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Effect Of Filler Material On Mechanical Properties Of Hybrid Composite Material

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Abstract: 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. This work was intends to develop a eco-friendly hybrid reinforced composite material using Jute and E-glass fibers with fly ash filler material. The effect of filler materials on the static, dynamic and wear properties has been investigated. It was found that as the percentage of fly ash is increased there is considerable decrease in the tensile and flexural strength but an incremental improvement in the hardness of the material. Dynamic analysis was carried out in order find the natural frequency and mode shapes for material. Wear test were carried out at room temperature and at constant speed and time and by varying the load. Scanning Electron Microscope (SEM) analysis was done on the surface of the fractured tensile specimens in order to analyze is the performance of the hybrid composite material with fly ash as filler material.

Index Terms - FRC, E-glass, Jute, fly ash, SEM.

I. INTRODUCTION

This is sample paper format only please use this format and follow this structure as per your requirement Composite are materials containing two are more physically dissimilar and mechanically inseparable constituents exist in different phases. The concept of composite is however not really a new to the mankind more then three thousands years itself. Eygeptian people built walls from composite bricks consisting of mud and straw as the reinforcement. Around 1200 AD Manglions developed a bow using animal glue, bone and wood as composite constituents, the advantages of the composite material is said to be the light in weight, better strength, good corrosion resistance and durable. There is an increase in the applications that are found in fibre reinforced composites because of variety of different fibres/ resin system is available to the engineers and researchers. The main advantage of these composites are low density, high strength. These composites are used in specific applications where high cost and brittle failure are considered to be secondary aspect. The newer materials has brought new prospects for the researchers and designers out of which carbon fibre and its derivatives have better stiffness and strength. By having more then one type of fibres in a resin system can form a hybrid composites, these will have the combined advantage of individual fibres and these can also modify the undesirable properties of the material to some extent. Hybrid composites are mainly used in commercial aircraft structure, in these aircrafts special emphasis is given for safety and weight. The matrix material used will limit the use of polymer composite materials are only for low temperature applications (<1150C). The hybrid composites are used for pilot's cabin door for the aircraft and now this can be used for some the transport vehicles. Hybrid composites made out of boron/graphite were initially used in fighter aircraft components. Since the natural fibers are available abundantly, less cost, eco friendly, environmental friendly,

light weight hybrid composites with natural fibres can used where lesser modulus of elasticity are acceptable.The reinforced composites have failed in case of a temperature gradient in applications like automobiles, military aircraft. This problem can be overcome by adding some filler materials in low proportions which may vary the thermal properties of the reinforced composites without comprising in the strength of the material

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II. LITERATURE REVIEW

Anilkumar H.C[01] has done the survey and they have found out the effect of particle size of the fly ash on the mechanical wear properties of fly lung burning ash reinforced aluminium alloy (Al 6061) composite specimens, prepared by stir casting path and figured , the tensile strength, decreased with increase in particle level reinforced fly ash, Just as well as studied the effect of embrace the content of fly lung burning ash on mechanical properties ofeutectic Al-Si alloys and concluded that with increase in content of travel ash, ultimate tensile yield strength increases by almost 44%.

Deepak Singla[02] he studied about the Metallic composites, which show significantly improved properties like better tensile strength, toughness, firmness, low density and good tribiological properties compared to alloys or any other type of monolithic materials. Travel ash is one of the most inexpensive and low density reinforcement available in large quantities as waste product during burning of coal in arctic power plants as well as Al 7075 as reinforcement are likely to over come the cost barrier as well as different physical and mechanized properties are improved and can be used in the automotive and aerospace applications.

Sankar.L[03] he had worked on aluminum-fly ash composites in automobile clutch plates, they used aluminum LM6 as matrix material with various weight percentage of fly ash (5%,10%,15%) and they investigated mechanical behavior and micro structure of al-fly ash composites and also they added the Mg to reduce the surface tension.

Finally they come up with the conclusion that this composite reduces the wear resistance in clutch plate and also it possess the less coefficient of friction so we can replaced existing metal clutch plate with this composite clutch plate.

R.Satheesh Raja[04] has investigated the significance of using fly ash as a filler material in polymer and particulate composites. The chemical composition and particle size of the fly ash will have a very important role in improving the physical and mechanical properties of the hybrid composite materials. In this article they used 4 lengths of fly ash (50 nm, 480 nm, 350nm, 300 nm) with 12 % weight ratio was added with epoxy resin to process the composite material by using a mould. They carried out tests like hardness and impact test they found that with 300nm fly ash powder provided the better impact strength and hardness compared to other two weight ratios. Thus by reducing the size of the fly ash can improve the bonding with epoxy.

III. METHODOLOGY

. 2.1. Materials

High performance epoxy resin LAPOX L12 with the curing agent K6 hardener were used as the matrix. Bi-directional E-glass fiber and Jute fibers were used in making the hybrid composite material. The hybrid composite material with different proportions of filler material like fly ash has been prepared by hand layup technique . The weight ratio of 10: 1 was maintained for epoxy and hardener. The specimens were prepared according to ASTM standards.

