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Tensile Test of Waste Plastic and Coconut Fiber with Epoxy Resin Reinforced Composite Material

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ABSTRACT - In this research, we are going to make a future material using of waste plastic fiber and epoxy resin reinforced Composite materials, in this we using The Waste plastic material, it generated millions of tons globally and only about 10% of total can recycle. Today's everywhere use of light material with good properties needed. And the plastic have and mechanical properties such as ductility Toughness, hardness etc. And it can take about 450 years to decompose. So' using this material we obtain excellent mechanical properties.

This Research done in two phase, In 1st phase we are going to compare tensile strength of composite material made up of waste plastic fiber and epoxy resin reinforcement and composite material made up of waste coconut fiber and epoxy resin reinforcement and take best one for further testing. From the first stage of testing we obtained that the tensile strength of composite material made up of waste plastic fiber and epoxy resin reinforcement (i.e. 14.807 MPa) is more then the composite material made up of waste coconut fiber and epoxy resin reinforcement (i.e. 8.384 MPa)

In 2nd phase we are going to compare tensile strength of best one composite material of 1st phase of testing (i.e. composite material made up of waste plastic fiber and epoxy resin reinforcement) with different shape of same cross section area such as cuboidal, triangular prism, cylindrical. And getting the result of higher flexural strength and its corresponding shape. From the 2nd phase of testing we obtained that the material of circular cross section have higher strength (i.e. 22.307 MPa).
There are various benefits of these composite material like- By reducing plastic waste, we save our environment.
We can remove plastic and wood by using this material and hence we can reduce deforestation and save our environment.

Keywords - Eco-friendly, Light weight, Cost effective.

1. INTRODUCTION -

In this research, we are going to make a future material using of plastic waste fiber and epoxy resin reinforced composite materials. The use of composite material increasing day by day. Every industries of the world use advance composite material for lighter the component and get higher efficiency. The reason of increasing the demand of composite material because of its wide range of properties. In present time composite material used in aeronautical industries at very large scale. In this we using the waste plastic material that generated millions of tones globally per year. 9200 million tons of plastic are estimated to be generated last 67 years from 2017. Due to large demand, plastic production increasing day by day but recycle rate is very low (rarely 10% has been recycled). And it take approximately 400 years to completely decompose. And it's possible that the world total plastic demand touches to approximate 1 billion per year after 25 years. Due to long decomposition time, we use plastic because in total production of plastic, only 10% can be recycled and 90% of plastic waste generated. But waste plastic also have good mechanical property like good strength, elasticity, hardness, etc. By using these property we can made a composite material. Which have more mechanical property and also reduce the plastic waste and use it in other form. We can also protect the environment. Various large firm research, how to manage plastic waste, some western country made road using plastic waste to reduce plastic waste.

In this research we are going to study and analysis of the mechanical behaviour of waste plastic fiber and epoxy resin reinforcement composite material. Tensile strength test perform on this product, which is prepared by us, in which apply different amount of force on the prepared materials and find the highest value load wearing capacity of material.
There are various benefits of these composite material like- By reducing plastic waste, we save our environment.
We can remove plastic and wood by using this material and hence we can reduce deforestation and save our environment.

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1.1 Waste plastic fiber -

It is fiber of waste plastic that generated millions of tons globally per year. And recycle only 10% of total generation and 90% become waste that take approx. 450 years to decompose totally. But it have good mechanical properties like ductility, toughness, hardness etc. and this fiber made by extrusion process by using waste plastic.

Figure 1. Waste plastic fiber

1.2 Epoxy Resin -

Epoxy is a type of adhesive which have highest bonding capacity. It is used by mixing resin and hardener in appropriate amount. Epoxy is also called as poly-epoxides. Epoxy is normally very viscous liquid. The ratio of resin and hardener is 1:0.8.

Epoxy resin have various properties like: Greater strength.

Less shrinkage after bonding. High adhesion to various material. Cost effective.

Lesser toxicity.

Figure 2. Epoxy (resin and hardener)

1.3. Waste coconut fiber –

Coconut waste generate millions of tons in costal region per year. That easily available with very low cost.

