MECHANICAL CHARACTERIZATION OF BASALT AND GLASS HYBRID COMPOSITES

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Abstract : This examination concentrated on flexural, tensile, compression, impact and affect properties of plain woven basalt, plain woven glass and basalt-glass polyester cross breed composites fabricated utilizing hand lay-up strategy with various layering game plan. It was observed that, the hybrid composites indicated transitional pliable and flexural properties between plain basalt and plain glass polyester composites while for affect properties for cross breed composite demonstrated higher incentive than plain basalt and plain glass polyester composite. Moreover it was noticed that by controlling the stacking grouping in different sequences mechanical properties can be moved forward. This study has been undertaken to investigate the determinants of stock returns in Karachi Stock Exchange (KSE) using two assets pricing models the classical Capital Asset Pricing Model and Arbitrage Pricing Theory model. To test the CAPM market return is used and macroeconomic variables are used to test the APT. The macroeconomic variables include inflation, oil prices, interest rate and exchange rate. For the very purpose monthly time series data has been arranged from Jan 2010 to Dec 2014. The analytical framework contains**.**

Keywords: Basalt fiber, Glass fiber, Hybridization, stacking sequence, Mechanical Strength.

Introduction: Composite involves diverse materials with particular properties to make a prevalent and exceptional material. Composites are gathered by fortification or by sorts of network in which fortifications are stack conveying component though lattice material help them to keep in wanted area and progress toward becoming burden exchange medium amongst support and grid. Fiber fortify composites are picking up enthusiasm for different application, yet their development is restricted because of durability. Hybridisation of fiber is a way to deal with influence composites to toughen by joining diverse sort of fiber and these hybrid composites offer great mechanical properties contrast with non hybrid composites. Blending of fiber in unit network, hybrid fiber strengthened composites offer extensive variety of mechanical properties. Hybrid composites have a few three fundamental favorable circumstances over composites which made of utilizing one sort of fiber support. To begin with, they furnish new freedom to planner with some one of a kind properties. Second, powerful cost usage of costly filaments can be gotten by mostly swapping them to slightest costly strands. Third, they give assorted mix of mechanical properties like pliability, quality and firmness. Additionally, half breed composites are weight sparing, change of fractural sturdiness, diminishment in score affectability, great effect opposition, longer weariness life contrasted with composite which made of single fortification. With propel increment in utilization of polymer strengthened alongside engineered fiber has prompt extraordinary request in field of barrier, car, sport zone and so on. The purpose for is advancement of cost adequacy of structures and parts to accomplish top estimations of mechanical quality and firmness . Manufactured strands (Glass, Kevlar, Carbon, Nylon and so forth.) are fundamentally utilized for making composites, yet these filaments are not condition well disposed. As of late there is huge development in condition mindfulness and new direction supported the utilization of strands which are condition cordial [6]. Along these lines, Basalt fiber is taking as an essential fortification for this examination. Basalt shake is a thick, hard, molten shake, which is hard volcanic magma. Basalt rocks have 52.8% of 2, 17.5% of 2 3, 10.3% of 2 3, 8.59% of CaO, 4.63% of MgO, 3.34% of 2 3 and other synthetic structure like 2 , 2, 2 5, MnO, 2 3. Basalt fiber can be produced using basalt by liquefying and extrusion process in a solitary advance. Basalt fiber offers comparable execution to S-2 Glass Fiber and furthermore cost of the basalt fiber is in the middle of cost of S-2 glass and E-glass Fiber. Basalt fiber is a backup of steel and carbon fiber having low lengthening and high unbending nature [7]. Basalt fiber has a few properties like High Tensile Strength, Good consumption obstruction, Dimensional Stability, High Heat Resistance, Fire Resistance, Excellent Fiber-Resin Adhesion, Good Thermal Conductivity, Good Chemical Resistance, Durability, Do not contain different added substances, Larger strain to disappointment, Non-poisonous . Be that as it may, one noteworthy hindrance of basalt fiber is it has higher cost contrast with E-glass fiber. With the goal that taking E-glass fiber is an optional fortification for this examination is a decent decission, this reason as well as E-glass fiber demonstrates some great mechanical properties also. There are less writings which demonstrate hybridization with basalt fiber have explored on debasement of Glass-Basalt with epoxy sap in seawater and they demonstrated that hybrid material encounters some physical harm or irreversible compound corruption while hybrid composites put in the ocean water for long time have researched about mechanical characterization on hybridization of Basalt-sisal-glass filaments and they gave result that consolidating sisal-basalt strands gives great execution contrast with sisal-glass strands, accordingly sisal-basalt-epoxy can be best blend for air ship basic applications. Thickness, youthful modulus and rigidity of basalt fiber can increment by utilizing polypropylene pitch rather than the most composites likewise these composites are extraordinarily helpful for aviation or defensive layer structure application. There are various investigations accessible on the mechanical portrayal of cross breed composites in mix with E glass, for example, carbon filaments , sisal , caraua , coir, Jute , banana and hemp , bamboo strands. The constituents of a composite, for example, filaments and grid, impact the components working in the composites all through stacking, harm advance, disappointment writes and in the long run the quality. Mechanical conduct of hybrid fiber composites

