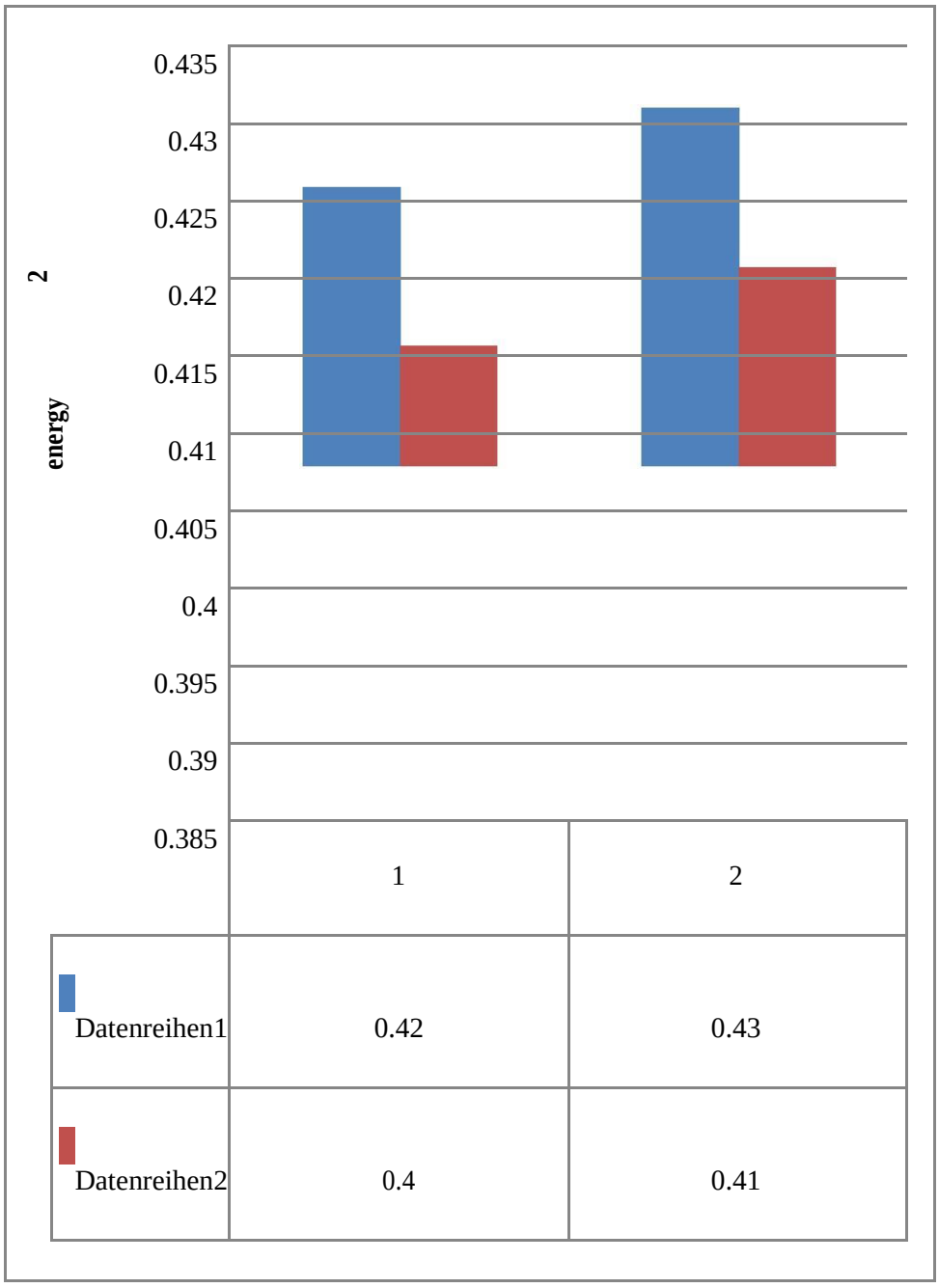
2. IZOD TEST RESULT

The impact strength of two materials are shown in graph in below



Comparison Of Izod Test Results

Series 1 – (W.P + C.F + P.F)