Figure 3. waste coconut fiber

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2. LITERATURE REVIEW

Asheesh Kumar and Anshuman Srivastava et al. investigated the mechanical properties of composite material made up of jute and epoxy resin reinforcement. And perform various tests like tensile and compression tests for various application. They also compare composite material made up of jute and epoxy resin reinforcement to other composite material made of different natural fiber (such as hemp, ramie, e-glass fiber, etc.) and epoxy resin reinforcement. And compare their strengths.

K. Devendra, T. Rangaswamy et al. investigated the Strength Characterization of composite material made up of E-glass fiber and epoxy resin reinforcement. And perform various tests like tensile, impact and hardness tests for various application. They also compare composite material made up of jute and epoxy resin reinforcement and use various filler material such as fly ash, Al_2O_3 in different amount. And compare their strengths.

Anurag Saroj et al. investigated the mechanical properties of composite material made up of bagasse and epoxy resin reinforcement. And perform various tests like tensile and flexural tests for various application. They also compare composite material made up of bagasse and epoxy resin reinforcement to different composition. And compare their strengths.

Shinde Rohit Anil, Jadhav Raviraj Mohan, Mali Sagar Vilas, Patil Shivtej Mohan investigated the mechanical properties of composite material made up of natural fiber and epoxy resin reinforcement. And perform various mechanical tests like tensile, flexural and impact tests for various application. They also test friction of composite material with mild steel disc on different load and different time. And compare their results.

3. EXPERIMENTATION

3.1. Materials for Composites

Epoxy (Araldite epoxy) and waste plastic fiber used as a material for formation composites in this experimental work. The epoxy used as matrix phase of composite and waste plastic fiber used as a dispersion phase. Waste plastic fiber made by extrusion process.

3.2. Preparation of mould

The mould is made up of aluminium composite panel which inner dimension is L=150 mm, W=26 mm, H=10 mm. and then proper grease apply inside the mould for preventing sticking.

Figure 4. Mould

3.3. Specimen preparation

First epoxy resin and hardener are mixed in the ratio of 1:0.8 respectively. Then put in worm water for removing bubble then 20% of mould volume pour by epoxy and then put waste plastic fiber in remaining 70% part of mould after that remaining 10% volume of mould filled by epoxy and then compress by uniformly distributed load of 2kg for 24 hours.

3.4. specimen finishing

After removing specimen from mould after 24 hours, its edges are maintained by fine grade sand paper and maintain its original dimension.

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4. TENSILE STRENGTH

The tensile test perform on the universal testing machine (UTM). In this specimen is mounted in the UTM as shows in the figure-5. Then load is applied and value of load is obtained.

Figure 5. Universal Testing Machine

Table 1 - Specimen specification

S.NO.	Dimension	Value (mm)
1	Length	150
2	Width	26
3	Hight	10
4	C/S Area for all specimen	260 Sq mm
5	Volume for all specimen	39000 Cu mm

4.1. 1st phase of testing –

Comparison between composite material made up of waste plastic fiber and epoxy resin reinforcement and composite material made up of waste coconut fiber and epoxy resin reinforcement.

Figure 6 – Specimen – S1T

Figure 7 – Specimen – S2T

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Table 2 - Composition specification

S.NO.	Specimen Designation	ersed phase material	Dispersed phase material percentage	Epoxy Percentage
1.	S1T	Waste plastic fiber	70%	30%
2.	S2T	Waste coconut fiber	70%	30%

Table 3 – Test result 1

S.NO.	Specimen Designation	Load at peak (KN)	Elongation at peak (mm)	Load at yield (KN)	ield stress (MPa)	Elongation at yield (mm)
1.	S1T	3.850	16.550	3.185	12.250	7.330
2.	S2T	2.180	10.030	0.560	2.154	36.900

Table 4 – Test result 2

S.NO.	Specimen Designation	Tensile strength (MPa)	Load at break (KN)	Elongation at break (mm)	Breaking strength (MPa)	% Elongation
1.	S1T	14.807	0.380	31.790	1.462	5.69
2.	S2T	8.384	0.560	36.900	2.154	2.73

