A literature review on Composite material and scope of Sugar cane Bagasse

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***Abstract*— Rising environmental anxiety has lifted the research and industrial attention towards the growth of natural fiber based on green composite material. Research is going on to develop newer fiber-reinforced plastic composites in order to replace metals and alloys. In this review paper, we are going to discuss about various recent work or review report on natural fibers and fillers used for manufacturing cost effective composite materials and its applications. Also, this paper concentrates on scope of sugarcane bagasse particle used as reinforced material for making composite material.**

***Index Terms*— Sugarcane bagasse fiber (SCBF), Epoxy, Polymer composite, Natural filler/fiber.**

I. INTRODUCTION

In the present time, development of material tending towards green composite due to challenges of global environmental concerns like as follows: (1) Rising sea levels, (2) Rising average global temperatures, (3) Decreasing polar ice cap, (4) Rapidly depleting petroleum resources, etc. These issue intensified pressures on engineers, researchers, and industrialists towards manufacturing and new product design using green material partially or fully. The biodegradable waste disposal problem and benchmarks for cleaner as well as safer environment provide an abundant component of scientific research towards eco-composite materials, which easily have degraded or bio-assimilated. The abundant presence of natural fibre and any other available agro-waste has been also responsible for latest development in research towards green composite material.

1.1. Definition of composite

The Composite material prepared by mixing two or more different elements in order to make the resulting material having superior properties from its parental materials. There are two parts of composite material, matrix and filler/fiber (reinforcing phase). We can reinforced in various phase, in the form of fibers, sheets, or particles. It is surrounded in the other materials called the matrix phase. Metal, ceramic, non-metal, and polymer material can be used as reinforcing element and matrix material in development of composites. The fiber/filler used in composite are stiffer and stronger then the matrix material (Called continuous phase), which serve as load carrying members. Continuous phase (matrix) of composite acts as the load transfer medium between fibers/fillers. The matrix having ductile property than the fibers and due to that acts as the source of composite toughness

1.2. Merits and Demerits of Composites:

- Environment friendly and non-toxic.
- Biodegradable, compostable.
- User friendly and Cheaper.
- Non-abrasive .
- Light weight /small density.
- Income Source for rural/agricultural community.
- Heat and noise insulating property.
- Renewable and endless supply of raw materials.
- Free from health hazard (no skin irritations).
- Adequate specific strength.
- High and excellent toughness, thermal properties.

There are following disadvantages observed by the researchers as follows:

- Less compatibility with hydrophobic polymer matrix.
- Degradation of fiber due to storage for a long time period.
- Moisture absorptivity.

- Tendency to form aggregates during processing
- Relatively low thermal stability and less resistance to moisture.
- Hygroscopicity.

1.4 Types of Composites

Composite materials is divided into various categories depending on continuous phase, discontinuous phase, etc. They are as follows:

(a) According to type of continuous phase (matrix) material:

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

(b) According to the type of reinforcing (fiber/filler) material, they are classified as:

- Fibrous Composite
- Particulate Composites

1.4.1 Classification according to type of matrix material

The Composites are made from individual materials stated as constituent materials. There are two main categories of constituent materials as, matrix and reinforcement. The matrix material surrounds, and supports the reinforcing materials by maintaining their relative positions while the reinforcements convey their special mechanical and physical properties to enhance the matrix properties. The further classifications of composites are as follows.

Metal matrix composites

Some properties like as, higher strength, fracture toughness and stiffness are offered by metal matrices based composite material. Metal matrix can bear elevated temperature in corrosive atmosphere in comparison to polymer composites [7]. Titanium, aluminum and magnesium are the popular matrix metals currently in trend, these materials particularly used in aircraft applications [8]. Because of these characteristics metal matrix composites are under consideration for wide range of applications like as, combustion chamber nozzle (in rocket, space shuttle), housings, tubing, cables, heat exchangers, structural members etc.

CERAMIC MATRIX COMPOSITES

This type of composite materials consists of ceramic fibers/fillers reinforced in a ceramic matrix. Examples, silicon carbide fibers fixed in a matrix made from a borosilicate glass. One of the main objectives, in producing ceramic matrix composites is to enhance the toughness of material. Naturally, it is expected and definitely found that there is a simultaneous improvement in strength and stiffness of ceramic matrix composites [6].

