Properties Of Hybrid Composites And Its Applications: A Brief Review

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Abstract from the past few decades the world depends upon the glass fiber reinforced composites. These composite materials used in so many areas like aerospace, automotive, construction and household purposes also due to their high mechanical properties. But for these composites there are some drawbacks like high cost, high density, high weight. In addition to this it have large impact on environment while preparing these fibers and their related composites. These drawbacks have been overcome by the natural fibers. The advantages of Natural fibers over synthetic fibers are low density, less weight, biodegradable in nature, less cost, recyclable, easily available and nontoxic in nature. Many researchers show interest towards natural fibres due to its advantages. Due to less cost and ecofriendly nature the natural fibers have capability to replace the synthetic fibres. This paper discusses about the mechanical properties of composites reinforced by natural fibers and factors which influences the mechanical properties of natural fibre reinforced composites.

Index Terms: Natural fibers, Processing of fibers, Hybridization, Behavior of fibers, bonding materials

1 INTRODUCTION

Hecomposite material is a product formed by combining two different materials of different chemical and physical properties. This composites material having different and higher properties than the individual materials. Composite material consists of a matrix and a fiber that maybe a natural or synthetic. Thermoplastic polymers and thermosetting polymers are used as the matrix for composites. The thermoplastic materials used as matrix are polypropylene, polyethylene and polyvinyl chloride. The thermosetting polymers are epoxy and polyester resins. The role of matrix is that it is used to protect the fibers from environment and acts as a load transfer media between the fiber and the matrix[1]. Now fibers are hair like material which are continuous longitudinal filaments. These are similar in the form of threads. They can be spun into threads, ropes etc. They can also be mated into sheets. The fibers used for composite materials are maybe natural or synthetic fibers. Synthetic fibers used are carbon, glass and aramid etc. There are so many natural fibers used for composites. Initially the composites are prepared by using synthetic fibers mainly using glass fibers because of its cost is lower than the other synthetic fibers and it's mechanical properties. Due to the disadvantages of synthetic fibers like higher density, higher cost, non-biodegradable nature, higher consumption of energy and hazard to human health etc. But nowadays researches and industrial applications are shifted to natural fibers due to their attractive properties than the synthetic fibers. These natural fibers cheap, renewable, recyclable, biodegradable and easily Plants such as jute, hemp, pineapple, sisal, ramie, abaca, banana, kenaf, bamboo etc. are the most used natural fibers for composites.

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Due the advantages of natural fibres like renewability, low density, availability as well as price make them an alternative to synthetic fibers. The main drawback of natural fibers is moisture absorption and less adhesion to matrix. The bond between the fiber and the matrix is responsible for better mechanical properties. If the bond is strong the composite should have good mechanical properties. Surface treatment is one of the methods which improves the bond between fibre and matrix. By this treatment the impurities present on the surface should be removed and the properties of fibers and the composites is increased [1,2]. In some composites more than one fiber is used. Such composites are called hybrid composites. The mechanical properties of the composites also depend on the stacking sequence. Better stacking sequence of fibers and matrix produces better mechanical properties [3]. With increase in the fiber content up to certain limit less than the weight percentage of matrix the mechanical properties should be increased. The mechanical properties are improved by increase the fiber content in the composite[4,5]. The geometry of the fibre also influences the mechanical properties of composites. The composites reinforced with natural fibres are can't be used in outdoor applications because of moisture absorption behavior of natural fibres. The natural fibres have less mechanical properties than the synthetic fibres. Hybridization is one of the ways to increase the mechanical properties of composites reinforced with natural fibres[5,18,24,25]. One of the main disadvantages of natural fibers is moisture absorption. The capacity of moisture absorption increases with increase in natural fiber content. It can be reduced by chemical treatment with some chemicals like silane, NaOH and sometimes water also used. By the surface treatment the weight and diameter of fibers were decreased [6]. Natural fibers can be used industries also because of their mechanical properties and they are easily available. Hydrophilic nature is also one of the serious drawbacks of natural fibers and it reduces the bonding between the fiber and the matrix. Hydrophilic nature can be modified by the surface treatment of fibers [7]. Natural fibres and synthetic fibres are the two main categories of fibres. The fibres which are available naturally are called natural fibers. The fibers which are prepared artificially are called as synthetic fibers. Plant fibers are again classified as primary fibers and secondary fibers. The plants which are mainly grown for fibers such as jute, sisal, and hemp etc. are belongs to primary. In secondary the fibers are by products from the plants. Coir and pineapple fibers are belongs to the secondary fibers. The plant fibers are again classified on the basis of figure 1 sources of extraction fibers. The classification of natural fibers is shown in the.