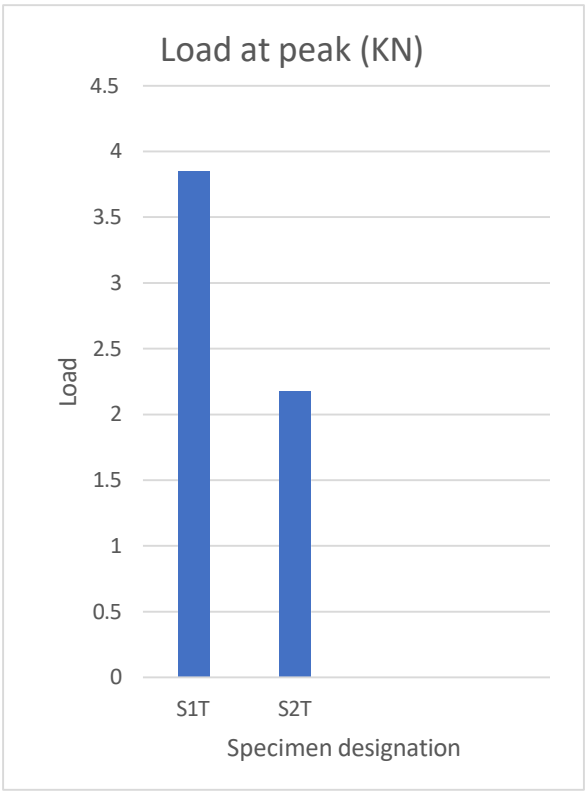

Figure 8 – Chart of load at peak

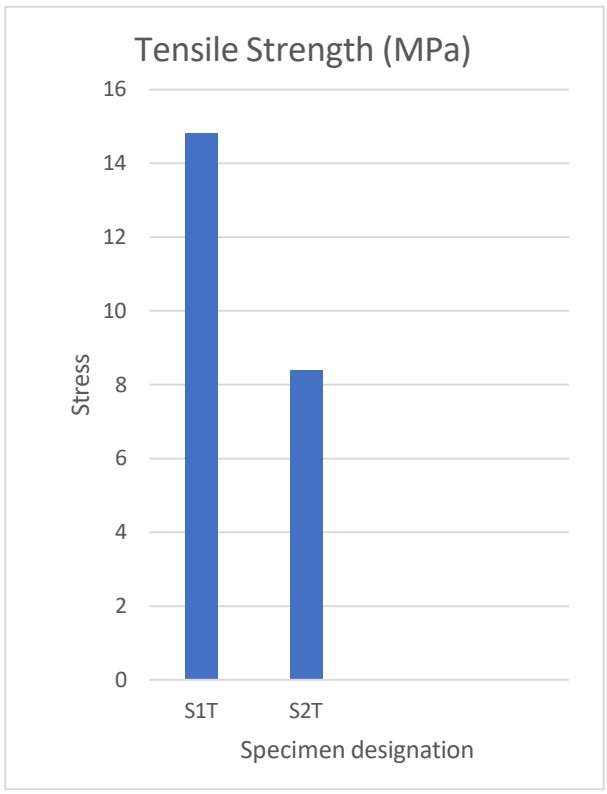

Figure 9 - Tensile Strength chart

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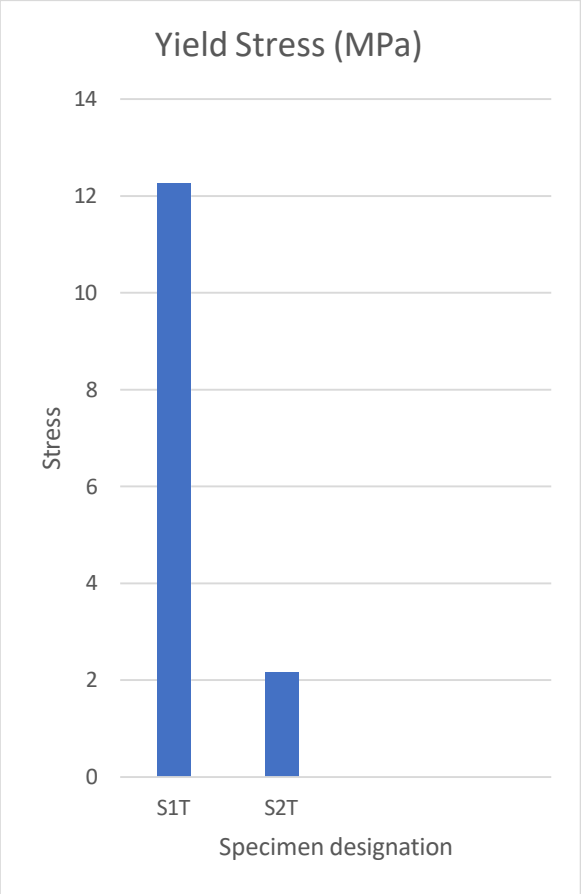

