Fabrication of composite materials by using short pineapple leaf fiber PALF : A Review

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Abstract

Composite materials (also called composition materials or shortened to composites) are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter or less expensive when compared to traditional materials. In the last decades, the use of natural fibers as reinforcement in polymeric composites for technical application has been a research subject of scientist. Interest in natural fibers has increased worldwide due to their low cost, low density, hardness, higher fatigue endurance, good thermal and mechanical resistivity and to their environmental friendliness. The Asian markets have been using natural fibers for many years e.g., jute is a common reinforcement in India. Natural fibers are increasingly used in automotive and packaging materials. India is an agricultural country and it is the main stay of Indian economy. Thousands of tons of different crops are produced but most of their wastes do not have any useful utilization. Agricultural wastes include wheat husk, rice husk, and their straw, hemp fiber and shells of various dry fruits. These agricultural wastes can be used to prepare fiber reinforced polymer composites for commercial use.

Introduction

Pineapple Leaf Fiber (PALF), the subject of the present study, is a waste product of pineapple cultivation. Hence, pineapple fibre can be obtained for industrial purposes without any additional cost. Over the past decade, cellulosic fillers have been of greater interest as they give composites improved mechanical properties compared to those containing non-fibrous fillers. Natural fibres are plant based which are lignocellulosic in nature and composed of cellulose, hemicelluloses, lignin, pectin and waxy substances. Cellulose gives the strength, stiffness and structural stability of the fibre, and are the major framework components of the fibre. The lignin, hemicelluloses and pectin provides the adhesive to hold the cellulose framework structure of the fiber together. Natural fibers possess mechanical, thermal and electrical properties that can justify their uses in many applications. Study on mechanical, thermal and electrical properties of composites helps to analyze the properties of materials to assess strength, ductility,fatigue,thermal conductivity, specific heat,dielectric constant, dissipation factor, dielectric loss, electrical resistivity, under different conditions such as fiber type and architecture, fiber volume fraction, direction of heat flow, and service temperature, and helps to assists in the evaluation and design of materials and products that are more efficient and less costly because they last longer. Recently, car manufactures have been interested in incorporating natural fiber composites into both interior and exterior parts. This serves a two-fold goal of the companies to lower the overall weight of the vehicle thus increasing fuel efficiency and to increase the sustainability of their manufacturing process. Many companies such as Mercedes Benz, Toyota and Daimler Chrysler have already accomplished this and are looking to expand the uses of natural fiber composites.

Types of composites

BASED ON MATRIX TYPE

Metal Matrix Composites (MMC)
Ceramic Matrix Composites (CMC)
Polymer Matrix Composites (PMC)

1. Metal Matrix Composites: Higher strength, fracture toughness and stiffness are offered by metal matrices. Metal matrix can withstand elevated temperature in corrosive environment than polymer composites. titanium, aluminum and magnesium are the popular matrix metals currently in vogue, which are particularly useful for aircraft applications. Because of these attributes metal matrix composites are under consideration for wide range of applications viz. combustion chamber nozzle (in rocket, space shuttle), housings, tubing, cables, heat exchangers, structural members etc.
2. Ceramic matrix Composites: One of the main objectives in producing ceramic matrix composites is to increase the toughness. Naturally it is hoped and indeed often found that there is a concomitant improvement in strength and stiffness of ceramic matrix composites.
3. Polymer Matrix Composites: Most commonly used matrix materials are polymeric. In general the mechanical properties of polymers are inadequate for many structural purposes. In particular their strength and stiffness are low compared to metals and ceramics. These difficulties are overcome by reinforcing other materials with polymers. Secondly the processing of polymer matrix composites need not involve high pressure and doesn't require high temperature. Also equipments required for manufacturing polymer matrix composites are simpler. For this reason polymer matrix composites developed rapidly and soon became popular for structural applications

COMPOSITES BASED ON RE-INFORCINMATERIAL

(1)Fibrous Composite:

A fiber is characterized by its length being much greater compared to its cross-sectional dimensions. The dimensions of the reinforcement determine its capability of contributing its properties to the composite. Fibers are very effective in improving the fracture resistance of the matrix since a reinforcement having a long dimension discourages the growth of incipient cracks normal to the reinforcement that might otherwise lead to failure, particularly with brittle matrices. Man-made filaments or fibers of non polymeric materials exhibit much higher strength along their length since large flaws, which may be present in the bulk material, are minimized because of the small cross-sectional dimensions of the fiber. In the case of polymeric materials, orientation of the molecular structure is responsible for high strength and stiffness.

