Characterisation of Mechanical Behavior in Aminosilane Surface modified nano Silicon Natural Kenaf and Glass Fiber Reinforcement of Epoxy Hybrid Composite material

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Abstract- The main objective of our work is to perform and to analyzed the mechanical behaviors of kenaf and glass fiber using various mechanical tests such as strength, hardness and many other properties which helps to apply in various industrial and mechanical oriented applications. In this research, Kenaf is separated as treated and untreated composite materials. The kenaf is dipped with the mixture of ethanol and silicon di oxide which is known as treated process and the non-dipped kenaf is known as untreated process. The plates are arranged in the form of 2 kenaf layers and the glass fibre is inserted in the middle, it is molded with the help of epoxy resin. Then each plate are separated with silicon of 1%,2% and 2.5%. Then various tests such as flexural, tensile, impact are being performed and noted as treated and untreated values .The resulting values are plotted in the form of graph which will be easy for the comparision of treated and untreated materials. By finding these ratios, it helps in the replacement with other material properties. So we conclude that our aim is to test and compare both treated and untreated plates to find their properties and applications.

Keywords – Kenaf fibre, Glass fibre, Silane, Siline, Epoxy resin

I. INTRODUCTION

Glass fibre, which is a material with various Mechanical properties. It is also one of the fibre reinforced composite material combined with kenaf. These combination results to show their better than the individualone.Its major role is to achieve more strength and capacity to carry over the load, light weight for the corrosion resistance. Glass fibre normally exists with long life span, under various conditions it ensure itself to high tensile, impact loadings, inter laminar shear strength and acts as low penetration to the hardness. During long time use, it is not easy to obtain critical stresses and minor cracks on the smooth surface. The overall performance of these combinations looks like more inferred. Vishwas et al. [1] Besides on hybridization of the kenaf/glass fibre composites behaves with impact test, which overcomes the damaged area to be preferred for increased energy absorption. The fine kenaf and glass fibre contributes to be preserving natural fossil resources. Kishor Kumar et al. [2], By the way fracture toughness and its vibrational modal analysis, it's to be cleared that there is plenty of vibration capturing capacity is available in glass fibre. Similar to the hybridization; it also performs as high level energy to be absorbed. Jeswin Arputhabalan et al. [3], Influencing with water absorption for these reinforced composite material, it contributes extremely fine fibre compared to the other materials. However its unique feature that helps to be required conventional composites. Other than its properties, it is considered for the reduction of using alternative glass fibre layers on the composite material. Muhammad et al. [4],These physical and chemical properties like as stronger, longer, lighter, capable of replacing other materials are considering and evaluated as per the ASTM standards. These polymers are polymerized and obtained tensile and compression testing and analysis with infrared spectroscopy and scanning electron microscopy. Dapeng Wang et al [5], The flexural properties of fibres are comparatively high than the composite material. For structural application these composite materials helps in designing process and other mechanical properties. The tests have been done and evaluated and the following results