Figure 10 – Yield stress chart

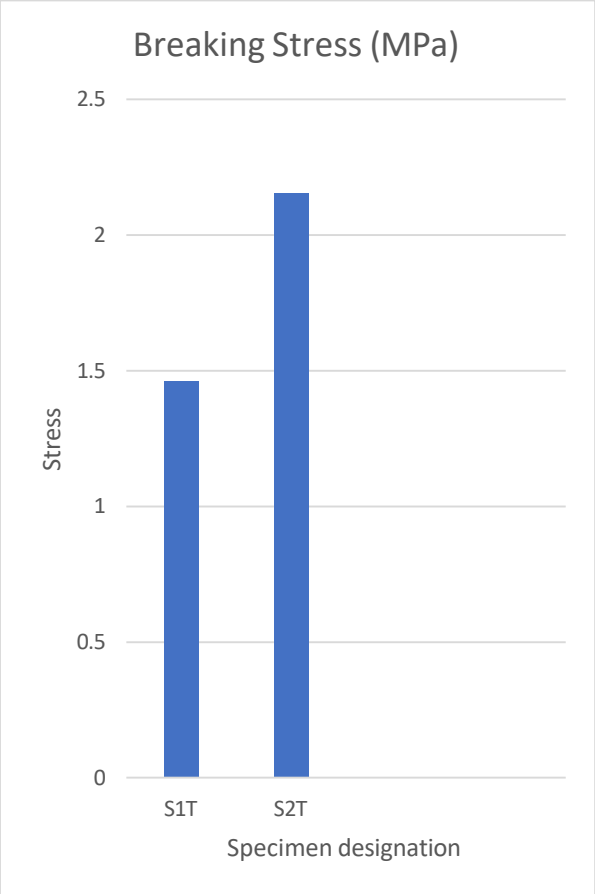

Figure 11 – Breaking stress chart

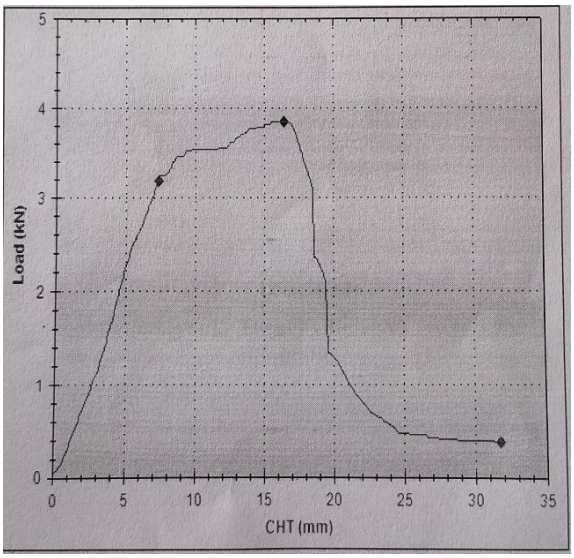

Figure 12 – Graph of specimen S1T

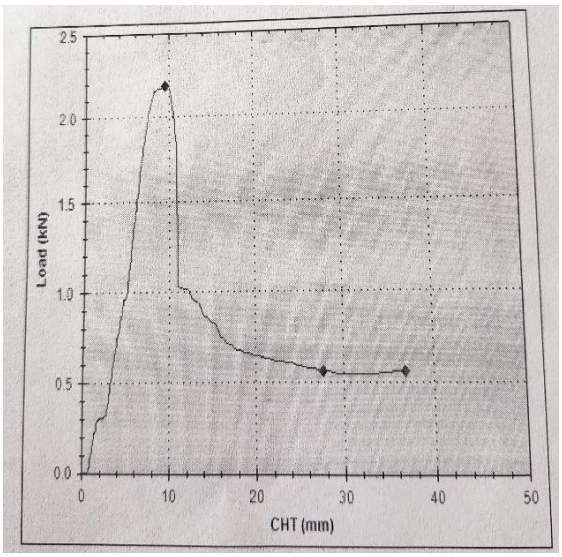

Figure 13 – Graph of specimen S2T

Result :- Above comparison it clear that the strength of specimen S1T is greater then specimen S2T. So, we prefer west plastic fiber for further test.

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4.2. 2 phase of testing –

From the result of 1st phase of testing we get the strength of composite material made up of waste plastic fiber and epoxy resin reinforcement is greater then the strength of composite material made up of waste coconut fiber and epoxy resin reinforcement.