(2)Particulate Composites:

In particulate composites the reinforcement is of particle nature. It may be spherical, cubic, tetragonal, a platelet, or of other regular or irregular shape. In general, particles are not very effective in improving fracture resistance but they enhance the stiffness of the composite to a limited extent. Particle fillers are widely used to improve the properties of matrix materials such as to modify the thermal and electrical conductivities, improve performance at elevated temperatures, reduce friction, increase wear and abrasion resistance, improve machinability, increase surface hardness and reduce shrinkage.

(3)hybrid composite

Hybrid composites are more advanced composites as compared to conventional FRP composites. Hybrids can have more than one reinforcing phase and a single matrix phase or single reinforcing phase with multiple matrix phases or multiple reinforcing and multiple matrix phases. They have better flexibility as compared to other fiber reinforced composites. Normally it contains a high modulus fiber with low modulus fiber.The high-modulus fiber provides the stiffness and load bearing qualities, whereas the low-modulus fiber makes the composite more damage tolerant and keeps the material cost low. The mechanical properties of a hybrid composite can be varied by changing volume ratio and stacking sequence of different plies.

NATURAL FIBER REINFORCED COMPOSITES

The interest in natural fiber-reinforced polymer composite materials is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable, and biodegradable. Natural fibres are plant based which are lignocellulosic in nature and composed of cellulose, hemicelluloses, lignin, pectin and waxy substances. Cellulose gives the strength, stiffness and structural stability of the fibre, and are the major framework components of the fibre. According to the type of fibre, cellulose has its own cell geometry which is responsible for the determination of mechanical properties of plant fibres. Hemicelluloses occur mainly in the primary cell wall and have branched polymers carbon sugars with varied chemical structure. Lignin is amorphous and has an aromatic structure. Pectin structure is complex, their side chains are often cross-linked with the calcium ions and arabinose sugars. The lignin, hemicelluloses and pectin provides the adhesive to hold the cellulose framework structure of the fibre together. Their availability, renewability, low density, and price as well as satisfactory mechanical properties makes them an attractive ecological alternative to glass, carbon and man-made fibers used for the manufacturing of composites. The natural fiber- containing composites are more environmentally friendly, and are used in transportation (automobiles, railway coaches, aerospace), military applications, building and construction industries (ceiling paneling, partition boards), packaging, consumer products, etc.

APPLICATIONS OF NATURAL FIBER COMPOSITES

The natural fiber composites can be very cost effective material for following applications:

1.Building and construction industry: panels for partition and false ceiling, partition boards, wall, floor, window and door frames, roof tiles, mobile or pre-fabricated buildings which can be used in times of natural calamities such as floods, cyclones, earthquakes, etc.

2. Storage devices: post-boxes, grain storage silos, bio-gas containers, etc.
3. Furniture: chair, table, shower, bath units, etc.
4. Electric devices: electrical appliances, pipes, etc.
5. Everyday applications: lampshades, suitcases, helmets, etc.
6. Transportation: automobile and railway coach interior, boat, etc.
7. Toys

The reasons for the application of natural fibers in the automotive industry include:

8. Low density: which may lead to a weight reduction of 10 to 30%
9. Acceptable mechanical properties, good acoustic properties.
10. Favorable processing properties, for instance low wear on tools, etc.
11. Options for new production technologies and materials.
12. Favorable accident performance, high stability, less splintering.
13. Favorable eco-balance for part production.
14. Favorable eco-balance during vehicle operation due to weight savings.
15. Occupational health benefits compared to glass fibers during production.
16. No off-gassing of toxic compounds (in contrast to phenol resin bonded
17. Wood and recycled Cotton fiber parts).
18. Reduced fogging behavior.
19. Price advantages both for the fibers and the applied technologies.