2.2 Tensile Test

Tensile test is one of the fundamental test of an engineering. These tests are been conducted to understand the different properties of different material and how they will behave under the loading conditions. The properties can be used in order to design and analysis of engineering component. The new material that is used for specific use with these test mechanical properties like Young‘s modulus , ultimate strength and percentage elongation can be found out.

2.3 Flexural Test

The strength of a material subjected to three point bending is determined by flexural test. In this test bending strength of material before rupture is determined. The results may vary in the specimen due to change in strain rate and loading geometry.

2.4 Hardness Test

The hardness of the material in the Rockwell scale is found out from the indentation and by measuring the penetration depth under heavy loads. The Rockwell hardness is the non dimensionless no and hence denoted by HRA,HRB, HRC etc.

2.5 Natural Frequency Test

Most of the structural components are been subjected to dynamic loading under these loading conditions the components have to perform under a dynamic environmental conditions. From which most of the fracture results are due to vibration. The dynamic analyzer consists of computer, accelerometer, data acquisition system, amplifiers, modal hammers. With the help of a impact hammer the specimen is said to excited at selected point manually and the resulting vibration of the specimen in a selected point is measured by accelerometer. Bee wax is used to mount the accelerometer on to the specimen and the signal is passed to the analyzer where frequency spectrum is obtained. Frequency response will be analyzed and the output from the

2.6 Wear Test

The progressive loss of the substance from the body due to relative motion is known as wear. Thus it is also referred as the removal of material from the surface of one body which is in relative motion with the other and due to mechanical or chemical action. The samples which are fabricated out from the hybrid composites are subjected to varying load conditions by keeping speed and time constant. The wear set up with specimens is shown in fig.1. The SEM micrographs of hybrid composite materials with different % of fly ash has been studied.

2.7 SEM analysis for hybrid Composites with different % of fly ash filler material

Themain intentions of studying the SEM micrographs are to understand the failures of materials at laboratory level and detail

investigation into in-service component. The basic approach is to characterize the fracture morphologies of specimen failure under known failure modes. One of the major issues of laminate composites is delamination. The delamination failure resistance of the material is influenced by a number of factors such as moisture, temperature, fiber orientation and even cracks

length

Fig.1. Wear test set up with specimens

Sl No	Description	Units	Details
1	Speed	Rpm	100 to 2000
2	Normal load	N	4 to 200
3	Friction Force	N	0.11 to 200
4	Wear	mm	±2
5	Wear track diameter	mm	10 to 100
6	Sliding speed	mts/sec	0.4 to 9.8
7	Preset timer	Hr/min/sec	98/58/59
8	Pin size	mm	4,5,6,8,10
9	Wear disc		EN 31 Steel

Sl No	Item	Specifications
1	Test Rig	Pin on disc TR-20-PHM-CHM-600
2	Controller	Electronics controller
3	Software	Winducom 2010
4	Computer	Pentium 4, 512 MB, 2GB.

Table 1 Wear rest rig specification and instrument used for wear test

IV. RESULTS AND DISCUSSION

The reinforced hybrid composites using Jute and E- glass with Epoxy with different percentage (5%, 10% and 15%) filler material like fly ash powder was prepared by using hand layup technique. The experiments are carried out to understand tensile, flexural and hardness (RHN) behavior of the above said material.

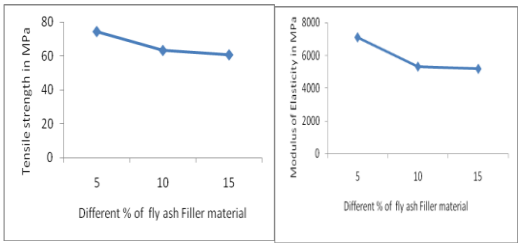

Fig. 2 Variation of Tensile strength and Young‘s modulus with different % of fly ash powder

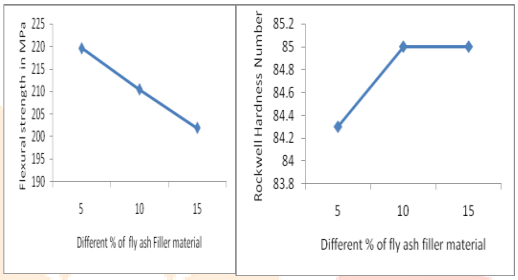

Fig. 3 Variation of Flexural strength and hardness with different % of fly ash powder

It is evident from Fig.2 and 3 that there is an decrease in the strength of the material as the % of fly ash is increased. This is because as the % of fly ash is increased the % of fiber is getting reduced that reduces the strength of the composite material. But there is an increase in the hardness of the material as the percentage of fly ash is increased this is because of hollowness of fly ash and the strong interfacial energy between resin and fly ash.