So, we further test on the composite material made up of waste plastic fiber and epoxy resin reinforcement in different shape such as Cuboidal, Triangular prism, Cylindrical.

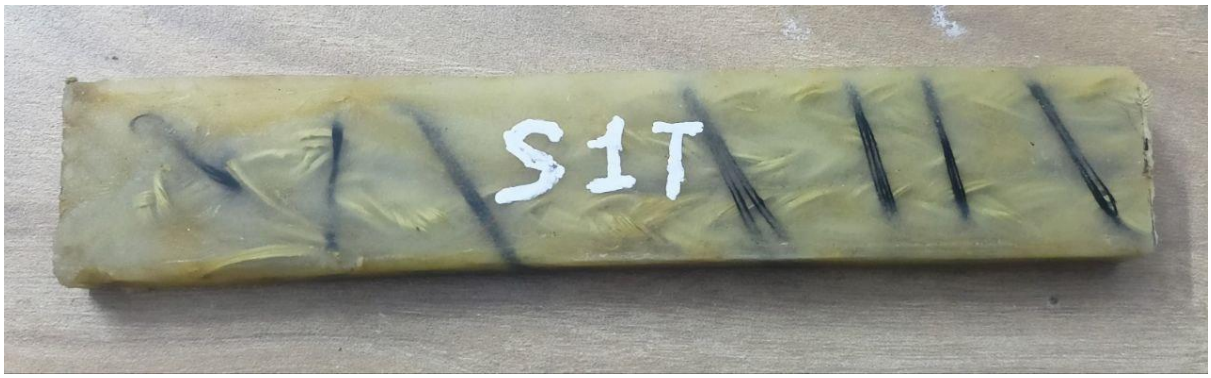

Figure 14 – Specimen – S1T

Figure 15 – Specimen – S3T

Figure 16 – Specimen – S4T

Table 5 - Composition specification

S.NO.	Specimen Designation	Dispersed phase material	ecimen shape	Dispersed phase material percentage	Epoxy Percentage
1.	S1T	te plastic fiber	Cuboidal	70%	30%
2.	S3T	te plastic fiber	riangular prism	70%	30%
3.	S4T	te plastic fiber	Cylindrical	70%	30%

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Table 6 – Test result 3

S.NO.	Specimen Designation	Load at peak (KN)	Elongation at peak (mm)	Load at yield (KN)	eld stress (MPa)	Elongation at yield (mm)
1.	S1T	3.850	16.550	3.185	12.146	7.330
2.	S3T	4.600	50.050	0.615	2.365	56.280
3.	S4T	5.800	30.080	3.725	14.326	2.790

