MECHANICAL AND WEAR CHARACTERIZATION OF BASALT FIBER REINFORCED POLYURETHANE COMPOSITES

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ABSTRACT
In this work the investigation of experimental study of basalt fiber reinforced polyurethane composite was carried. Composite laminates were prepared by mixing chopped strand basalt fiber and polyurethane with proper curing agents. This was placed on the matched plate mold and pressed at 1500kgf/cm2 for 4 hrs at room temperature. The basalt fiber reinforced polyurethane composites were manufactured at various ratios such as (30:70 and 35:65). The mechanical properties of basalt fiber reinforced polyurethane composites like tensile modulus, tensile strength, flexural strength, shear strength and impact strength has been analyzed. Tensile and flexural tests showed that different composites withstand more load than basalt fiber composites.

KEYWORDS: *Mechanical properties, Basalt fiber, polyurethane*

I. INTRODUCTION

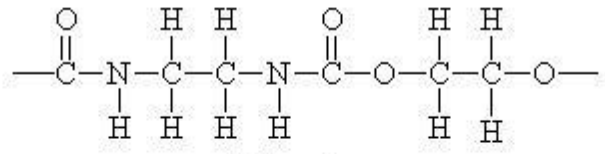
Basalt fiber is made from a single material, crushed basalt, from a carefully chosen quarry source and unlike other materials such as glass fiber, essentially no materials are added. The basalt is simply washed and then sent to be melted down .The manufacture of basalt fiber requires the melting of the quarried basalt rock at about 1,400 °C (2,550 °F). The molten rock is then extruded through small nozzles to produce continuous filaments of basalt fiber. There are three main manufacturing techniques, which are centrifugal-blowing, centrifugal-multiroll and die-blowing. The fibers typically have a filament diameter of between 9 and 13 µm which is far enough above the respiratory limit of 5 µm to make basalt fiber a suitable replacement for asbestos. They also have a high elastic modulus, resulting in excellent specific tenacity three times that of steel. Basalt fiber is a material made from extremely fine fibers of basalt, which is composed of the minerals plagioclase, pyroxene, and olivine. It is similar to carbon fiber and fiberglass, having better physic mechanical properties than fiberglass, but being significantly cheaper than carbon fiber. It is used as a fire proof textile in the aerospace and automotive industries and can also be used as a composite to produce products such as camera tripods

Figure: 1 Basalt Fiber

1.1. Polyurethane

Polyurethane is a unique material that offers the elasticity of rubber combined with the toughness and durability of metal. Because urethane is available in a very broad hardness range (eraser-soft to bowling-ball-hard), it allows the engineer to replace rubber, plastic and metal with the ultimate in abrasion resistance and physical properties. Polyurethane can reduce plant maintenance and OEM product cost. Many applications using this ultra-tough material have cut down-time, maintenance time and cost of parts to a fraction. Polyurethane are made by using three chemical compositions they are as follows

Polyol + Ethylene glycol + Methyl lsocyanate = Polyurethane



Polyurethane

Polyurethanes are versatile, modern and safe. They are used in a wide variety of applications to create all manner of consumer and industrial products that play a crucial role in making our lives more convenient, comfortable and environmentally friendly. Polyurethane is a plastic material, which exists in various forms