Series 2 - Polypropylene

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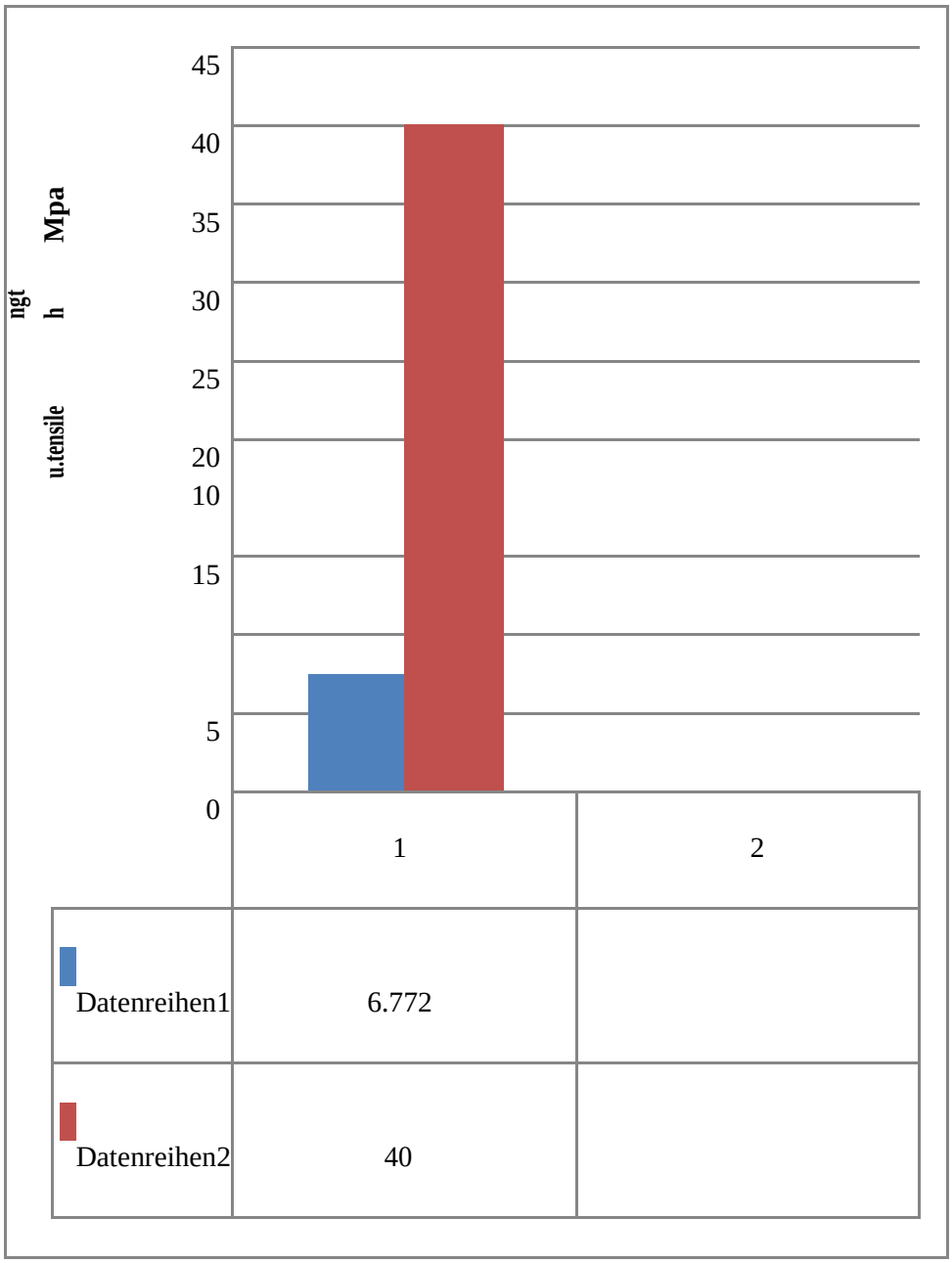
In izod test the impact strength of the our natural composite material more than the other two material. The impact value is 0.43.

3. TENSILE TEST RESULT

The tensile test of two materials are shown in graph in below



Comparison Of U.Tensile Strength Test Result

Series 1 – (W.P + C.F + P.F)

Series 2 - Polypropylene

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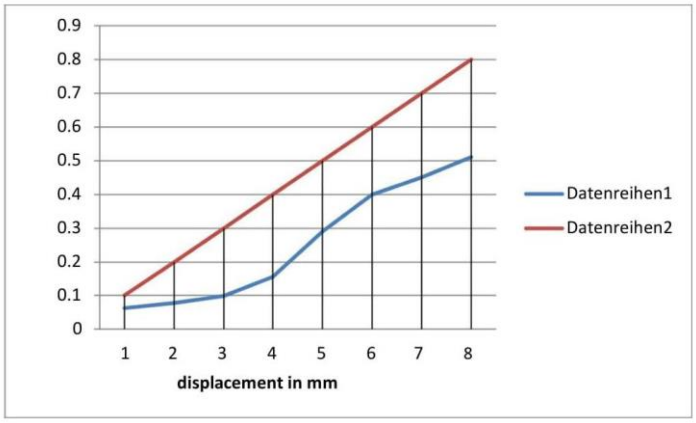
In tensile strength of the our natural composite material is less than the polypropylene. the tensile strength is 40 Mpa.

4. FLEXURAL TEST RESULTS

The flexural test of two materials are shown in graph in below



Comparison Of Flexural Test

Series 1 – (W.P + C.F + P.F)

Series 2 - Polypropylene

When compare to the three materials the (W.P + C.F + P.F) our composite material is more than polypropylene.

CONCLUSION

The natural fibers have been successfully reinforced with the epoxy resin by simple wet hand lay-up technique. The aim of this project is to find the tensile, Bending, hardness and impact strength of natural fiber reinforced composites. The fibers like coconut fibers, palm fiber, wood powder, were successfully used to fabricate composites with varying the fiber percentage. The new hybrid composite produced with natural fibers as reinforcements gives good mechanical properties as compared with polypropylene. These hybrid-bio-composite can be used in automobile (mainly car door) applications.□ □

In the present work, composite with multiple natural fibers such as Coconut fiber, palm fibers, wood powder have been successfully reinforced with the epoxy resin by simple and inexpensive hand lay-up technique. The mechanical testing results of fabricated composite car door indicate that, concept of using multiple natural fibers is viable for car door application. However, there is a scope to optimize the volume fraction of natural fibers as reinforcements to achieve enhanced mechanical properties of car door. So, it is clearly indicates that reinforcement of natural fibers have good and comparable mechanical properties as conventional composite materials.□

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Biography

Author was born in Omakuppam village,Tamilnadu in India, in 1996. He is interested in Material Science and Engineering. He was participated in the State Level HISTORICAL ESSAY COMPETITION-2007-08.Now,He is Studying Computer Aided Design at Podhigai College of Engineering. He was Member in SAE INDIA in 2014-16.Also He is Member in INDIAN WELDING SOCIETY and INTERNATIONAL ASSOCIATION OF ENGINEERS.