POLYMER MATRIX COMPOSITES

Polymer matrix composites (PMCs) consists polymer (e.g., epoxy, polyester, urethane), reinforced by thin diameter fibers (e.g., graphite, aramids, boron). Generally, the mechanical properties of polymers are insufficient for many structural determinations. In particular, their strength and stiffness are low compared to metals and ceramics. These complications are overwhelmed by reinforcing other materials with polymers. Secondly, the processing of polymer matrix composites needn't contain high pressure temperature. Also equipment's essential for manufacturing polymer matrix composites are simpler. Due to this reason, polymer matrix composites developing rapidly and soon become popular for structural applications. There are two types of polymer matrix composites, first one fiber reinforced polymer (FRP) and another particle reinforced polymer (PRP). In first type, Fibers are the reinforcement and the main source of strength while matrix glues all the fibers together in shape and transfers stresses between the reinforcing fibers. In the second type, particles are used for reinforcing and to increase the modules and to decrease the ductility of the matrix. Particles used for reinforcing include ceramics and glasses such as small mineral particles, metal particles such as aluminum and amorphous materials, including polymers and carbon black. These types of composites have application in aircraft manufacturing, space industry, in the making of sporting goods etc. [9-12].

1.4.2 According to the type of reinforcing material

Reinforcement is a strong, inert woven and nonwoven fibrous material incorporated into the matrix to improve its metal glass and physical properties. Typical reinforcing materials are asbestos, boron, carbon, metal glass and ceramic fibers, flock, graphite, jute, sisal and whiskers, as well as chopped paper, macerated fabrics, and synthetic fibers. According to the type of reinforcing material, composites are classified in following two types.

PARTICULATE COMPOSITES

In such type of composites the reinforcement is of particle nature in various shape such as spherical, cubic, tetragonal, a platelet, or of other regular or irregular shape. They enhance the stiffness of the composite to a limited extent, used to improve the properties of matrix materials like thermal and electrical conductivities, improve performance at elevated temperatures, reduce friction, increase wear and abrasion resistance, improve machinability, increase surface hardness and reduce shrinkage [9].

FIBER BASED COMPOSITES (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

Fibers are divided into two groups, synthetic fibers and natural fibers. Synthetic fibers are man-made fibers which are a result of research by scientists to improve natural occurring plant and animal fibers. First synthetic fiber was Nylon. Fibres made from plant, animal and mineral sources are known as Natural fibers. It can be further classified according to their origin such as fruit fibers, bast fibers and leaf fibers. Fruit fibers are extracted from the fruits of the plant, they are light and hairy, and allow the wind to carry the seeds. Bast fibers are found in the stems of the plant. Fibers extracted from the leaves are rough and sturdy are called leaf fibers.

As the naturally derived fibers are low cost, renewable and biodegradable in nature, so from last few decades, area of engineering and research has been shifting towards the use of these fibers as reinforcing material in the polymer matrix. Last few decades various researches conducted on mechanical properties of natural fiber based polymer composites with special prominence on wood/polymer composites. A detailed literature survey is carried out to find the scope of composite with the present work.

2. LITERATURE SURVEY

A detailed comprehensive literature review on natural filler reinforced polymer composite material, and sugar cane bagasse fiber reinforced polymer composite material is presented including different type of polymer, filler dimensions, applications, etc.

Jayaramudu, Agwuncha, Ray, Sadiku, and Rajulu *et. al.* [1] studied with natural Polyalthiacerasoide woven fabrics mixing with epoxy composite. The woven fabrics extracted from bark of the tree to make hybrid composites. The hand lay-up technique was used to fabrication of hybrid composite at room temperature. The surface modification of woven fibre was done by the process of alkali treatment. The microstructure and morphology studied was completed using Fourier transforms infrared spectroscopic (FT-IR) and scanning electron microscopic methods respectively. The FTIR analyses represent the least value of hemi-cellulose and lignin contents of alkali treated woven fabric. The hybrid composite suggested for various applications in building and construction industries as panels for partitioning, flooring, storage tanks and table taps, etc.

