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STUDY OF MECHANICAL BEHAVIOUR OF KEVLAR AND GLASS FIBRE REINFORCED WITH POLYPROPYLENE LAMINATED HYBRID COMPOSITES

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Abstract: Now days, there are many requirements about new product in the industries. The products require strong, weightless the product wants to work long life. So they interested in the composite material. Composites made by combination of two or more different types material and there is two reinforcement used the manufacturing that is called hybrid composites. There are many composite. We have taken the polypropylene as matrix material, because they have maximum temperature and melting point. Any material having disadvantage also, so ignoring the disadvantage we are using Kevlar and glass fibre and epoxy resin. They give high bonding strength and mechanical behaviour.

So the present research work is undertaken to examine the Mechanical behaviour of polypropylene Kevlar and glass fibre and epoxy based hybrid composites.

Keywords: *Polypropylene, Kevlar, Glass fibre, Hybrid Composites*

1. Introduction

Composite materials often shortened to composites are engineered or naturally occurring materials made from two or more constituent materials with significantly different physical or chemical properties which remain separate and distinct at the macroscopic or microscopic scale with the finished structure. Composite materials refer to the engineered materials that are made by combing two or more different materials. They adopt physical and chemical properties of the materials and offer a better alternative which is stronger durable and more beneficial. Some of the common composite materials that are used in different industries include fiberglass reinforced plastic, and is especially used in the fiberglass pipe and tank industry. Concrete, bricks etc. are also some of the popular composite material used in different industries.Composites are made up of individual materials referred to as constituent materials. There are two categories of constituent materials: Matrix and reinforcement. At least one portion of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties. Produces material properties unavailable from the individual constituent materials while the wide variety of matrix and strengthening materials allows the designer of the product or structure to choose an optimum combination.

2. Literature Review

This section focuses on the research work that has already been carried out for testing the mechanical properties of the fibre reinforced hybrid composites. Literature review of such work needs to be done in order to understand the background information available, the work already done and also to show the relevance of the current project. This chapter presents a general idea of the factors which affect the mechanical properties of hybrid fibre reinforced polymer composites. The literature surveys are. Dr. Rathnakar.G and Dr. H K Shivanand in his journal paper titled 'A Review Polymer Based Laminated Composites for Flexural and Shear Properties' has discussed about the polymer based composite and also flexural properties of the composite material. R.Sakthivela, D.Rajendran in their journal paper titled 'Experimental Investigation and Analysis a Mechanical Properties of Hybrid Polymer Composite Plates 'has discussed about the Mechanical properties of the hybrid composites. Jin Zhang, Khunlavit Chaisombat, Shuai He, Chun H. Wang in their journal paper titled 'Hybrid composite laminates reinforced with glass/carbon woven fabrics' has discussed about the hybrid composite and also properties of glass fibre and mechanical properties. Reasing continuously due to the addition of the glass fibers. It was also found that the water absorption decreases considerably with the addition of glass fibers.

3. Materials and Properties

Polypropylene is currently one of the fastest growing polymers. Much of this growth is attributed to polypropylene's ability to displace conventional materials (wood, glass, metal) and other thermoplastics at lower cost. Polypropylene (PP) is a tough, rigid plastic and produced in a variety of molecular weights and crystallinities. The density of PP is between 0.895 and 0.92 g/cm³. Therefore, PP is the commodity plastic with the lowest density. With lower density, moldings parts with lower weight and more parts of a certain mass of plastic can be produced. Unlike polyethylene, crystalline and amorphous regions differ only slightly in their density. However, the density of polyethylene can significantly change with fillers. Glass fibers are among the most versatile industries materials known today. They are readily produced from raw materials, which are available in virtually unlimited supply. All glass fibers described in this article are derived from composites containing silica. They exhibit useful bulk properties such as hardness, transparency, resistance to chemical attack, stability, and increase as well as desirable fibre properties such as strength, flexilibility, and stiffness. Glass fibers are used in the manufacture of structural composites, printed circuit boards and a wide range of special-purpose products.Kevlar is the registered trademark for a para-aramid synthetic fiber, related to other aramids such as Nomex and Technora. Currently, Kevlar has many applications, ranging from bicycle tires and racing sails to body armor, because of its high tensile strength-to-weight ratio; by this measure it is 5 times stronger than steel. It is also used to make modern drumheads that withstand high impact. When used as a woven material, it is suitable for mooring lines and other underwater applications. Kevlar is synthesized in solution from the monomers 1,4-phenylene-diamine (para-phenylenediamine) and terephthaloyl chloride in a condensation reaction yielding hydrochloric acid as a byproduct. The result has liquid-crystalline behavior, and mechanical drawing orients the polymer chains in the fiber's direction. Hexamethylphosphoramide (HMPA) was the solvent initially used for the polymerization, but for safety reasons, DuPont replaced it by a solution of N-methyl-pyrrolidone and calcium chloride.