are plotted in the form of graph. The hybrid of any material such as kenaf or a glass fibre helps in increase in transverse as well as longitudinal strength. Fouad et al. [6],As the effect of the kenaf fibre plate the fibre material and treatment of chemicals on the tensile response of thermoplastic fibre metal laminates are being investigated. Overall the treated and untreated laminates given show the higher tensile and flexural value of strength and modulus of treated and untreated laminates. The investigation of tensile performance of the laminates gives different orientations and number of fibre layers. Parthipan et al. [7], Based of scanning electron microscope observation it was found that impregnation significantly helps to enhance the compatibility of kenaf and glass fibre, Apart from mechanical properties the advantage is reflected in the reduction of energy consumption and environmental impacts. The SEM observation revealed greatly improved interface compatibility between kenaf and glass fibre. Noor Azammi et al. [8], The fibre volume fraction are manufactured by the process of resin transfer moulding. The lamination process is being tested for strength and modulus factor under tensile test and modulus under tensile and flexural loading. The similarity between the kenaf and glass fibre lamination process shows as the tensile and flexural modulus is compared with the volume factor of 15%. Ramesh et al. [9], The major effect of the fibre hybridization and arrangement helps along with the loading axis and helps to know about the flexural dynamics and statical properties. The aim of our process is to analyise the effect of the hybridization and configuration process on the mechanical dynamic factor and static flexural properties of kenaf and glass fibre composite. This implies the reliability and strength of the material. Savitha et al. [10], Kenaf plants are usually harvested for several times in a particular year which depends upon the source of the plants. The yield and work of these plant components are affected by various factors by both natural and artificial method. It also helps in reducing the wastage of composite material and helps to develop a healthier environment. Rassamann et al. [11], Epoxy based hybrid Nano composites is prepared by dispersing different Nano particles and composite material. The increase of value in the dynamic mechanical properties and kenaf material of epoxy hybrid composites material are relatively higher than any other material. It shows a high possibility in the rate of advanced light weight structure. Saba et al. [12],The purpose of this research is to develop more kenaf composites and glass reinforced hybrid composite materials. The damage progression of the two materials is similar. The kenaf and glass hybrid composite materials are fabricated successfully using the combination of two methods namely layup method and cold press method. The polymer matrix may get failed with a whole and cracking sound in initial method. Salleh et al. [13], The Mechanical properties of kenaf fibre polypropylene composite material have been elaborated. As for the mechanical and physical testing which are normally performed towards composites material such as high force tension. Explorations on kenaf fibre reinforced composites have created more influence among the research due to some of the ecological factors. SadiaMahzabin et al. [14], The Kenaf material is one of the natural fibre used for reinforcements in case of polymer matrix. Kenaf is one of the important sources of fibre which is used as a composites. In overall bout 35% of kenaf is known as best fibre which is appropriate for paper textiles and industries. The morphology of bio composites was not an effected material for fibre hybridisation. NurulHidayah et al. [15],Kenaf and glass composite materials has a good power in recent development of the materials with a high strength and weight factor. The glass fibre which are fabricated by the method of compression moulding process gives good mechanical properties. The comparison charts shows the difference between tensile test, flexural tests and other modes of tests to be performed. Alias et al. [16], The coated glass fibre were hybridised with the kenaf fibre to create hierarchical composite laminates by means of hand layup and vacuum bagging method. The kenaf laminated epoxy composite by spraying process to improve the flexural and thermo mechanical properties, which helps to show the higher values. NabihahSallih et al. [17], the kenaf on the bio composite based on the water adsorption and impact properties. Both water adsorption and impact properties are found to be reliant on loading process. The increase of water adsorption percentage on bio composite as loading is been increased. Hence the impact strength of the material is reduced by continuous loading. Indra Reddy et al. [18], Higher kenaf content with lower barrel temperature result in composite sheets when compared to the high average mechanical properties in various modes and methods of testing process. The average fibre length found in this study results in final composites properties when comped to those with longer fibres which is manufactured using compression moulding machines. Haniffa et al. [19],The variation within the theoretical and experimental values of the tensile modulus are not considerable. The scale ratio among the reinforcement of different aspect ratios acts as control factor in various mechanical properties. The overall mechanical behaviour of the hybrid composite helps in the systematic comparison and used as parameter for optimizing the hybrid properties. Abu Bakarsulong et al. [20],An experimental study is been carried out which helps to investigate the tensile and flexural characters of polymer hybrid composite material. The tensile and flexural properties of the kenaf fibres are increased by the reinforcing action of the fibres. Hence these composite materials are used for various applications.

II. EXPERIMENTAL PROCEDURES

2.1 Material Used

The epoxy resin is used as a liquid in the treatment of kenaf fibre. The epoxy resin has a density of 1.2 g/cm^3. It is blue in colour with a kinematic viscosity of 12,000 Cps. At first two bottle of ethanol is poured in a vessel and stirred for about 10 minutes. Then 25ml of 3-Aminopropyletriethoxysilane is used added with ethanol and then stirred for about 5 minutes. Then the pieces of kenaf fibre is dipped in the mixture of chemical liquid and left for 30 minutes. The ethanol and 3-Aminopropyletriethoxysilane reacts with the kenaf fibre dipped inside. After 30 minutes the kenaf fibre is taken out and dried in sunlight for about 2 days. The kenaf mats pieces dipped are known as treated. And the other kenaf fibre mats are untreated. For SEM test the pieces of kenaf with glass fibre mats are cutted into small pieces and the SEM image of the mats are taken.

2.2 Treatment of Reinforcements

The composites of kenaf and glass fibre are fabricated into 270mm square shape plates and are cutted into the required size for tensile test, flexural test impact test and Inter laminar shear stress (ILSS). The Nano particles and kenaf fibre are treated in an oven at a temperature of 100 degree Celsius which helps to eliminate the bound moisture. Ethanol and water with the value of 95/5% are initially taken and treated for about 10 minutes. The necessary quantum of silane substance of 2wt% is in general added as drop by drop to form an uniform blend and then it is stirred for 5 to 10 minutes. The silicon dioxide and kenaf fibre are absorbed in the ethanol and water solution for about 10 to 15 minutes. Then they are taken out and washed with the help of ethanol to eliminate the excess of silane and are dried in the oven with the temperature of 100 degree Celsius to remove the moisture content in the material.