Despite the advantages mentioned above, use of cellulose fibers in composites has not been extensive. Possible reasons that contribute to unsatisfactory final properties of the composite include:

(i) Limited thermal stability at typical melt processing temperatures of about 2000C. This limits the type of thermoplastic that can be used with the fibers.
(ii) Poor dispersion characteristics due to strong hydrogen forces between the fibers.

(iii)Limited compatibility due to their highly hydrophilic character. These results in poor mechanical properties of the composites produced.
(iv)High moisture absorption of the fibers that can affect the dimensional stability of the composite and the interfacial bond strength
(v) High biodegradability when exposed to the environment. This limits the service life of composites particularly in outdoor applications.

The studies show that the problems mentioned above are common, independent of the type and origin of the fiber employed. Other factors that may hamper increased use of cellulose fibers in plastics are problems and costs associated with the collection and storage which are not yet mechanized and standardized to produce fibers of high and uniform quality. Now, some of the works on these natural fiber reinforced composites are summarized.

LITERATURE REVIEW

Maries et al. [1], Investigated the thermal properties such as thermal conductivity, diffusivity and specific heat of polpster/natural fiber (banana/sisal). Thermo physical behavior of hybrid pineapple leaf fiber and glass has been investigated. The results show that chemical treatment of the fibres reduces the composite thermal contact resistance. Hybridization of natural fiber with glass allows a significantly better heat transport ability of the composite.

Min S. Mishra et al. [2], Investigated the tensile, impact strength and flexural strength of biofiber (pineapple fiber/sisal fiber) reinforced polymer matrix composite with different modified surface. The surface modification of sisal fiber such as alkali treatment produced optimum tensile and impact strength, while cyaneoethylation resulted in maximum increase in flexural strength of hybrid composite.

P.A. Sree kumar et al. [3], Investigated on dielectric constant, loss factor, dissipation factor and volume resistivity on short sisal fiber reinforced polyester composite. The values are high for the composites having fiber content of 50 vol.%. This increment is high at low frequencies, low at medium frequencies, and very small at high frequencies. The volume resistivity varies with fiber loading at lower frequency and merges together at higher frequency. When temperature increases the dielectric constant values increases followed by a decrease after the glass transition temperature.

M. R. Ishak et al. [4], has studied and compared the mechanical properties of short kenaf bast and core fibre reinforced unsaturated polyester composites with varying fibre weight fraction i.e. 0%, 5%, 10%, 20%, 30% and 40%. The compression moulding technique was used to prepare the composite specimens for tensile, flexural and impact tests in accordance to the ASTM D5083, ASTM D790 and ASTM D256 respectively. The overall results showed that the composites reinforced with kenaf bast fibre had higher mechanical properties than kenaf core fibre composites. The results also showed that the optimum fibre content for achieving highest tensile strength for both bast and core fibre composites was 20%wt. this study also observed that the elongation at break for both composites decreased as the fibre content increased. This study observed that For the flexural strength, the optimum fibre content for both composites was 10%wt while for impact strength, it was at 10%wt and 5%wt for bast and core fibre composites respectively.

Xueli et al. [5], have determined the thermal conductivity, thermal diffusivity and specific heat of flax fiber – high density polyethylene (HDPE) bi composite in the temperature range 170ºC - 200ºC. It was found that the thermal conductivity, thermal diffusivity, and specific heat decreased with increasing fiber content, but thermal conductivity and thermal diffusivity did not change significantly with temperature in the range studied. The specific heat of the biocomposites increased gradually with temperature

F.Z. Arrakhiz et al. [6], have investigated Mechanical properties of alfa, coir and bagasse fibers reinforced polypropylene (PP) composites. In order to improve the composite's mechanical properties, fibers were alkali treated before compounding to remove natural waxes and other non cellulosic compounds. It was found that mechanical properties of the composites obtained with these three fibers were found to be superior to those of the neat polymer.this study also observed Addition of various amount of reinforcement fibers yielded noticeable increases in both tensile and flexural modulus as well as the torsion parameter. This study observed 56–75% increases in tensile modulus by the use of alfa, coir and bagasse while the flexural modulus increased by 30–47% when compared to neat PP. this study shows increase in torsion modulus when the fiber content exceeds a threshold level.