Table 7 – Test result 4

S.NO.	Specimen Designation	Tensile strength (MPa)	Load at break (KN)	Elongation at break (mm)	Breaking strength (MPa)	% Elongation
1.	S1T	14.807	0.380	31.790	1.462	5.69
2.	S3T	17.692	0.615	56.280	2.365	3.71
3.	S4T	22.307	4.245	60.932	16.481	3.5

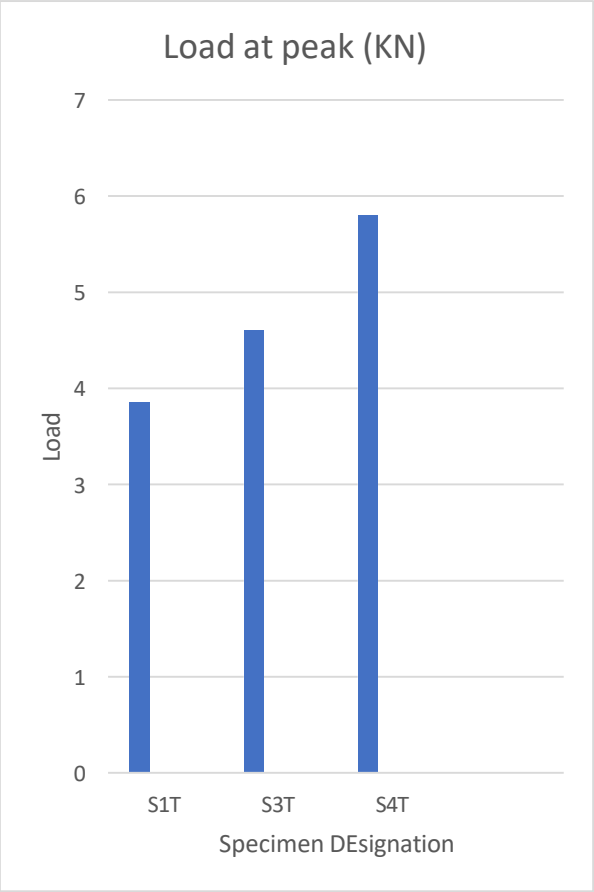

Figure 17 – Chart of load at peak

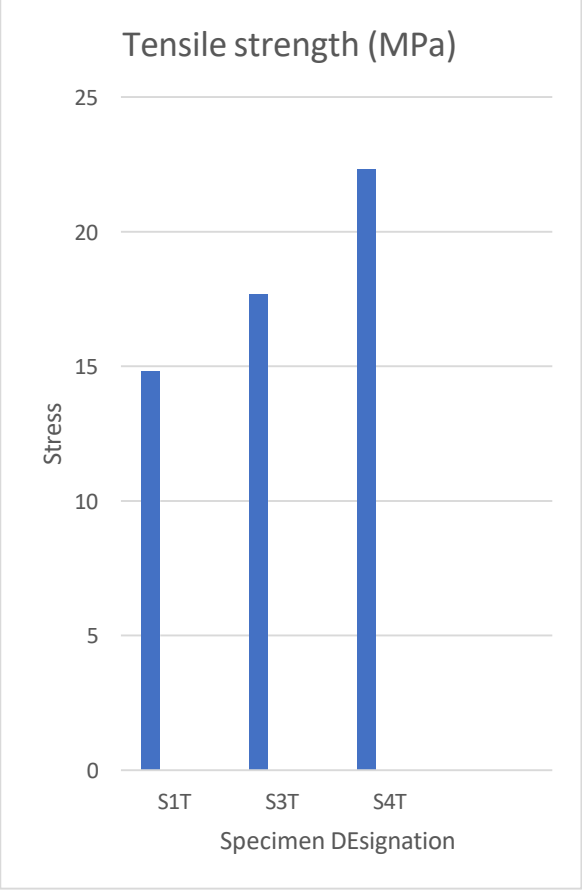

Figure 18 - Tensile Strength chart

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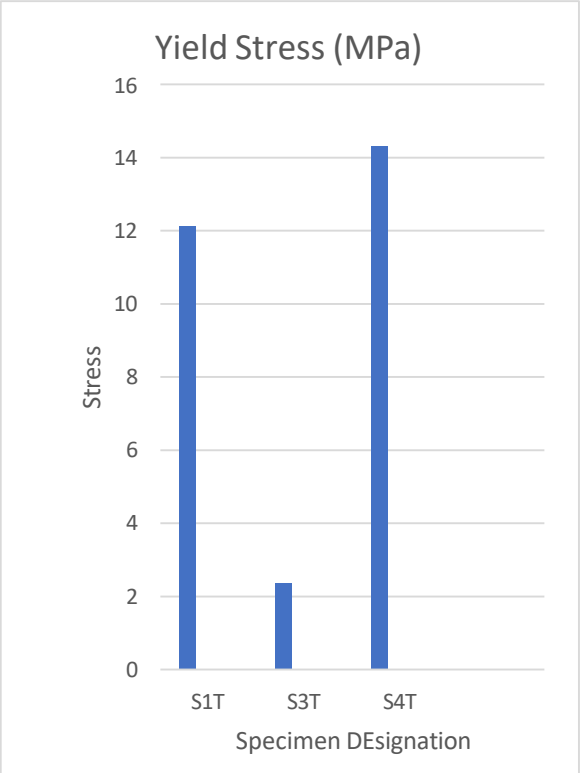