2.3 Composite Fabrication

The quantity of fibre at 50% of volume and silicon dioxide at different values of 1.0, 2.0 and 2.5 were mixed with epoxy resin at a room temperature and stimulated continuously until the process gets completed. Then the epoxy and hardener with the ratio of 10:1 is taken and stirred until it forms as a homogeneous solution. Then the compression moulding is done by applying wax over it which helps to separate the plating after the moulding process. At first two kenaffibre are placed and the glass fibre is placed in the between the two kenaf fibres. Then using compression moulding the process takes places for about 30 to 40 minutes with the temperature of 92 to 96 degree Celsius. After the fabrication process is done the plates are left to cool down for about 10 minutes and taken out.

2.4 Specimen Preparation Process

The epoxy kenaf and glass fibre silane 4 oxide particle is prepared and reinforced as shown. These composite material sheets are cutted by moulded sheets by shearing process. The abrasive water absorption is prepared by the test specimens on ASTM standards. Many test such as tensile test, Impact test, Flexural test and Inter laminar shear stress (ILSS). The further more tabulations and its properties are briefly explained below.

III GENERAL CHARACTERIZATION

3.1 Mechanical Testing

These testing are obtains properties like Tensile, Impact, Interlaminar shear strength, Hardness were carried out fully by pure ASTM standards. The ASTM standards for the tensile is ASTM D-3039 and for the flexural is ASTM D-790, and for the impact is ASTM D-256, and for the water absorption is ASTM D-5229, and for the inter laminar shear strength is ASTM D-2344, and atlast for the hardness is ASTM D-2240.Tensile test is performed using a machine called as Universal testing machine with maximum capacity load of 100KN(SR.NO. 121101) then follows by impact test which it is carried out by mini impact testing machine with maximum capacity load of 30J.Then finally all the samples are here to undergone various testing's and preferred for results. According to various ranges of silicon, the results will be changed. In terms of its properties, it will shows table no.1 its capacity and its withstands.

Table 1 Material composition

S.no	Material	Epoxy%	Kenaf & Glass%	Silicon%
1	EKG	50	50	0
2	EKGS1	49	50	1
3	EKGS2	48	50	2
4	EKGS3	47.5	50	2.5

3.2 Morphological analysis

The SEM is the process of scanning the plates to make a magnifies image consisting with the electron beam and its analysis. It is also called as a effective micro analysis. Although the solid of inorganic and organic materials and composite materials are also included to get magnified image. The two dimensional image is also fully examined. The SEM image test and magnified images are successfully carried out by the TESCAN VEGA3 machines as shown in figure.1 (a),(b).

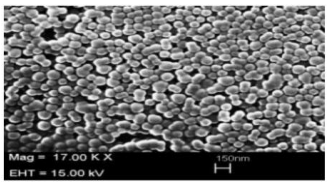


Figure. 1 a) SEM image of kenaf fiber

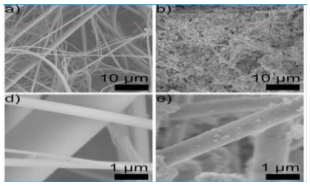


Figure. 1 b) SEM image of nano

IV RESULT AND DISCUSSION

4.1 Mechanical properties and procedure

The tensile, flexural , impact, hardness test are received and silane-treated with silicon di oxide dispersed kenaf and glass fibre-reinforced epoxy hybrid composite materials are used presented in the table 2 and 3. It is used that addition of the include and surface-modified silicon di oxide. The mechanical properties are improved in the epoxy resin fetched and kenaf and glass fibre resultant. The tensile material percentage are improvement of 53-60 above are found as a tensile strength and modulus of EKG, EKGS1, EKGS2 and composite designed. The kenaf fibre material and dispersed silicon di oxide particles are improvement of the load sharing ability are composite material. It acquired moisture particle are absorbs in the creating bonding with matrix. And other mechanical properties are improved in the epoxy resin fetched and kenaf and glass fibre resultant. The flexural material percentage are improvement of 55-62above were observe flexural strength and modulus are EKG, EKGS1, EKGS2 and composite designed. It silicon di oxide particle are continuous load sharing and long kenaf and glass fibre are improvement and highly compacted tested. The impact test were absorbed in silicon di oxide are kenaf and glass fibre into a epoxy resin of mechanical properties . The impact percentage and improvement of 57-65 above were observed impact strength and modulus are EKG, EKGS1, EKGS2 and composite material. It acquired moisture particle are flexural test is greater than impact test load sharing with bond matrix are kenaf and glass fibre are improvement and highly compacted test.The results for each and every tests are shown in table 2,3 and figure.3, 4.