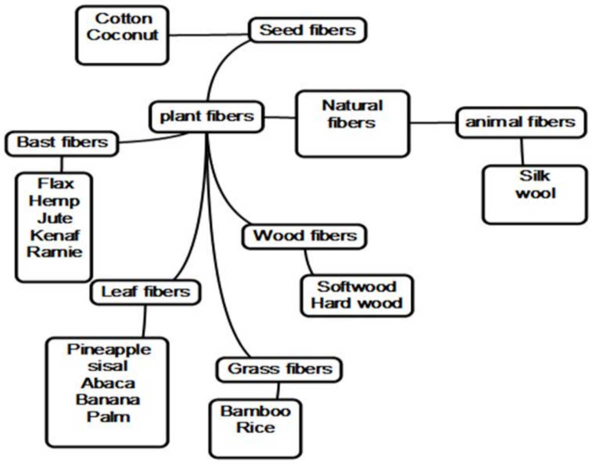

Figure 1: Classification of natural fibres

2 PROPERTIES OF NATURAL FIBRES:

The properties like density, tensile strength, modulus, percentage of elongation and moisture content are shown in table 1.

TABLE 1:
NATURAL FIBER'S PROPERTIES
Source: *Fictitious data, for illustration purposes only*

FIBER	DENSITY (G/CM3)	TENSILE STRENGTH (MPA)	YOUNG'S MODULUS (GPA)	ELONGATION AT BREAK (%)	MOISTURE CONTENT (WT. %)
FLAX	1.5	345-1100	27.6	2.7-3.2	10.0
HEMP	1.47	690	30- 60	1.6	10.8
JUTE	1.3-1.4	393-773	13.0-26.5	1.2-1.5	12.6
KENAF	1.3	930	53	1.6	-
RAMIE	1.5	400-938	61.4-128	1.2-3.8	-
ABACA	1.5	400	12.0	3.0-10.0	15
PINEAPPLE	1.3	413-1627	34.5-82.7	1.6	11.8
SISAL	1.4	468-640	9.4-22.0	3.0-7.0	11.0
COIR	1.1	131-175	4.0-6.0	15-40	8.0
COTTON	1.5-1.6	287-800	5.5-12.6	7.0-8.0	-

Paul et.al.[1] has done experimental study on the mechanical properties of polypropylene composites reinforced by natural fibres produced by compression molding using film stacking method. Kenaf, coir, hemp, jute and sisal are used. They reported that the polypropylene composites reinforced with coir fibres shows less mechanical properties where hemp reinforced composites shows the higher values. Mechanical properties are increased by fiber weight fraction. The mechanical properties obtained are compare favorably with that of glass fibers. They concluded that natural fibers have a capability to replace the glass fibers. Jai inder Preet Singh et.al.[2] has done experimental study on the effect of surface treatment on mechanical properties of natural fibers. Natural fibers are treated with water. Compression moulding is used to prepare composites using epoxy as the matrix. The tensile strength, flexural strength and impact strength were investigated. It has been found that the mechanical properties are increased by surface treatment. The tensile strength, flexural strength and impact strength of of treated and untreated fibre reinforced composites are shown in table 2.