T.P. Sathishkumar et al. [7], this study emphasis the importance of the newly identified snake grass fibers which are extracted from snake grass plants by manual process.this paper have investigated the tensile properties of the snake grass fiber are studied and compared with the traditionally available other natural fibers. The mixed chopped snake grass fiber reinforced composite is prepared using the isophthallic polyester resin and the detailed preparation methodology is presented in this study. Fiber pull-outs on the fractured specimen during the physical testing of the composites are also investigated. This work experimental evidence also shows that the volume fraction increases the tensile, flexural strength and modulus of the snake grass fiber reinforce composite.

Maneesh Tewari et al. [8], this work shows a bagasse-glass fiber reinforced composite material is developed with 15 wt%, 20 wt%, 25 wt% and 30 wt% of bagasse fiber with 5 wt% glass fiber mixed in resin.this study has conducted Scanning electron microscopy (SEM) on bagasse fibers 13.0m m in diameter and 61.0m m in length which shows fibers are well dispersed in the resin matrix. This study shows fiber increases the modulus of elasticity of the epoxy,Mixing of bagasse with glass fiber also improves the modulus of elasticity.this study also shows Addition of bagasse fibers decreases the ultimate tensile strength,But addition of glass fiber further increases the ultimate tensile strength in comparison to commercially available bagasse based composite.this study shows that impact strength increases with Bagasse-glass reinforced fibers due to fiber more elasticity.this study also showed Addition of bagasse fiber reduces bending strength,But addition of glass fiber further increases the bending strength in comparison to commercially available bagasse based composite.

K. Laoubi et al. [9], study the behavior of E-glass fiber unsaturated polyester composites, subjected to moderate and high temperatures. The obtained results show that the chemical, physical and mechanical properties of the resin and the composite change with the rise of the temperature. A thermo gravimetric analysis (TGA) revealed that the thermal degradation of the composite occurs in two steps: the first between 130 and 200 C and the second between 250 and 440 C.

A. K. RANA et al. [13], this work investigated on Jute fibers, were its chopped to approximately 100 mm in length and then processed through a granulator having an 8-mm screen, Final fiber lengths were up to 10 mm maximum. this study shows These fibers along with polypropylene granules and a compatibilizer were mixed in a K-mixer at a fixed rpm, 5500, and dumped at a fixed temperature, 390°F, following single-stage procedure. In this work fiber loadings were 30, 40, 50, and 60 wt %, and at each fiber loading, compatibilizer doses were 0, 1, 2, 3 and 4 wt %. The Kmix samples were pressed and granulated.in this work ASTM test specimens were molded using a Cincinnati injection molding machine,At 60% by weight of fiber loading, the use of the compatibilizer improved the flexural strength as high as 100%, tensile strength to 20%, and impact strength (unnotched) by 175%. This study shows a Remarkable improvements were attained even with 1% compatibilizer only.this work investigate the fiber surface morphology, fiber pull-out, and fiber-polymer interface by SEM.

Uma Devi et al. [14], investigated the mechanical behavior of PALF reinforced polyester composites as a function of fiber loading, fiber length, and fiber surface modification. Tensile strength and modulus of this thermoset composite were found to increase linearly with fiber content. The impact strength was also found to follow the same trend. However in the case of flexural strength, there was a leveling off beyond 30 wt % fiber content. A significant improvement in the mechanical properties was observed when treated fibers were used to reinforce the composite. The best improvement was observed in the study of silane A-172-treated fibre composites. Uma Devi and his members summarized that the PALF reinforced polyester composites exhibit superior mechanical properties when compared to other natural fiber polyester composites.

Munirah Mokhtar et.al [16], carried out research to characterize PALF and to investigate the effect of fiber treatment on the mechanical properties of PALF reinforced polypropylene (PP) composite. PALF was prepared from raw pineapple leaf. It was then chemically treated to hinder the water content. Both PP and PALF were compounded using two roll mill machine prior to compression molding via hot press machine to form a sheet. After forming the composite sheet, samples were prepared for tensile test (ASTM D638), flexural test (ASTM D790) and impact test (ASTM D256). Scanning Electron Microscope (SEM) was used to investigate the miscibility between the fiber and matrix. It was found that PALF contain 87.56% holocellulose, 78.11% alpha cellulose, 9.45% hemicellulose and 4.78 % lignin. The chemical constituents obtained were in the range to data reported in literatures. It was also observed that the flexural modulus and strength of treated PALF reinforced PP composite increased linearly with increment of fiber loadings. This trend was similar for impact strength where it exhibited a slight reduction at the initial stage but increased later as the fiber loading increased. The study has demonstrated that the optimum fiber loading for the best performance of the composite achieved was 30 wt%. This was clarified further by SEM where fibers and matrix have shown better miscibility at 30 wt% of treated.