Table. 2 Kenaf and glass fibre of untreated process

Material	Tensile strength (MPa)	Tensile modulus (MPa)	Flexural strength (MPa)	Flexural modulus (MPa)	Izod Impact (J)	Inter laminar shear strength (MPa)	Hardness (HRC)
EKG	139	6192	213	5820	4.82	33	92
EKGS1	147	6254	234	5891	4.98	37	93
EKGS2	162	6463	247	5942	5.43	42	95
EKGS3	184	6684	262	6084	6.21	48	98

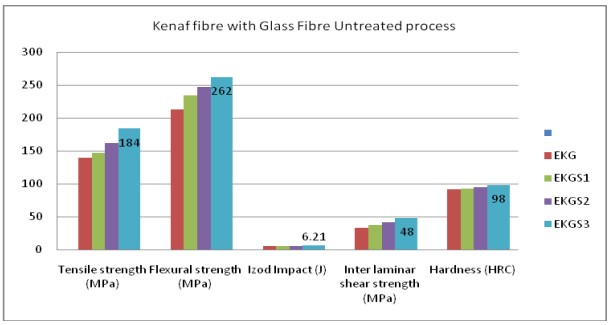


Figure.3 Kenaf and glass fibre of untreated process

Table. 3 Kenaf and glass fibre of treated process

Material	Tensile strength (MPa)	Tensile modulus (MPa)	Flexural strength (MPa)	Flexural modulus (MPa)	Izod Impact (Joules)	Inter laminar shear strength (Mpa)	Hardness (HRC)
EKG	142	6198	219	5829	4.91	34	92
EKGS1	153	6262	241	5897	4.99	38	96
EKGS2	171	6472	253	5958	5.58	44	97
EKGS3	191	6691	269	6091	6.32	49	99

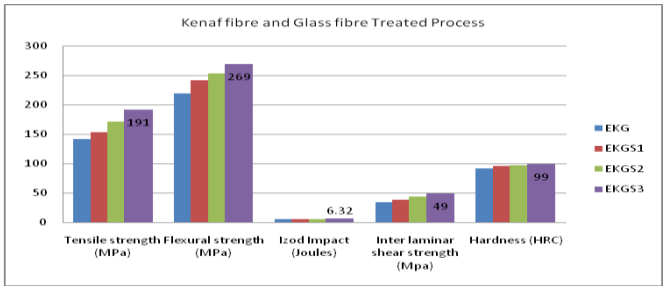


Figure.4 Kenaf and glass fibre of treated process

4.1.1 Tensile test

During tensile test, the natural glass fibre and kenaf fibre reinforced to shows the breaking load values for each and every testings. Addition with the silicon to the all the plates which will considerably increases the breakeven point. It also obtains yield stresses and also leads to the ultimate stresses. There exists there sudden elongation on the pulling up in the each of the end. The remarkable values which to shows better than the other composites. The final resultant values are obtained morphologically. For the untreated process the percentage elongation values are 1.440, 1.430 and 1.930 for each EGK, EGKS1 and EGKS2.Then its universal testing values are 39.171 N/mm², 36.307 N/mm² and 40.957 N/mm² for EGK, EGKS1 and EGKS2 respectively. The same like in treated plates are also tabulated as on the percentage elongation and its universal testing values. Which in percentage elongation value 2.430, 1.600 and 1.190 which is totally differ from untreated process. Then for the universal testing values it obtains 46.911N/mm²,37.916N/mm² and 30.882N/mm² for each EKG, EKGS1 and EKGS2.It comparisons shows the treated process as much more capable property. It completely defines there is percentage increase in the treated process. Comparing to this plates, there is 0.8%, 0.3% and 0.2% increases in the plates. The figure 5.(a),(b) are shows their each plates behaviour in its treated and untreated plates.

Figure.5 a) Tensile Untreated

Figure 5. b) Tensile Treated

Then tensile values depends on its universal values are tabulated below. Here it is clear that's the breaking load occurs on either on the both the treated and untreated plates depends upon the pulling force, which been surface has to recover to withstand its properties.