TABLE 2:
MECHANICAL PROPERTIES OF TREATED AND UNTREATED FIBERS[2]

TYPES OF FIBER	TENSILE STRENGTH OF NON TREATED FIBERS	TENSILE STRENGTH OF TREATED FIBERS	FLEXURAL STRENGTH OF NON TREATED FIBER	FLEXURAL STRENGTH OF TREATED FIBER	IMPACT STRENGTH OF NT FIBER	IMPACT STRENGTH OF TREATED FIBER
JUTE	179	432	85	89	480.76	76.92
SISAL	177	275.6	65	72	346.15	101.92
BANANA	102	288	68	75	475	88.46

Ashwin et.al.[3] investigated the mechanical and wear properties of aloe vera, kenaf and jute reinforced epoxy composites. Compression moulding is used to prepare the composites. The composite materials prepared by jute, kenaf and aloe Vera in different stacking sequence. Based on the results obtained by experimental investigation it shows that the stacking sequence has an effect the properties of composites. The properties of composites of various stacking sequences are shown in the table 3. Indira et.al.[4] investigated the mechanical properties of epoxy and polyester composites reinforced with natural fibres. Jute, pineapple leaf and glass fibers used. Hand layup method is used to fabricate the composites. It has been found that epoxy resin composites shows better results than that of polyester composites. They have found that these composites are light in weight and have better mechanical properties. They concluded that polyester and epoxy resin composites can be used in automobile parts, construction and packaging materials.

TABLE 3:
MECHANICAL PROPERTIES OF COMPOSITES OF VARIOUS STACKING SEQUENCES[3]

SAMPLE	TENSILE STRENGTH (MPA)	FLEXURAL STRENGTH (MPA)	IMPACT STRENGTH (J/MM 2)	WEAR RATE (%)
KJAJK	45.593	55.871	0.0097	3.13
AKJKA	56.107	68.039	0.0097	2.54
JKAKJ	51.718	63.297	0.0076	3.14
JAKKKAJ	64.906	94.806	0.0128	2.93

Indira et.al.[5] has done experimental study on the mechanical properties of jute, glass and pineapple fiber hybrid composites. Fibers are considered in 1:1:1 ratio. Hand layup method is used. They have found that with increase in fibre content tensile strength and flexural strength are increased. Maximum tensile strength found at 0.42 volume fraction of fibre and its value is 75 MPa. And also found that these composites reinforced with natural fibres are light in weight and possess good mechanical properties. Ashik et.al.[6] investigated the mechanical properties moisture absorption and of natural fibers. Coconut, glass fiber and epoxy resin Along with hardener used for composite preparation. Hand layup method is used to fabricate the composites of different proportions of epoxy. He observed that the moisture absorption capacity is increases with time and fiber content. In impact test and flexural test it is observed that impact strength and flexural strength more for the composite which is rich coconut fiber. They concluded that fiber content plays important role in moisture absorption and mechanical properties. Asim et.al.[7] studied the effect of surface treatment with NaOH ans silane on the mechanical properties of natural fibers. Pineapple leaf fibre and kenaf used as fibers. These fibers are treated with NaOH and silane. They found that the mechanical properties are increased after surface treatment. But the fibres with silane treatment show better properties than the other. Diameter of fibers is reduced after the treatment. In droplet test the silane treated fibers shows highest IFSS. Tensile strength and tensile modulus of silane treated fibers are higher than the NaOH. The results from SEM analysis show that the impurities present on the surface of fibres were removed. They concluded that chemical treatment with NaOH and silane increases the mechanical properties of natural fibers. The results are shown in the table 4.