4. Sample Preparation

Polypropylene sheet and glass fibre and Kevlar fibre are cut according to the size required. Epoxy resin is prepared. Resin LY 556 and hardener HY951 is mixed in the ratio of 10:1 in container. Initially resin in applied on the propylene sheet and the Kevlar fibers placed over it then resin is applied on the Kevlar fibre the glass fibre is placed over it and again resin is applied and polypropylene sheet is placed it. After making the laminated a weight is placed over it in such way equal pressure is applied on it. Keep this set for curing 24hrs so than laminated composites are formed. Like this by placing the fibers in different angle more specimen is prepared. We have prepared three specimen with 0, 30, 60 degree. This specimen is cut according to the ASTM standards and tested. For each test have specific ASTM standards.

5. Results and Discussion

Tensile test is widely performed test to determine several mechanical properties of material that are important in design. In these test, a standard specimen is subjected to a gradually increasing uniaxial tensile load until it fractures. Universal testing machine is used to perform the tensile test.

The specimen is mounted between the upper and lower cross heads. The lower cross heads is movable and is designed to elongate the specimen at a constant rate. The applied load and resulting elongation are measured simultaneously and continuously.

Fig 5.1 Universal Testing Machine

The laminated, specimen has to be cut according to the ASTM standards. The standards used for tensile test is ASTM D638.The test is conducted using universal testing machine.

Table 5.1 Dimensions of Tensile Test Specimen

Dimension	Millimeter
Length	165
Width	12.35
Thickness	4

FOR SPECIMEN WITH 0^{O} FIBRES

Table 5.2 Tensile Test Value of Specimen 0º

PROPERTIES	VALUE
Tensile load	2.53 kN
Tensile strength	52 MPa
Yeild load	1.50 kN

FOR SPECIMEN WITH 30^{O} FIBRES

Table 5.3 Tensile Test Value of Specimen 30º

PROPERTIES	VALUE
Tensile load	1.76 kN
Tensile strength	32 MPa
Yeild load	1.30 kN

FOR SPECIMEN WITH 60^{O} FIBRES

Table 5.4 Tensile Test Value of Specimen 60º

PROPERTIES	VALUE
Tensile load	1.85 kN
Tensile strength	33 MPa
Yeild load	1.20 kN

From above the result we can determine that the specimen with 0^o fibre orientation placed has have high load compared with others.According to the result we can say that laminated composite of zero degree angle ply has more strength.

FLEXURAL TEST

The three point bending test is very common and universal testing machine can be support by two bottom supports.By appling the load on the top member and causing bending,the specimen is subjected to tension at its lower surface.The load and the deflection of the specimen are measured.The stress at fracture in bending is known as flexural strength.

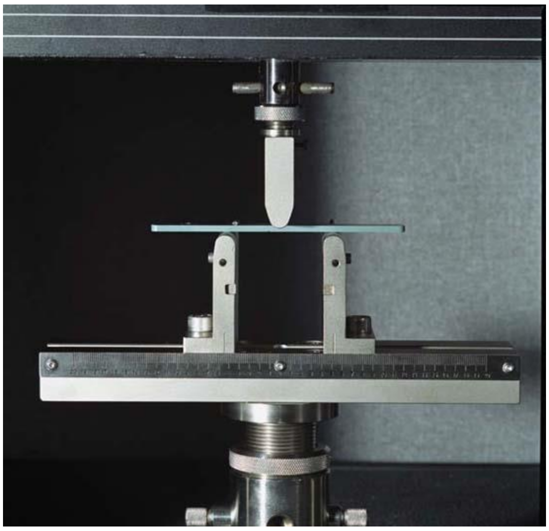

Fig 5.2 Flexural test setup

The flexural test was carried out according to the standard ASTM D70.Three point bending test were prepared to measure flexural strength.

Table 5.5 Dimensions of Flexural Test Specimen

Dimension	Millimeter
Length	110
Width	12.27
Thickness	4.3

FOR SPECIMEN WITH THE 0^O FIBRE

Table 5.6 Flexural test Value of Specimen 0^o

PROPERTIES	VALUE
Flexural load	0.13 kN
Flexural strength	68.46 MPa

FOR SPECIMEN WITH THE 30^{O} FIBRE

Table 5.7 Flexural Value of Specimen 30^{o}

PROPERTIES	VALUE
Flexural load	0.15 kN
Flexural strength	77.61 MPa

FOR SPECIMEN WITH THE 60^{O} FIBRE

Table 5.8 Flexural Value of Specimen 60^{o}

PROPERTIES	VALUE
Flexural load	0.12 kN
Flexural strength	63.47 MPa

IMPACT TEST

The impact test method used here is Charpy impact test. The standard is ASTM A370

Table 5.9 Dimensions of Impact test Specimen

Dimension	Millimeter
Length	65
Width	12.5
Thickness	4.3

At the point of impact, the striker has known as amount of kinetic energy. The impact energy is calculated based on the height to which the striker.