relies upon substance of fiber, weight and volume part of support, L/D proportion and introduction edges of strands, distinctive sort of filaments, concoction treatment of fortification, stacking successions and numerous others . Composites containing transversely and arbitrary situated strands demonstrates lesser mechanical properties than longitudinal arranged composites, yet woven texture tangle indicates higher mechanical properties contrast with other.The point of this investigation was to create woven basalt-glass polyester mixture composite with eight diverse sort of stacking succession of woven fiber and to think about their impact on ductile, flexural and affect properties.

METHODS AND MATERIALS USED

Hybrid composite specimen preparation

Woven basalt fiber and woven glass fiber of 10 mill bidirectional fabric and weight 20 GSM as a reinforcement and epoxy resin as a matrix are used to manufacture the hybrid composite each of six layers . Woven basalt tangle and glass fibre secured from Anand composites. pvt. Ltd. hyderabad, India was utilized as fabrication. The grid material comprises of Polyester Resin, Methyl ethyl ketone peroxide (MEKP) impetus and cobalt Nitrate quickening agent was utilized. Figure 1 and 2 separately demonstrates woven basalt fiber and woven glass fiber which were cut with require measurement (300mm x 300mm). The elastic properties of woven filaments were tried utilizing IS 1969 which are uncovered .

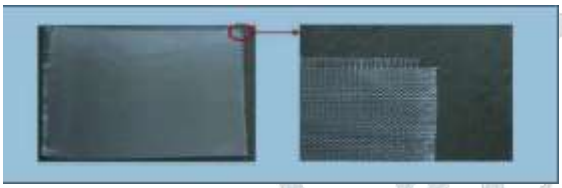

Figure: woven glass fiber

Figure: woven basalt fiber.

Utilizing the hand lay-up procedure plain Basalt-polyester, plain Glass-polyester and Basalt-glass-polyester cross breed composites with six different stacking groupings were made-up with 3 mm thickness. The framework material comprising of unsaturated polyester, quickening agent and impetus in the proportion of 1:0.03:0.012. Put woven Basalt Fiber or E-glass fiber according to the stacking grouping and apply grid material on each layer of texture with the assistance of Brush which was utilized for constraining Resin into Fabrics. Composite was restored for 8-10 hours at room temperature. A similar method was more than once took after to make other composite according to various stacking arrangements. The detail game plans of stacking grouping are appeared in table 2.

Details of stacking sequence arrangements

Specimen no.	Stacking sequence
1	BGBGBGBGBGGB
2	GBGBGBGBGBBG
3	2G2B2G2BG2BG

Mechanical characterization of composite material

Tensile Test

Tests for pliable test were cut into the composite covers by utilizing VMC (Vertical Machining Center). Tests were performed on Universal Testing Machine (demonstrate:- L arrangement H50KL, cross head development:- up to 1100 mm, limit:- 5 tons) at a consistent cross-head speed of 5 mm/min according to D638 ASTM standard. Tests were set between the grippers and pulled until ultimate tensile strength. Five examples to every composite overlays were tried according to D638 ASTM standard and afterward mean of the outcome was noted. Figure 3 demonstrates the trial setup for pliable testing.