***TABLE 4*:**
PROPERTIES OF PINEAPPLE AND KENAF FIBRES[7].

TESTING	FIBRES	UNTREATED	NAOH-SILANE	NAOH	SILANE
FIBRE DIAMETER	PALF KF	78.8 83.5	50.6 52	47.8 46.4	42.4 39.4
TENSILE STRENGTH(MPA)	PALF KF	290.61 282.60	424.63 247.81	432.01 455.74	629.90 551.23
TENSILE MODULUS(MPA)	PALF KF	5381.59 7132.65	6599.71 11867.02	8396.76 15247.35	10998.39 19707.86
IFSS(MPA)	PALF KF	1.70 1.27	1.93 1.72	1.81 2.89	2.35 4.54

Akash et.al.[8] investigated the mechanical properties of green hybrid composites produced by hemp, sisal fibers and epoxy matrix. Compression molding is used to fabricate the composite. NaOH was used for the surface treatment. The results shows that the hardness of composite is increases with increase in the fiber content and the flexural strength increases up to 40% of fiber and then decreases. The maximum value of flexural strength is 82 MPa. Moisture absorption results show that with increase in fiber content moisture absorption capacity increases. Rana et.al.[9] has done experimental study on the mechanical properties of epoxy hybrid composites reinforced with sisal and glass fibres. Acytelated sisal fibres are used as the reinforcement. The sample prepared by varying percentage of sisal(pure epoxy, 2% sisal, 2% sisal + 2 layers of glass fibre, 4% sisal+ 2 layers of glass, 6% sisal + 2 layers of glass). With increase in the percentage of sisal the tensile strength. impact strength and flexural strength are increases up to 4% of sisal and it is decreased for composite containg 6% sisal an 2 layers of glass fibres.Saurab Dhakal and Keerthi Gowda [10] investigated the mechanical properties of banana polyester composites. Compression molding was used prepare the composites. The composites are of 3mm and 5mm thickness and the volume fraction of fibres varied as 5%, 10%, 15%, 17.5% and 20%. The weight of matrix, hardener and catalyst were taken in the ratio of 100:1:1. The results showed that with increase in the fibre volume fraction the tensile strength and flexural strength were gradually increases. For maximum tensile strength obtained at 20% volume fraction for 3mm and 5mm were 22.67 Mpa and 23.04 Mpa respectively. Maximum flexural strength also found at 20% volume fraction of fibre and the values for max flexural strength for 3mm and 5mm thickness composites were 115.38 Mpa and 124.61 Mpa respectively. So with improvement in fibre volume fraction the tensile strength and flexural strength will increases significantly. Ajith et.al.[11] has done experimental study on the mechanical properties on the mechanical properties of epoxy and polyester composites reinforced with jute fibre. 5% and 10% NaOH was used for surface treatment before the preparation. The results show that tensile strength and flexural strength are more for epoxy composites. The properties are more for 5% NaOH treated fibres. The maximum tensile strength at 5% NaOH treated fibre reinforced epoxy composites and its value was 12.46 N/mm2. And jute fibre reinforced polyester composite has a maximum value of 9.23 N/mm2. The flexural strength also obtained at 5% NaOH treated fibre reinforced polyester composites has a maximum value of 44.71 N/mm2 over 38.6 N/mm2. For epoxy composites also maximum flexural strength obtained at 5% NaOH. The hardness and impact strength obtained for both composites are around same. Better properties are obtained at 5% NaOH. The SEM images show that the less adhesion between fibres and matrix, air gaps are the main reason for less strength. Radhika et.al.[12] has conducted study on moisture absorption of jute epoxy composites. NaOH is used for surface treatment of fibres. The composite was prepared by hand layup technique using compression molding. The composites were coated with acrylic paint and epoxy. Tensile strength and moisture absorption tests were conducted. NaOH treated fibre reinforced composites shows less moisture absorption than the untreated fibre reinforced composites. The moisture absorption test were conducted in differebt pH solutions(4,7,8) and it shows there is no change in the moisture absorption even there is a change in the pH of solution. Olusegun et.al.[13] studies the mechanical properties of fibres like hemp, banana, ukam, sisal and E-glass. The fibres surface treated with NaOH. The composites were prepared by hand layup technique. The glass fibre shows the highest properties. The ukam fibre has maximum tensile and impact strength of 16.25 Mpa and 9.8 J/m respectively. Sisal shows highest compressive strength 42 Mpa and bending strength of 0.0036 Mpa. By the obtained results the author concluded that the natural fibres can replace glass fibres. Agnivesh et.al.