4.1.2 Impact test

The impact test that is used in determining the behaviour of the material by subjecting the material into a sudden shock. This test is used to determine to know how the material will respond to a sudden applied stress. At first the material EKG, EKGS1, EKGS2 of untreated plates are used for the impact test and the point of sudden shock were the plates are broken are noted and tabulated. In the same way the EKG, EKGS1, EKGS2 of treated plates are used in the impact test and the values are tabulated. For the impact tests, untreated process and treated process as thickness along with in the range of about to1-2mm as shown in figure 6 (a), (b). For the untreated plates of

EKG,EKGS1 and EKGS2 obtains the value of 1.15mm,1.70mm and 1.55mm.Then on the treated plates, the obtained values are 1.10mm,0.90mm and 2.00mm respectively.

Figure. 6 a) Impact Untreated **Figure . 6 b) Impact Treated**

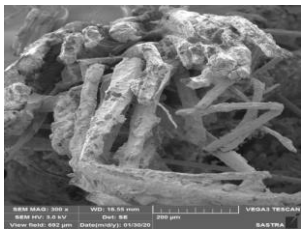
4.1.3 Flexural test

The Flexural test is employed which helps to measure the bending of the material. It helps to refer to the material resistance and permanent indentation. At first the EKG, $EKGS_1$, $EKGS_2$ and $EKGS_3$ of untreated plates are taken. The force is applied at a particular point with a certain pressure. After that the point where the force is applied is marked with the help of chalk. Then the EKG, $EKGS_1$, $EKGS_2$ and $EKGS_3$ of treated plates are taken and the same procedure is followed. Then the plates are taken and the marked area is zoomed by micro hardness test and result is noted as shown in figure. 7(a), (b).

Figure. 7a) Flexural Untreated **Figure.7 b) Flexural Treated**

4.2 Morphology Analysis

Morphological analysis scanning electron microscope helps to perform a focused beam of high energy electron which helps to generate a multiple signals on the surface of solid specimens. The plates of EKG, $EKGS_1$, $EKGS_2$ and $EKGS_3$ is undergone SEM test and the result is noted as images. The signals that are derived from the electron-sample interaction that reveal the information of the sample of external morphology and chemical composites that helps in developing the image result. The SEM is also able of performing various analyses in the selected point location on the plates for the images. The accelerated electrons present in the SEM helps in carrying significant amount of kinetic energy which helps in developing the SEM image. The SEM test is usually used to generate the high resolution in order to develop spatial variation in chemical compositions as shown in figure.8 (a,b) as untreated and treated tensile testing. And the impact test analysis for untreated and treated in kenaf glass fibre as shown in figure 8. (c,d).



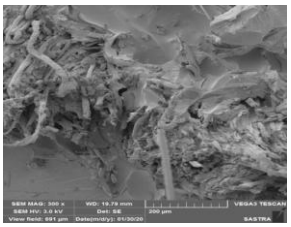
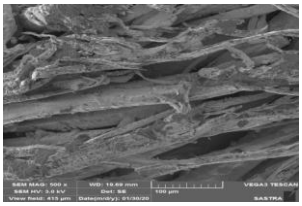


Figure. 8 a) Un Treated Tensile **Figure. 8 b) Untreated Tensile**



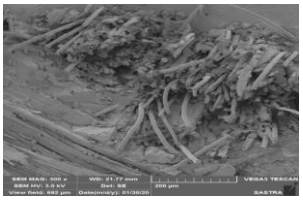


Figure. 8 c) Treated Impact **Figure 8 d) Untreated Impact**

4.3 Image Damage Analysis

The impact damage of various fabricated composite plating is shown. The droplоad of impact is separated into 3 layers such as side damage mid surface damage and penetration damage at the end of untreated composites of E and EKS3. The surface damage found on the composite EK is more than composite EKS3 this is due to the absence of load in micro mechanism. The least amount damage of the impactor receiving side of composites takes place in EKS3. The mixing of 2.5% silicon in composite matrix were it absorb high load and transfers to matrix due to the no stress intensity factor. It shows the impact damage between E and EKS3 of the penetration side damage. It shows the impact damage of treated composite designation of EKS3 in side receives damage and penetration side also undergoes impact damage. Thus the silane treated process improves the impact load phenomenon of absorbed layer composites.

IV.CONCLUSION

Materials and composites of various volume and surface activated kenaf and glass fibre and silicon di oxide reinforced epoxy composites are prepared. The tests such as impact, tensile,fluctural and hardness help in developing the mechanical properties of the kenaf and glass fibre in many ways. The fibre helps in improving the mechanical properties and also in addition of epoxy composites helped to improving the surface. The treated and untreated plates of kenaf and glass fibre silane particle helps in increase of adhesion of matrix. Thus it is suggested that even as make a high concert natural composite material used in structural and machine guard applications to performing a surface modified and silicon added hybrid composite materials.

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