K Sabeel Ahmed et al.[18], focused on evaluation of in-plane elastic properties of untreated woven jute and jute-glass fabric hybrid polyester composites under tension. Theoretically, the laminate elastic properties are predicted using the Classical Lamination Theory (CLT) and rule of hybrid mixture model using the resin and fiber properties together with volume fraction. Experimentally the elastic properties were evaluated by tension test in warp and weft direction and in-plane shear test based on ASTM standards. The results indicated that the young's modulus in both warp and weft direction improve by inclusion of glass fiber, where as Poisson's ratio is decreased. Prediction by CLT and model showed closed arrangements with the experimental values with maximum deviation of about 20%.

F. G. Shin et al. [21], carried an experimental study of unidirectional bamboo-epoxy laminates of varying laminae number, in which tensile, compressive, flexural and interlaminar shear properties are evaluated. The results showed that the specific strength and specific modulus of bamboo-epoxy laminates are adequate, the former being 3 to 4 times that of mild steel. Their mechanical properties were generally comparable to those of ordinary glass-fiber composites. The fracture behaviour of bamboo-epoxy under different loading conditions were observed using both acoustic emission techniques and scanning electron microscopy. The fracture mode varied with load, the fracture mechanism being similar to glass and carbon reinforced composites. Microstructural analyses revealed that natural bamboo is eligibly a fiber composite in itself; its inclusion in a plastic matrix will help solve the problems of cracking due to desiccation and bio erosion caused by insect pests. Furthermore, the thickness and shape of the composite can be tailored during fabrication to meet specific requirements, thereby enabling a wide spectrum of applications.

Saha et al. [22], in their paper, jute fibers were treated with alkali(NAOH) solution and physic-chemical properties of jute fibers was investigated. The treatments were applied under ambient and elevated temperatures and high pressure steaming conditions. The results indicated that the uniaxial tensile strength increased by up to 65% for alkali-steam treatment. The treatments without steaming were not as effective. Physico-chemical characterization of fibers showed that the increase in tensile strength was due to the removal of non-cellulosic matters like lignin, pectin and hemicellulose.

Li et al. [23], conducted a research to study the mechanical properties, especially interfacial performances of the composites based on natural fibers due to the poor interfacial bonding between the hydrophilic natural fibers and the hydrophobic polymer matrices. Two types of fiber surface treatment methods, namely chemical bonding and oxidization were used to improve the interfacial bonding properties of natural fiber reinforced polymeric composites. Interfacial properties were evaluated and analyzed by single fiber pull-out test and the theoretical model. The interfacial shear strength (IFSS) was obtained by the statistical parameters. The results were compared with those obtained by traditional ways. Based on this study, an improved method which could more accurately evaluate the interfacial properties between natural fiber and polymeric matrices was proposed.

Dr.Sihama I.Salih et al. [24], Investigation was carried out on study the mechanical properties and thermal and acoustic insulation properties of prepared polymer composite. Petiole date palm fibers with the length (2-3mm) and with different volume fraction ratio (10, 20, 30 and 40%) were used as filler in preparation of polymer composite. This research imply study effect of pre- deformation for petiole date palm fiber by chosen compression loads (0, 2, 4 and 6 MPa) on the mechanical properties as well as on the thermal and acoustic insulation properties of prepared composites. This research concluded that the pre-deformation to the fibers improves the thermal and acoustic insulation properties of prepared composite, as well as an increase in the tensile strength and hardness values with increasing compression load on the fibers. The highest values of the tensile strength and hardness reach to (133MPa) and (106) respectively for the polymer composite filled with 40% volume fraction of petiole date palm fibers which pre-deformed under compression load equal to 6 MPa.