Figure: Experimental setup for flexural testing

Flexural testing

The flexural test was performed on rectangular examples which were cut from composite cover utilizing Universal Testing Machine according to ASTM D790. The flexural test was started by stack applying at the focal point of example with the particular rate and the diversions were estimated and then mean of that outcome was accounted for. Figure 4 demonstrates the test setup for flexural testing.

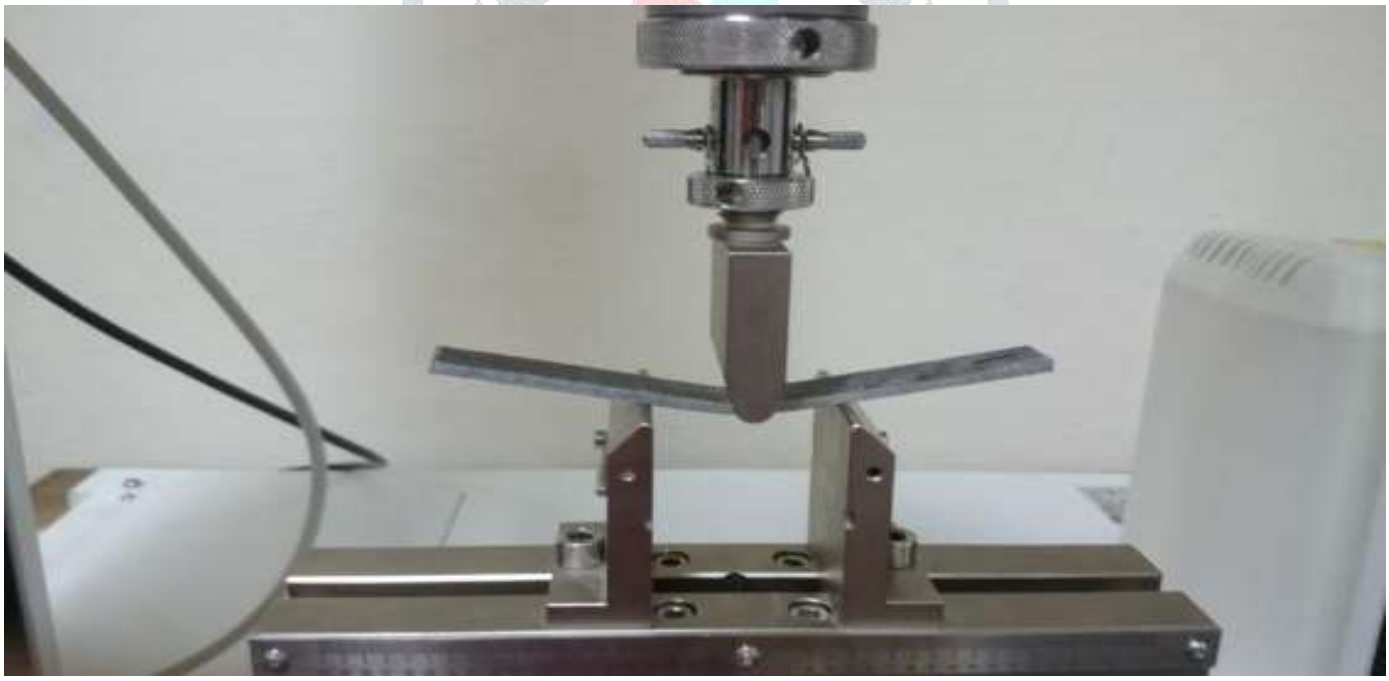

Figure: Experimental setup for flexural testing

Impact testing

The impact response of basalt and glass hybrid composites was performed to know for how much measure of vitality used to break specimen. An indent Izod testing machine was utilized for estimating the breaking load according to ASTM D256. three examples for every stacking arrangement were inspected and the mean of the esteem was accounted for. Figure 5 demonstrates the exploratory setup for affect testing.