[14] studied the effect of suraface treatment with NaOH on the surface morphology of abaca fibre. The fiber was treated with 1% and 3% NaOH of 500 ml capacity. Due to the surface treatment the hydroxyl groups and waxy residuals were removed from the surface. So the bonding between the matrix and fibre was improved. Because of increase in the adhesion the mechanical properties can be increased. The SEM images shows that the with the surface treatment the surface of fibre becomes smooth and the bonding between fibres and matrix increased. Venkata Ramana and Ramprasad[15] studied the impact, tensile strength and flexural strength of carbon/jute hybrid composite. Hand layup technique was used to prepare the composites. Carbon epoxy, jute epoxy and jute-carbon epoxy are the three specimens. The results show that the carbon epoxy having higher tensile strength of 370 Mpa and flexural strength of 11.41 GA. Jute carbon epoxy shows properties 16 times greater than the jute epoxy composite. And jute epoxy shows the higher impact strength of 2 Joules. So by incorporating carbon fibre in the jute epoxy composites the properties are increased. Muktha and Keerthi Gowda [16] investigated fire resistance and water absorption behaviour of polyeater composites reinforced with untreated banana. The results show that with increase in the fibre volume fraction reduces the burning rate and increases the thermal stability. And the water absorption was increases with the fibre volume fraction due to presence of cellulose. By the results natural fibre can be used at where there is less contact with the water and fire. Hari om maurya et.al.[17] studied the mechanical properties of short sisal reinforced epoxy composite 5,10,15 and 20 mm fibres were used. Results show that with increase in the length of fibre impact strength increases found a maximum value of 27.62 kJ/m2 at 20 mm fibre reinforced composites. But there is no change in the tensile strength. 10 mm sisal fibre composites shows higher tensile strength of 40.25 Mpa and 5 mm sisal fibre composites shows less tensile strength of 32.30 Mpa.15mm sisal epoxy composite having higher flexural strength of 128.79 Mpa. By this the length of fibre also influences the mechanical properties of fibres. Huang Gu [18] investigated the tensile behavior of coir fibre after chemical treatment with NaOH. He prepared the composite using polypropylene as the matrix. They were treated with 2%, 4%, 6%, 8%, 10% NaOH for 4 weeks at room temperature. To remove residual NaOH on the surface of fibres the fibres were soaked for 24 hours in water. The tensile strength of fibres after the treatment decreases gradually. But the tensile strength of composite increases after treatment and it is found to be maximum at 8% NaOH (734.4 MPa). The tensile strength reduces for 10% NaOH treatment and the value is 680 MPa. He concluded that the strength of fibre decreases after the treatment but the adhesion between fibre and matrix increases which leads to increase the strength of composite. Tran Huu Nam et.al.[19] investigated the effect of surface treatment with NaOH on mechanical properties of coir fibre reinforced poly butylene succinate composites. Hot press molding was used to prepare the composites. The fibres were treated with 5% NaOH for 24, 48, 72 hours. And also treated with 3%, 7% NaOH for 72 hours. The SEM images shows that with increase in the concentration and time of treatment the surface of fibres become smooth. For 5% NaOH treated fibres the tensile strength increases up to 72h and the max value is 238.26 MPa. For soaking time of 72h the interfacial strength found maximum value of 3.196 MPa. Tensile strength and flexural strength increases with increase in the fibre mass content found maximum at 25% mass content and the values are 53 MPa and 68 MPa respectively. They concluded that the composites of coir fibres could be successfully developed with good strength. Zhang et.al.[20] has done experimental study on the mechanical properties of urea formaldehyde resin composites reinforced with sisal fibre. Compression molding was used to prepare the composites. 2% NaOH treated fibres were used to prepare the composites. The composites prepared by varying the sisal fibre content. At 50% weight the impact strength found to maximum and its value is 9.62 kJ/mm2. The impact strength increases from 30% to 50% of fibre loading by 62.98%. The flexural strength found maximum at 30% weight and the value is 58.58 MPa. Later the value of flexural strength decreases. Hardness decreases with increase in the fibre content and the maximum value of 72 found at 30% weight. Water absorption capacity increases with increase in the fibre loading. Pradip Sature, Ashok Mache [21] investigated the mechanical properties and water absorption behavior of hemp, jute and glass fibre hybrid composites. The composites prepared by following some stacking sequences. The composites are hemp epoxy, jute epoxy, jute hemp glass epoxy and jute hemp epoxy. The results are shown in the below table 5.