Nor Hamidah Mohd et al. [25], have discussed the flexural and morphological properties of epoxy/glass fiber/silane treated Organo-montmorillonite Composites. Organo-montmorillonite Composites was treated with 3-amino-propyltrimethoxysilane. Epoxy (E) composites reinforced with glass fiber (GF) and OMMT were prepared with the hand-layup technique. The surface modification of OMMT using a silane coupling agent was carried out as follows: a 205.8g ethanol solution (95% ethanol and 5% water) was stirred before 10.8 ml of silane coupling agent was added. The mixture was then stirred for 5 hours using a mechanical stirrer. Next, the mixture was filtered and dried for 4 hours. The flexural properties of the E/GF/OMMT composites were characterized by the three-point bending flexural test. The flexural modulus and strength of the E/GF composites were improved by the addition of silane-treated OMMT. The exfoliation of the OMMT in the E was studied using X-ray diffraction (XRD). It was found that the OMMT silicate layers were exfoliated successfully in the E matrix. The flexural fractured surface morphology of the E/GF/OMMT composites was investigated using scanning electron microscopy (SEM). It is interesting to note that parts of the silane-treated OMMT also adhered to the GF, which can promote better interfacial interaction and wettability between the E and GF.

A.V. Ratna Prasad et al. [26], conducted the experiments of tensile and flexural tests on composites made by reinforcing jowar as a new natural fiber into polyester resin matrix. The samples were prepared up to a maximum volume fraction of approximately 0.40 from the fibers extracted by retting and manual process, and compared with established composites like sisal and bamboo developed under similar laboratory conditions. Jowar fiber has a tensile strength of 302 MPa, modulus of 6.99 GPa and an effective density of 922 kg/m3. It was observed that the tensile strength of jowar fiber composite is almost equal to that of bamboo composite, 1.89 times to that of sisal composite and the tensile modulus is 11% and 45% greater than those of bamboo and sisal composites, respectively at 0.40 volume fraction of fiber. The flexural strength of jowar composite is 4%, 35% and the flexural modulus is 1.12 times, 2.16 times greater than those of bamboo and sisal composites, respectively. The results of this study indicate that using jowar fibers as reinforcement in polyester matrix could successfully develop a composite material in terms of high strength and rigidity for light weight applications compared to conventional sisal and bamboo composites.

Xue Li et al [30], have studied the thermal conductivity, thermal diffusivity, and specific heat of flax fiber–high density polyethylene (HDPE) biocomposites were determined in the temperature range of 170–200ºC. The fiber contents in biocomposites were 10%, 20%, and 30% by mass. Using the line-source technique, the instrumental setup was developed to measure the thermal conductivity of biocomposites. It was found that the thermal conductivity, thermal diffusivity, and specific heat decreased with increasing fiber content, but thermal conductivity and thermal diffusivity did not change significantly with temperature in the range studied. The specific heat of the biocomposites increased gradually with temperature.

Mingjiang Zhan et al [31], have fabricated composites with epoxy, chicken feather fiber (CFF), and E-glass fibers and investigate their properties for potential applications as printed circuit boards (PCBs). The electrical resistivity of the CFF composites was two to four orders of magnitude higher than that of E-glass fiber composites. The dielectric constant of the composites decreased with fiber contents. Composite with hybrid fiber had a low dielectric constant of 3.6–4.2 and a loss tangent of 0.027, which is similar to those of commercial PCB materials. The CFF composite can be potentially used for PCBs industry and the hybrid fiber composite has a good balance of properties and costs, while being more sustainable.