Figure: Izod impact testing machine

Compression Test

This test determines in-plane compressive properties by applying the compressive force into the specimen at wedge grip interfaces. ASTM D256 is most appropriate for composites materials reinforced by high-modulus fibers including tape and textile, but other materials may be tested. The Specimens should have a uniform rectangular cross section, 140 mm to155 mm (5.5 in to 6 in) long. The recommended width can be 12 mm (0.5 in) or 25 mm (1 in).

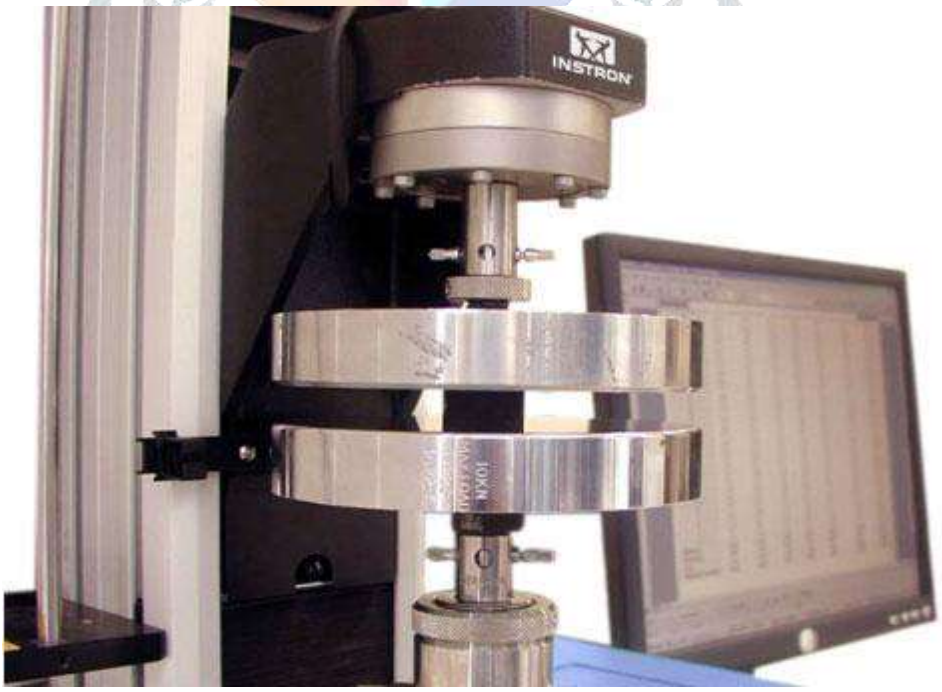

Figure: Experimental setup for compression test

RESULTS AND SPECIMEN ENHANCEMENT

Effect of stacking sequence on tensile test

Elasticity and tractable modulus for different composite examples are appears in Figure 6 demonstrates how elasticity changes with various layering course of action. It can ready to be seen that plain basalt polyester composite shows higher elasticity

contrast with plain glass polyester composites. Having diverse course of action of basalt and glass fiber indicates distinctive outcome in that we have seen that the estimation of elasticity lies between 246.2 MPa to 292.6 MPa, which is more noteworthy than plain glass polyester composite however littler than basalt polyester composite.
Six basalt layer at focus i.e BGBGBGBGBGGB layering course of action gives higher elasticity contrast with other half breed composites since basalt fiber has higher modulus than glass fiber.

Table tensile results of the enhanced stacking sequence

sequence	Max load(N)	Load at break(N)	Tensile stress(MPa)	Modulus(MPa)	Tensile strain at break(mm/mm)
BGBGBGBGBGGB	12470.7	12460.72	415.69	10228.62	0.07167

Effect of stacking sequence on flexural test
Table below shows the flexural strength and flexural modulus of stacking sequence which has maximum strength of all the composite specimens.
Flexural quality changes with various layering game plans appeared in fig.. It is unmistakably observed that plain glass polyester composite has higher flexural quality contrast with plain basalt polyester composite. Composite with the layering course of action of BGBGBGBGBGGB demonstrated higher flexural quality contrast with other hybrid composites. It was unmistakably seen that higher flexural modulus of half breed composite H3 (BGBGBGBGBGGB) indicates higher flexural modulus(24233.98 MPa) and lower flexural modulus of hybrid composite H1 (GBGBGBGBGBBG) indicates bring down flexural quality .