***TABLE 5**:*
MECHANICAL PROPERTIES OF DIFFERENT SAMPLES[21]

SAMPLE	TENSILE STRENGTH (N/MM2)	COMPRESSION STRENGTH (N/MM2)	FLEXURAL STRENGTH (N/MM2)	SHEAR STRENGTH (N/MM2)
JUTE/EPOXY	58.03	68.28	74.61	29.21
HEMP/EPOXY	75.14	80.56	126.07	37.58
JUTE-HEMP/EPOXY	63.41	75.67	109.47	34.22
JUTE-HEMP-GLASS/EPOXY	125.93	108.06	191.06	43.09

Arib et.al.[22] studied the mechanical properties of polypropylene composites reinforced with pineapple leaf fibre. Compression molding was used to prepare the laminates. The laminates prepared by varying the volume fraction of fibres (2.7%, 5.4%, 10.8%, 16.2%). The results show that the tensile strength and flexural strength increases with increase in the fibre loading and the maximum values found at the volume fraction of 10.8%. The maximum tensile strength is 38 MPa. The values of tensile properties decrease at 16.8%. The maximum value of flexural strength found at 5.4 % volume fraction of fibre reinforced composite and the value is 69.74 MPa. Rout et.al.[23] investigated the effect of fibre treatment on the mechanical properties polyester composites reinforced with coir fibre. Alkalization, bleaching and AN-grafting are the three fibre treatments conducted on the fibres. Alkalization done by varying NaOH concentration (2, 5, 10%). Bleaching of fibres done at 650,750,850c. Using Cu2+-IO-4 combination as initiator alkali treated fibres(5%) to graft copolymerization in an aqueous solution. The results show that flexural strength increases up to 5% NaOH treated fibres (61 MPa). Tensile strength of alkali treated fibres found maximum at 2% NaOH treated fibres (28 MPa). The tensile and flexural strengths of bleached composites decrease gradually with increase in the bleached temperature. The properties of AN grafting also found maximum at 10% acrylonitrile grafting. The results of moisture absorption shows that glass coir composites show less water absorption percentage than the coir composites.

The authors concluded that treatment of fibres before composite preparation improve the properties of composites.

3 Surface Morphology of Surface Treated Fibers

The microstructural changes in the natural fibres after the surface treatment with different chemicals have been studied by many researchers using Scanning electron microscope. The surface treatment of fibres removes the impurities and cementing materials present on the surface of the fibres. Effective surface area between the matrix and fibre increases after the surface treatment and it also increases the bonding between them. Effect of surface treatment with NaOH on the properties of fibre reinforced has been reported by [2] and [11]. The surface treatment with Silane has been reported by [7]. After the surface treatment the surface of the fibres become smooth and the bonding between fibres and matrix has been increases. The below images are some of the SEM images showing the microstructure after the surface treatment. The figure 2(a) shows the untreated kenaf fibre on which so many impurities present on the surface of fibre. Figure 2(b) shows smooth surface than the figure 2(a). It indicates the surface treatment with NaOH clean and removes the impurities on the surface of fibre. Figure 2(c) silane treated kenaf fibre and it is has very smooth surface than the NaOH treated fibres. Figure 2(d) shows NaOH-silane treatment has no effect on the fibre surface. Figure 3(a) shows the untreated pineapple leaf fibre. After the treatment with NaOH the surface of fibre becomes smooth and with small voids which are responsible for bonding between the matrix and the fiber. Figure 3(c) indicated the silane treated PALF fibre with more no of void than the NaOH treated fibres[7].