1.2. Compression Moulding

Compression molding is one of the original processing methods for manufacturing plastic parts developed at the very beginning of the plastics industry. In fact, it was widely used in the bakery industry for cookie or cake molding before plastic materials existed. Although it is also applicable to thermoplastics, compression molding is commonly used in manufacturing *thermoset* plastic parts. The raw materials for compression molding are usually in the form of granules, putty-like masses, or preforms. They are first placed in an open, heated mold cavity. The mold is then closed and pressure is applied to force the material to fill up the cavity. A hydraulic ram is often utilized to produce sufficient force during the molding process. The heat and pressure are maintained until the plastic material is cured. The most common method is Dough Moulding Compound (DMC) or Bulk Moulding Compound (BMC). Thermosetting resins are used in a partially cured state, either in the form of granules, putty-like masses or performs. The preheated material is placed directly into a heated mould. The material is forced into all cavities when the mould is closed with a top force. Heat and pressure are maintained until the material is cured. Another method is Sheet Moulding Compound (SMC). This process involves placing a reinforcing material, such as glass fibres, between layers of a thermoplastic and heating the materials so as to bond them together into a single sheet of material. This is then cut to size and reheated before being placed in a compression moulding press. This has a higher cost due to the handling and manufacturing costs in making the sheet. The material used in making the sheet is also heated three times – when making the initial thermoplastic sheet, then again when bonding with the reinforcement and finally, when making the part itself.

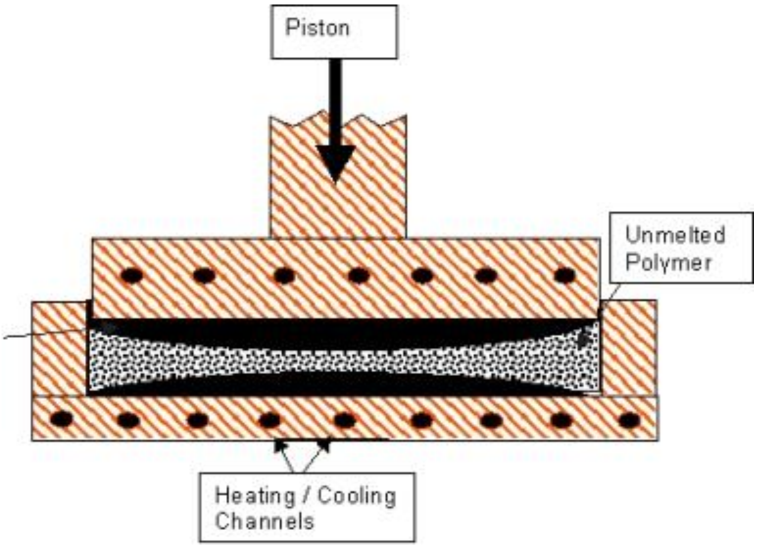


Figure:2 Compression Moulding

II. PREPARATION OF SAMPLES

For the sample preparation the first and foremost step is the preparation of the mould which ensures the exact dimension of the composite to be prepared. Prepare the mould for the preparation of 30%, 35%, fiber of the composite. The weight percentage of basalt fiber in the polyurethane composites determined. They next for The functions of these plates are to cover, compress the fiber after the polyurethane is applied, and also test samples according to tensile strength [ASTM D3039] of size 3x25x250mm,Flexural Modulus [ASTM D790] of size 3x12.7x50.8mm,Shear modulus of size 3x12.8x50mm were prepared from the cured sheet using cut off machine. As, the same procedure was repeated for using the resin only the ratio will be changed

Table:1 Preparation of Samples

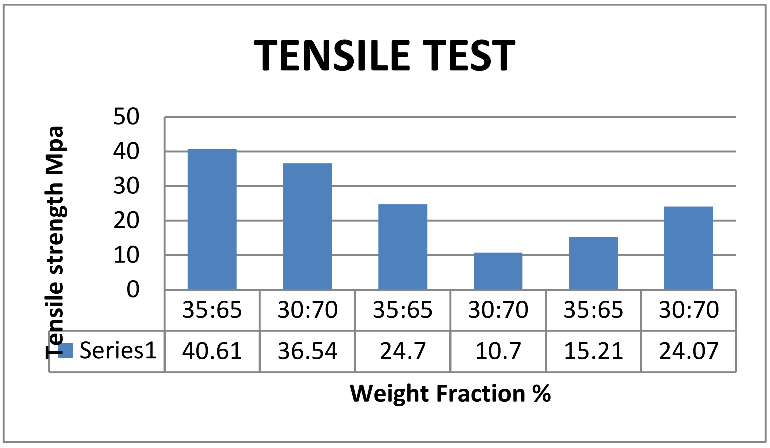
SPECIMEN NO	Ratio of Fiber & Resin	Weight	Resin	Temp	Process
01	35 : 65	300g	P+DE+I	36^0C	Compression moulding
02	30 : 70	300g	P+DE+I	36^0C	Compression moulding
03	30 : 70	300g	P+E+I	36^0C	Compression moulding
04	35:65	300g	P+E+I	36^0C	Compression moulding
05	35:65	300g	P+DE+I	120^0C	Compression moulding
06	30:70	300g	P+DE+I	120^0C	Compression moulding