Navin Chand et al [32], have studied on Effect of sisal fibre orientation on electrical properties of sisal fibre reinforced epoxy composites. The effect of temperature and frequency variation on dielectric constant (□□), dielectric dissipation factor (tan δ) and on a.c. conductivity (σa.c.) of the samples was measured. Measurements were in the temperature range 24–180ºC and in the frequency range 1–20 kHz. The sisal fibre epoxy composites were oriented parallel and perpendicular to the electric field. It was found that the dielectric constant, tan δ and a.c. conductivity increased with increasing temperature. The dependence of dielectric constant, tan d and a.c. conductivity with frequency has also been studied and it was found that □□ and tan δ of the epoxy and 0 and 90º oriented sisal fibre epoxy composites decreased with increasing frequency and a.c. conductivity increases with increasing frequency. Near the transition temperature of the epoxy the observed properties showed anomalous behaviour. Peaks for dielectric constant, tan d and a.c. conductivity were observed. Clear relaxation peaks for tan δ around 169ºC were observed in epoxy resin, shifting to the lower temperature side with increasing frequency. The relaxation time of epoxy and 0 and 90º oriented sisal fibre epoxy composites has been calculated and it was found that τ(s) was 4.09×10ˆ-5, 5.52×10ˆ-5 and 5.47×10ˆ-5, respectively at 100 ºC.

Summary of Literature Review

Through an exhaustive literature review it is observed that the literature is rich in study of mechanical properties such as tensile, flexural, impact strength of composite materials. The study on wear, thermal and electrical properties is least studied compared to mechanical property studies. the study on various fibers such as kneaf,bast coir etc with matrix material such as epoxy resin,polypropelene etc are extensively studied with various volume fraction such as 0%,10%,20%,30%,40%,50% and various fiber length such as 2mm, 6mm, 8mm, 12mm, 15mm, 25mm, 30mm.various studies has given various results on mechanical results, which all depends on fiber strength, type of matrix used, volume fraction of the fiber, best tensile strength,young's modulus,impact strength results are obtained for effective length of the fiber, electrical and thermal properties also changes based on fiber distributions, voids presence, based on volume fraction, fiber length, from which it can be concluded weather is it thermal insulator or conductor, electrical conductor or insulator, to find di-electric contant,dissipation factor, thermal diffusivity, specific heat etc which helps in selecting a material for particular applications. but The research on short PALF reinforced Bisphenol based composed is rare. Literature emphasizes that in order to increase "resource potential" of PALF and conditionally energize the utilization of PALF, there is a need to develop value added applications of PALF as reinforcing fibers in polymer composites which helps in design of materials and products that are more efficient and less costly because they last longer. Thus, there is a wide scope to explore the potential of PALF as a reinforcing agent and to study the behavior on mechanical, wear, thermal and electrical properties of PALF reinforced polymer composite.

Objective of the study

The knowledge gap in the existing literature review has helped to set the objectives of this research work which are outlined as follows:

- To develop a new class of PALF reinforced Bisphenol based composites to explore the potential of PALF.
- Experimental and theoretical investigation of mechanical properties such as tensile strength, compressive strength, shear strength, flexural strength of short pineapple leaf fiber reinforced Bisphenol-A resin composite. Mechanical Study help to assess strength, ductility, and fatigue under different conditions and helps to assists in the evaluation and design of materials and products that are more efficient and less costly because they last longer.
- Experimental investigation of thermal properties, such as thermal conductivity, thermal diffusivity and specific heat of short pineapple leaf fiber reinforced Bisphenol-A resin composite. To study the Thermal properties behaviour of polymer composite since it depends on fiber type and architecture, fiber volume fraction, direction of heat flow, and service temperature.

- Experimental investigation of electrical properties, such as dielectric constant, dissipation factor, dielectric loss, electrical resistivity, volume and surface resistivity and volume and surface conductivity of short pineapple leaf fiber reinforced Bisphenol-A resin composite.
- To study the effect of various fiber lengths with constant volume fraction on mechanical, thermal and electrical behavior of PALF fiber reinforced Bisphenol- a (thermoset resin) based composites.
- Analytical studies will be attempted for mechanical using finite element method (ANSYS).
- Comparison of experimental and theoretical analysis of mechanical properties of short pineapple leaf fiber reinforced Bisphenol-A resin composite

Conclusion

The fabrication of present study shows that the useful composite with good properties could be successfully developed using PALF as reinforcing agent for the biphenyl _A matrix. The Pineapple Leaf Fibre (PALF) is a waste product of pineapple cultivation Hence, Pineapple fiber can be obtained for industrial purpose without any additional cost. Over the past decade, cellulosic fillers have been greater interest as the give composites improve the mechanical properties compared to those containing non-fibrous fillers.

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