Figure 19 – Yield Stress chart

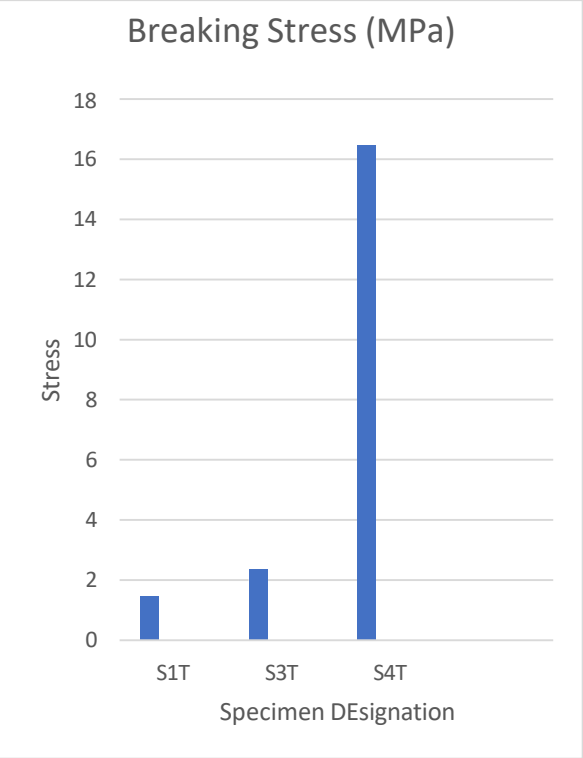

Figure 20 – Breaking Stress chart

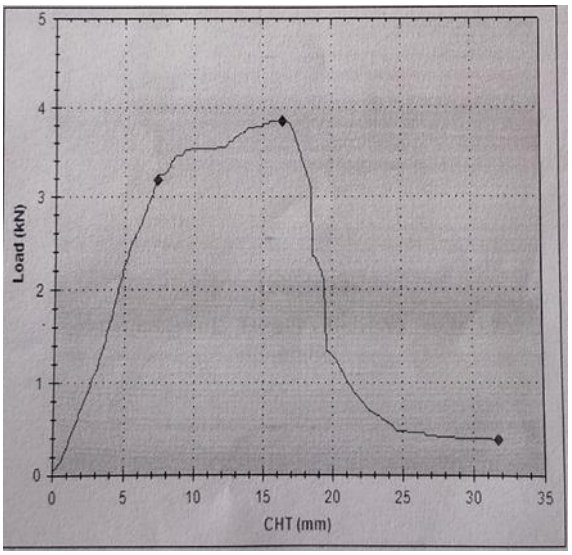

Figure 21 – Graph of specimen S1T

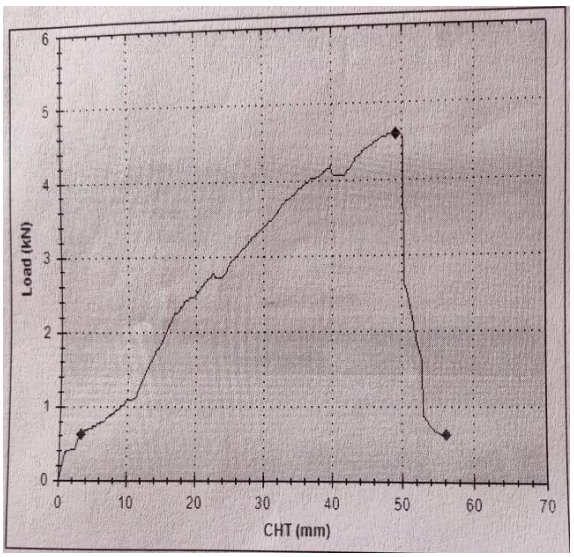

Figure 22 – Graph of specimen S3T

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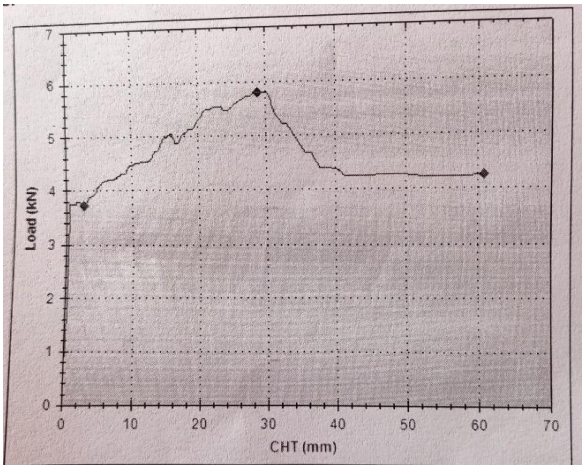

Figure 23 – Graph of specimen S4T

5. RESULT & DISCUSSION

We obtained the result from the both phase of testing and we observed that the composite material made up of waste plastic fiber and epoxy resin reinforcement in cylindrical shape have higher strength (maximum peak load = 5.800 KN).

- The highest value of tensile strength in 1st phase of testing is obtained in specimen "S1T" which is 14.807 MPa.
- The highest value of tensile strength in 2st phase of testing is obtained in specimen "S4T" which is 22.307 MPa.
- The highest value of tensile strength in both phase of testing is obtained in specimen "S4T" which is 22.307 MPa.
- The smallest value of tensile strength in 1st phase of testing is obtained in specimen "S2T" which is 8.384 MPa.
- The smallest value of tensile strength in 2st phase of testing is obtained in specimen "S1T" which is 14.807 MPa.
- The smallest value of tensile strength in both phase of testing is obtained in specimen "S2T" which is 8.384 MPa.
- The elongation percentage of in each specimen has not same
- In this study and analysis, we observed the result of tensile strength of fibre reinforced composite materials is varies from 8.384 MPa to 22.307 MPa. The result varies with variation in the raw materials and shape, the tensile strength changes with the changing the shape. And we found that the epoxy resin and west plastic fiber have good bonding strength.

6. CONCLUSION

- The waste plastic, an unutilized non-renewable waste can successfully use to produce composite material by good bonding with epoxy resin for valuable product.
- By reducing plastic waste, we save our environment.
- We can remove plastic and wood by using this material and hence we can reduce deforestation and save our environment.
- It has good tensile strength.
- It also has good adhesion with epoxy resin
- It is the water resistance composite materials.
- The both phase of testing and we observed that the composite material made up of waste plastic fiber and epoxy resin reinforcement in circular shape have higher strength. The maximum tensile strength is 22.307 MPa.

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