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Fig 5.3 Impact Test Machine

IMPACT TEST VALUES

Table 5.10 Impact Test Value

ANGLE	0^O	30^O	60^O
VALUE(JOULES)	2	2	4

From the above testing process we can conclude that each angle ply in laminated composites increases each unique property, in tensile test 0^o specimen had good result compared to other specimen. Likewise according to the application each laminated composites can different angle ply in it.

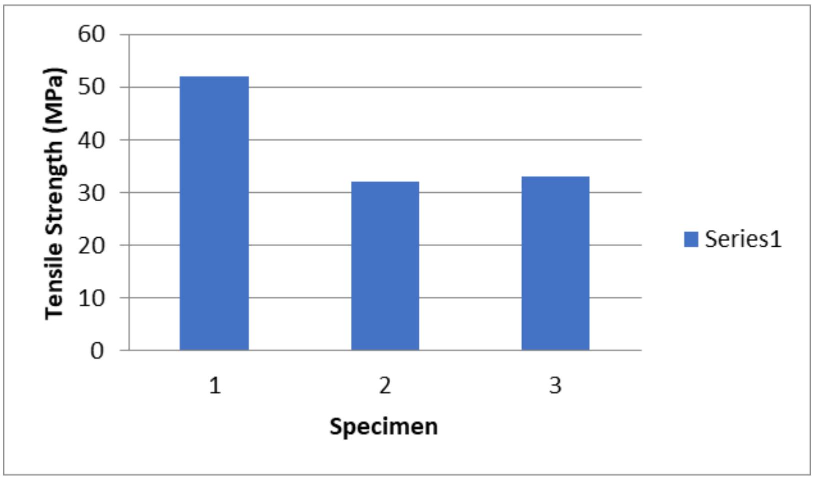

Fig 5.4 Comparison Graph of Tensile Strength

while comparing the result,we can see that the specimen 1 has the good result the specimen 1(0^o) can with stand high load so that it has good tensile property hence,it is suggested that the fibre orientation with 0^{o}preferred for designing of structures in automotive parts,boat hull etc.

COMPARISON OF FLEXURAL STRENGTH

For the flexural test it has been seen the specimen 2(30^o) has high value and it can with stand more load and has high displacement and in the flexural test we preffered the specimen 2.

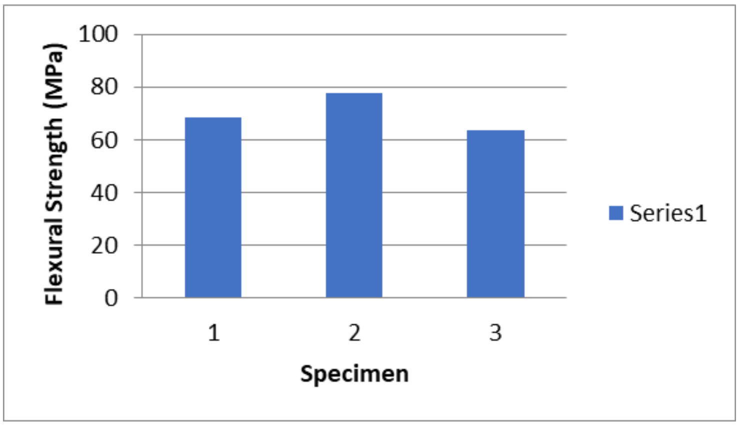

Fig 5.5 Comparison Graph Flexural Strength

In impact test specimen 3(60^o) has more impact strength. In flexural and impact testing specimen 3 had the better result it has more strength compared with other specimens.

6. CONCLUSION

The study of mechanical properties of polypropylene, Kevlar and glass fibre based on fibre orientation composite is conducted .Mechanical properties such as tensile strength, flexural strength and impact test were evaluate from the various tests. The fibre used composite the mechanical properties are based fibre orientation .Based on that we fabricate the composite material and also we get different mechanical properties based fibre orientation. The new class of hybrid composite material is successfully fabricated. Possible use of these composite such as sports goods, industrial fans, automotive parts, low cost housing is recommended.

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