4.1 Dynamic Characteristics of reinforced hybrid composites using Jute and E- glass with 5%,10% and 15% of fly ash as the filler material

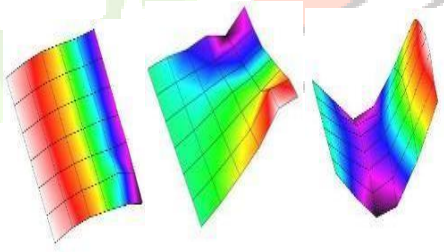

Fig. 4 Different Mode shapes

Table 2 Shows dynamic analysis results for the different % of fly ash powder

Sl. No	% of Fly ash	Ist Natural Frequency (Hz)	IInd Natural Frequency (Hz)	IIIrd Natural Frequency (Hz)
1	5	39.15	186.52	250.9
	10	37.45	163.8	243.05
3	15	35.73	142.72	189.5

Fig.4 shows the mode shapes, which helps in finding the suitable constraints for the structure to prevent failure in case of resonance. Also it helps in identifying the weaker zones along with the direction of weakness which gives the idea for improvement for the designers. Also from the observation of mode shape one can decide the direction of constraint required along with suitable thickness for the problem. Even though natural frequencies are unique, the mode shapes are not unique and does not represent actual deformation values. No damping is considered in most of the modal analysis to avoid the complexity.

4.2 Wear Characteristics of reinforced hybrid composites using Jute and E- glass with 5% Fly ash as filler material

Wear test has been conducted for Jute and E glass with 5% fly ash powder for different loading conditions at constant speed of 300 rpm for 15mins. The variation of wear strength is shown in figure 5

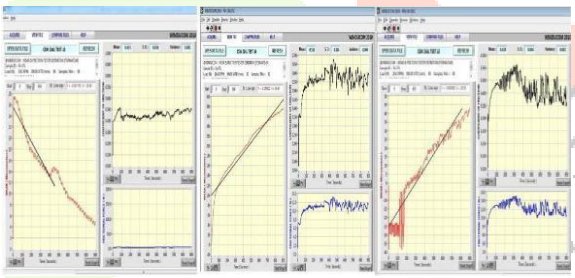

Fig 5 Variation of wear strength

Table 3 Weight loss , co-efficient of friction and Friction force for hybrid composite with Fly ash powder

SAMPLE ID	% of Filler	LOAD IN N	INITIALWT(gm)	FINAL WT (gm)	WT LOSS	Max Co-efficient of Friction	Frictional Force (N)
JUTE +EPOXY+E-Glass+ Fly ash powder	5	10	7.65812	7.65000	0.00812	0.44	4.53
		20	7.69236	7.59884	0.00352	0.39	11.16
		30	7.69967	7.69536	0.00431	0.42	12.6
	10	10	7.77655	7.77453	0.00202	0.338	4.12
		20	7.53290	7.52546	0.00744	0.334	9.02
		30	7.73043	7.72607	0.00744	0.366	12.03
	15	10	7.52482	7.52148	0.00334	0.374	4.75
		20	7.53159	7.52128	0.00031	0.421	7.58
		30	7.59357	7.57621	0.01736	0.384	13.2

The tribological properties of the hybrid composite with different % of filler material like fly ash have been studied. It was found that as the % of fly ash is increased the co-efficient of friction is getting increased and hence there is a considerable increase in the wear strength. For 15% fly ash wear rate and weight loss has reduced considerably.

4.3 SEM analysis for reinforced hybrid composites using Jute and E- glass with 5%,10%,15% fly ash powder as filler material

Fig.6 shows the fractured tensile specimen of hybrid composite with 5% fly ash as filler material at 100µm magnification. It can be seen from the figures that the fibers are detached from the resin surface due to poor interfacial bonding.The Fig.6 shows the fractured tensile specimen at 200µm magnification of hybrid composite with 10% fly ash as filler material. It was observed clearly the presence of air voids with more concentration of epoxy at some location.

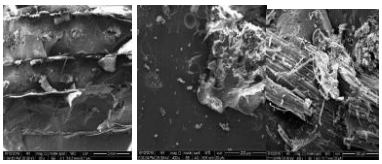

Fig.6 Tensile fracture for hybrid composite with different % fly ash powder

This is because of the uneven distribution of fiber and epoxy at some point in the specimen. The fractured tensile specimen of hybrid composite with 15% fly ash as filler material at 200µm magnification . It was observed that fibers are properly aligned in the epoxy and in some areas the air gaps are present is also clearly visible. Due to the presence of air gaps the strength of the hybrid composites will reduced

C**onclusions**

- Fabrication of multilayered hybrid composite using Jute/E-glass epoxy with different filler material is successfully carried out by hand layup technique. It was found from the studies that properties such as mechanical and physical is greatly affected by fiber type, Orientations and type of filler material.
- It is evident from the studies that as the % of filler material is increased there is a substantial decrease in the tensile and flexural strength of the material but the hardness has improved considerably. It was found from the wear test that as the % of fly ash is increased, the wear strength is increased and it was found that for 15% fly ash wear rate and weight loss has reduced considerably.
- Micro structure of the above said composite is observed using Scanning Electron Microscope. The fracture surface shows the presence of air voids and debris. Due to increase in the load the surface has damaged which is caused due to failure of fibers and epoxy which resulted in the separation of the fibers.

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