Table: flexural results of the enhanced stacking sequence

	Specimen label	Maximum Load (kN)	Maximum Stress (MPa)	Flex Modulus (MPa)
1	BGBGBGBGBGGB	0.82	453.17	24233.98
Mean		0.82	453.17	24233.98
Standard Deviation		-----	-----	-----

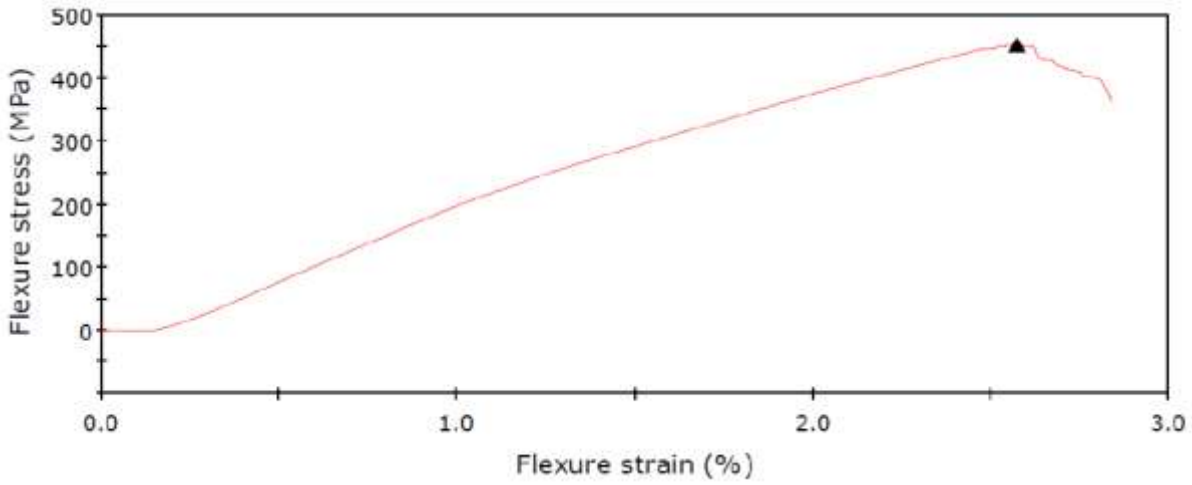

Figure: typical stress-strain curve showing flexural strength.

Figure: specimen failure.

Effect of stacking sequence on impact test

Table and figure below demonstrates that how the effect with various layering plans which completed with Izod affect test. Effect quality of plain basalt polyester composite gives higher esteemation contrast with plain glass polyester composite.On account of effect quality, composite with layering course of action of BGBGBGBGBGGB indicates higher incentive toughness of 7.46 than plain basalt polyester composite while other half breed appears middle of the road conduct between plain basalt and plain glass polyester composite. The lowest impact esteem was observed with stacking sequence GBGBGBGBGBBG(5.8) toughness.