Barnasree, Kumar, and Bhowmik *et. al.* [2] were studied wood dust particle reinforced in epoxy based composite for analysis of mechanical behavior. The sundy wood dust particle used as reinforcement and LY 556 epoxy for resin. The six different percentage of filler particle used in study. Tensile and flexural test were carried out using UTM and sample size based on ASTM Standard. The different design parameters like as filler content and speed for loading with tensile and flexural strength using GRA were optimized.Optimizationby GRA has the advantage of selecting best and worst options. GRG shows that test run number 13 is the best suited and test run number 3 is the least important. Epoxy composite with 10 fillercontents (wt%) at corresponding speed of 1 mm/min shows best performance and on the other hand with 0 filler content (wt%) at the speed of 3 mm/min shows theworst performance.

Motaung and Anandjiwala *et. al.* [3] studied of behavior of sugar cane bagasse particle reinforced composite like as, thermal degradation and kinetics of the untreated, alkali treated and sulphuric acid treated sugar cane bagasse (SB). It had been estimated by non-isothermal thermogravimetric investigation under nitrogen atmosphere The alkali treated fabricated samples represent the maximum values of thermal degradation. FTIR and XRD established different functionalization with fibre surface and improved crystallinity. The NaOH treated sample exposed the maximum thermal stability with acid treated samples presented the lowest.
Mohapatra, Mishra and Choudhary *et. al.* [4] was studied on teek wood dust (TWD) reinforced epoxy composite and thermal conductivity is analyzed. He used hand lay-up method for fabrication of composite with dust particle size 150, 200, 250-micronsand having volume fraction 6.5, 11.3, 26.8, 35.9. It was observed after experiment,thermal conductivity of composite decreases with respect of increase in filler content. Experimental results (TWD,150μ) was also compared with the theoretical models (such as Rule ofMixture model, Russel model, Maxwell model Baschirow & Selenew model) and found that the errors associated of all models in respect of experimental ones lie with range of 20.14 to 84%, 74 to111.84%, 79.13 to 115.79% and60.13 to 102% respectively. The newlydeveloped composite materials can be used for applicationsin automobile interior parts, electronic packages, ceiling roofs, building constructions, sports goods and furniture etc.

Dinesh and Jagdish *et. al.* [5] research focused on wear study of sisal fibre reinforced epoxy based composite materials. LY-556 and HY 951 used as resin and hardener respectively. 10%, 20%, and 30% sisal fibre used as reinforcement during fabrication of composite by had lay-up method. By increasing the percentage of the sisal fibre in fabrication work enhance the weight loss of the specimen of wear test. SFRECM can be used as substitute materials for human Orthopedic Implants.

Rout and sahoo *et. al.* [6] studied with analysis of erosion wear process of nonlinear problem with operating variables. The wear behavior of material depends on numerousconstraintslike as impact velocity, impingement angle, material, erodent size, etc. To obtain minimumrate of erosion, conduct experimentswith the material having combination of these parameters. Waste granite powder was considering as filler in the jute fiber in reinforced epoxy composite. It was concluded, industrial waste like as granite powder can be utilized to produce low cost natural fiber reinforced composite. Also, chemical treatment of fiber and filler had enhanced erosion resistance of composite samples.

Rajuand kumar *et. al.* [7] was studied the effect of variation of thickness on bending/flexural behavior of glass fiber reinforced in epoxy based laminated composite material. The laminate composite samples fabricated by using vacuum baggage technique. The fabricated specimen was subjected to static three-point bending and followed as per ASTM D90 standards. The flexural strength and stiffness of the composites were estimated to evaluate the flexural property of laminated composites.

Rout and Sahoo *et. al*. [8] researched *on e*rosion wear in non-linear problem due to its operating variables. The wear method depends on numerous parameters like as impact velocity, impingement angle, material, erodent size, etc. To obtain minimum erosion rate and the experiments to conducted the material with combination of these considerations. The waste granite powder was used as filler in the jute fiber reinforced epoxy composite. It was detected that granite filled samples contain better erosion resistance in comparison of unfilled ones.