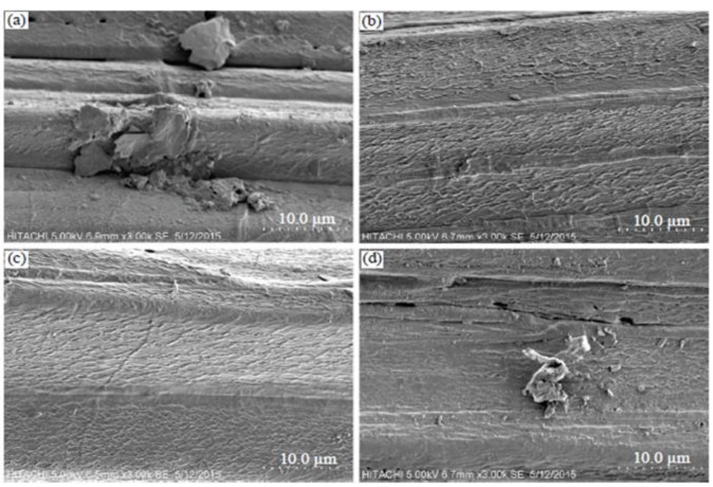

Fig 2: *SEM images of (a)Untreated,(b) NaOH,(c)Silane and (d) NaOH-Silane treated kenaf fibre*[7]

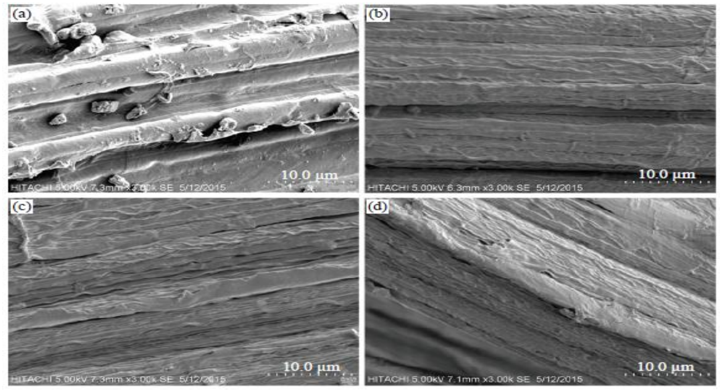

Fig 3: *SEM images of (a)Untreated,(b) NaOH,(c)Silane and (d) NaOH-Silane treated Pineapple leaf fibre*[7]

Figure 4(a) and 4(b) shows the microstructure of fractured jute epoxy composite. Figure 4(a) shows that fibres are not properly distributed and the matrix without the fibres. Figure 4(b) shows the air gaps which reduces the strength of the composites[11].

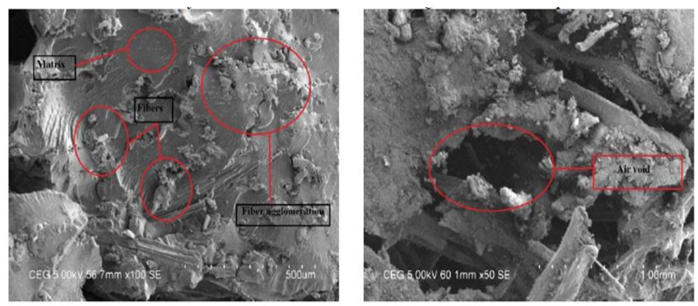

Fig 4:*(a)500µm magnification SEM image for jute epoxy composite; (b) 1mm magnification SEM image for jute epoxy composite*[11]

4 Factors Influencing The Mechanical Properties

4.1 Fibre content: The amount of fibre present in the composite by weight fraction or volume fraction is fibre content. The properties like tensile strength, flexural strength and hardness are increases with increase in the amount of fibre in the composite. The maximum values of the properties found at 40-50% of weight fraction of fibres[25].