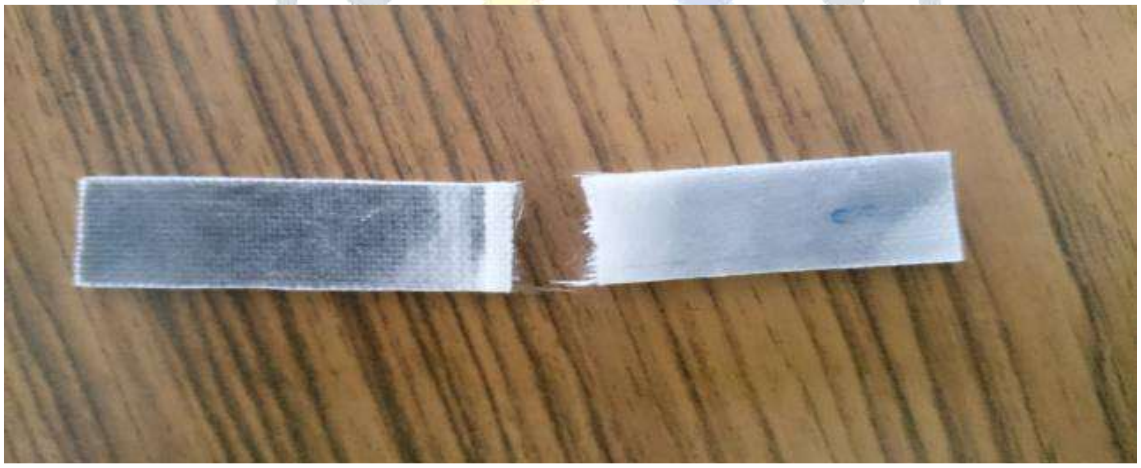

Figure: failure of specimen after undergoing impact test.

Effect of stacking sequence on compression test

The table below demonstrates the effect with various stacking arrangements which completed with UTM testing machine. Compression test was conducted on each sample specimen showing the stress-strain results. It was clear that the higher incentive modulus compression for the layering arrangement BGBGBGBGBGGB is noted as 3879.93MPa when compared to other stacking arrangements.

Figure: specimen after compression test.

Table: results of compression test for the enhanced stacking sequence.

	Specimen label	Maximum Load (kN)	Compressive Stress (MPa)	Modulus (Automatic) (MPa)	Test Date
1	BGBGBGBG BGGB	3.92	31.02	2473.85892	13-7-18
Mean		3.92	31.02	2473.85892	
Standard Deviation		-----	-----	-----	

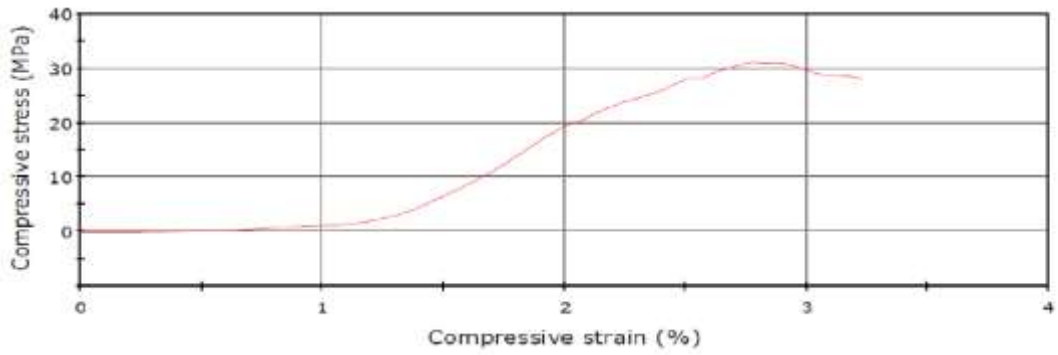

Figure: typical stress-strain curve showing compressive strength.

CONCLUSION

The effect of stacking sequence on tensile, flexural and impact properties for basalt-glass polyester hybrid composites was investigated in this study. Hand lay-up method used to fabricating basalt-glass polyester hybrid composite.
For tensile and flexural properties, the hybrid composites showed intermediate properties between plain basalt and plain glass polyester composites while for impact property hybrid composite (BGBGBGBGBGGB) showed higher value than plain basalt and plain glass polyester composite.

In order to obtain good tensile strength for basalt-glass hybrid polyester composites, there must be six basalt fiber layers at centre arranged as BGBGBGBGBGGB stacking sequence gives maximum tensile strength.
In order to obtain good flexural strength for basalt-glass hybrid polyester composites, there must be basalt fiber layer at extreme places as BGBGBGBGBGGB stacking sequence gives maximum flexural strength.

To get maximum impact strength for basalt-glass hybrid polyester composites, BGBGBGBGBGGB stacking sequence gives maximum impact strength..

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