III. RESULTS AND DISCUSSION

3.1. Tensile Test

Tensile testing of specimen prepared according to ASTM D 3039 type IV sample was carried out, using electronic tensile testing machine with cross head speed of 5 mm/min and a gauge length of 50 mm. The tensile modulus and elongation at the break of the composites were calculated from the stress strain curve. Four specimens were tested for each set of samples and the mean values were reported. The maximum of ultimate strength value for fiber ratio. The first samples gave good results when compared with the other samples. To improved chemical bonding and helped to withstand high tensile load by the composites made of them. To compare other ratio the first sample gave better tensile strength.

Table:2 Tensile Stress Vs Weight Fraction

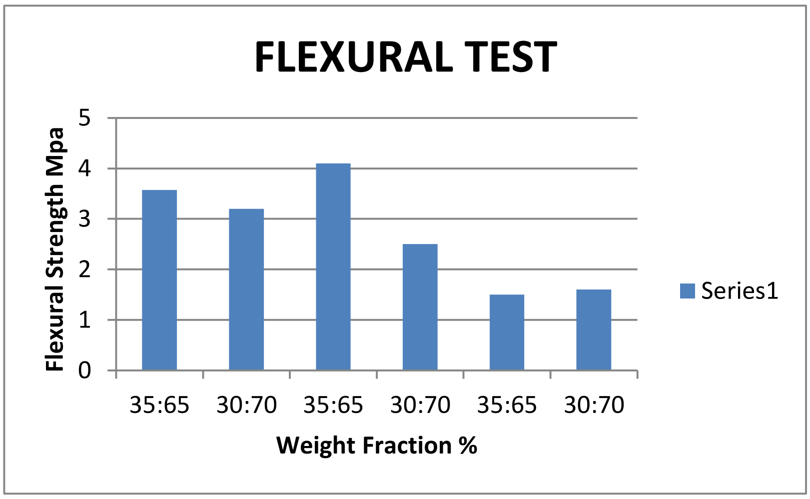


	35:65	30:70	35:65	30:70	35:65	30:70
Series1	40.61	36.54	24.7	10.7	15.21	24.07

3.2. Flexural test.

The flexural test was performed by the three points bending method according to ASTM D 790-03, and cross head speed of 1 mm/min. Four specimens were tested, and the average was calculated. The specimen was freely supported by a beam, the maximum load was applied in the middle of the specimen, and the flexural modulus is calculated from the slope of the initial portion of the load deflection curve. The first samples gave good results when compared with the other samples. To improved chemical bonding and helped to withstand high tensile load by the composites made of them. To compare other ratio the first sample gave better tensile strength.

Table:3 Flexural Vs Weight Fraction



IV. CONCLUSION

The mechanical behaviour of basalt fiber reinforced pu composites was studied. From the close results obtained for pu composites with fiber & resin ratio 35:65, and CHOPPED BASALT fibers, it can be concluded that shortest ratio fibers have good adhesion with the polyurethane resin for tensile properties. . In addition, the composite with chopped basalt fibers exhibited a same ratio good adhesion with higher flexural strength and then shear strength also good adhesion of the basalt fibers. It can be concluded that CHOPPED BASALT fibers is necessary to get composites with moderate mechanical properties as well as better adhesion between fibers and matrix.

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