4.2 Chemical treatment: Chemical treatment or surface treatment of fibres before composite preparation improves the tensile strength and flexural strength of the composites. By the surface treatment the impurities present on the surface of fibres which increases the bonding between the matrix and fiber lead to improvement in the properties. But the impact strength of composites decreases due decrease in the strength of fibre after the treatment. Different types of chemical treatment processes are alkalization, silane treatment, acylation and benzolization etc.

4.3 Bonding between matrix and fiber: Bonding between the matrix and fiber has a great impact on the properties of composites. The properties are higher for composite which have better bonding between matrix and fiber. And it can be achieved by surface treatment. Surface treatment creates some voids on the surface of the fibre and these voids are filled with matrix and leads to improve in the bonding between matrix and fiber.

4.4 Fibre form: Form of the fibre means long fibres, short fibres and fibre in powder form. With increase in length of fibres the impact strength increases because larger size fibres absorb more energy. There is no change in tensile and flexural strength with respect to the fibre length. Optimum size of fibres gives the better tensile and flexural strength.

4.5 Water absorption: The water absorption behavior of fibres reduces the bonding between the matrix and fibers. And it leads to decrease in the properties of composites. So the fibre reinforced composites can be used in the areas where there is less intraction with water. This behavior of fibres can be reduced by chemical treatment.

4.6 Stacking sequence: In some composites more than one fibres are used. The arrangement of fibres also influences the properties. By choosing the best stacking sequence of fibres the properties of composites can be improved.

4.7 Hybridization: hybridization is nothing but the reinforcement of both natural and synthetic fibres with the matrix. In hybrid composites more than one fibre is used. Hybridization leads to reduce the amount of usage of synthetic fibres and improve prove the properties of composites. The properties of hybrid composites are more than the natural fibre reinforced composites.

Advantages:
Reduction in density of the productsis less compared to synthetic fibresDensity of fibres is less and it reduces the weight of the compositesNatural fibres are cheaper than synthetic fibres.Natural fibres are non-toxic in nature. The manufacturing process of natural fibre reinforced composites is safer than that of synthetic fibre composites The waste produced during the manufacturing natural fibre composites can be recycled.In automobiles the fuel consumptions is due to less weight of composites.

Disadvantages:
Moisture absorption of fibres is very high leads to reduce the bond between the fibre and matrix. Poor fire resistance lower durability Preparation of fiber is labor intensive and time consuming. Fluctuation in cost depending on the global demand and reduction.

Applications:
The automobile manufactures like Merceds, Audi, BMW and Volkswagen are already used this composites for making interior and exterior partsUsed for construction purposes and medical industries. Used to make furniture: chair, Table, and bath tubs.Used to manufacturing of briefcases and helmets. Used in railway coach interiors Used in aircraft industries to make interiors These are also used in making daily used applications like plates and spoons.

5 Conclusion
The mechanical properties like tensile strength, flexural strength, impact strength and hardness of the natural fibre reinforced composites are studied. Surface morphology of fibres also studied. With increase in the amount of fibres the tensile strength and impact strength of composites increases. Flexural strength of composites increases upto certain level and then decreases with respect to fibre loading.Surface treatment of fibres improves the strength or bonding between matrix and fibre which leads to improve the properties. Hybridization reduces the usage of synthetic fibres and it gives the better mechanical properties. Due to high moisture absorption and less flame resistance behavior of natural fibres these cannot be used in the areas where water and flame are there. By the satisfactory mechanical properties of natural fibre composites these composites have a capability to replace the synthetic fibres. But the entire replacement of synthetic fibres is not possible due to its the higher properties.

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