Brien, Chin, Long, and Wetzel *et. al.* [9] was worked with development of Composites having polymer–matrix reinforced by polymer ribbon monofilaments. This material is mechanically robust and transparent composite materials. The outcome represents that these polymer–polymer composites offer good transparency with wide temperature range, and superior ballistic dispersion resistance compared with monolithic transparent polymers.

Wu, Chi, Wu, and Lee *et. al.* [10] work focused on basalt fiber (BF) reinforced with high density polyethylene (HDPE). The mechanical, thermal, and morphological studied. The micro-mechanical modeling of tensile properties for the BF/HDPE composites exhibits good selected models for the experimental study. The organic coating of BFs fiber was examined and confirmed using FTIR spectrum with the amount was approximate 0.15 wt.% detected from TGA study. The surfactant coating assisted the BF dispersion in the HDPE matrix.

Karaduman, Sayeed, Onal, and Rawal *et. al.* [11] was studied of the viscoelastic properties of jute/polypropylene nonwoven reinforced composites by dynamic mechanical analysis. The chemical treatment of fiber completed by alkali solution to obtain better adhesion property of the fiber-matrix interface. The degrees of highest storage modulus and loss modulus of nonwoven composites enhanced with increase in the jute fiber content.

Kumar, Sahoo and Bhowmik *et al.* [12] worked on fabrication and experimentation of sundi wood dust particle reinforced composite materials. In this work, sundi wood dust particle reinforced epoxy composite processed at seven different % of filler wt. The tensile and flexural tests were executed at three different speeds to investigate the mechanical behaviour of composites. The maximum load, tensile stress and strain, and flexural stress and strain values are observed at maximum and minimum with filler wt. of 10 % and 15 % respectively and speed of 1 mm/min.

Kumar, Babu, and Reddy *et. al.* [13] was focused with the study of flexural and tensile behavior of short Kenaf fiber reinforced composites. The fibers were chemically processed in 2% NaOH solution at room temperature. The size of short fibers of 4mm and 8 mm are used in this work. The composite lamina was fabricated by hand molding method using isopthalic polyester resin. The Flexural test and tension tests were carried out as per ASTM standards. Fiber matrix weight ratio of 1:20 had been used. Three and one specimens were prepared for Short natural fiber composite laminate and water absorption tests as per ASTM standards respectively.

Rathankar and Shivanand *et. al.* [14] worked on effect of fiber orientation of epoxy laminated composite. Three-point static bending test/Flexural test conducted according to ASTM standards. Hand lay-up method is adopted for fabrication of samples. In composite fabrication fiber orientation on 0^0, 45^0, 90^0 and laminated composite plate thickness 2mm and 4mm. Graphite fiber laminate 45^0 exhibit higher flexural strength than glass fiber laminate with same orientation.

Aarthi and Velmurugun *et. al.* [15] worked focused on analysis of property of resin and fiber performance of glass/epoxy laminates with Impact and compression test. Fabrication of composite followed by vacuum bag method by curing for specified time in hot air oven. It was observed delamination propagation extend throughout with width of sample specimen between middle plies influenced the sub-laminate buckling.

Kommula, Kanchireddy, Shukla, and Marwala *et. al.* [16] investigated on tensile properties of napier grass fiber strands extracted by mechanical and water retting process. The composites were fabricated with 0, 5, 10, and 15% of alkali treatment and with a volume fraction of fiber 10, 20, and 30%. The orientation and loading of fiber on the tensile strength of the composites were analyzed using universal testing machine.

Prasanna and Subbaiah *et. al.* [17] was investigated tensile, flexural and Impact strength of hybrid composite fabricated with sisal fiber and pineapple fibre. LY 551 and HY 951 used as resin and hardener respectively. The hybrid sample fabricated by Hand lay-up method. These composite used in various applications due to unique features like as recyclability, waste utilization, environment friendly, bio-degradability, high strength, and an alternative of plastics. By increase of % of sisal fiber increase in tensile and bending strength of sisal-pine fibers composite as well as increment in density. It was concluded, with increment of pine fiber % help to reduction in density of composite and addition of pine fiber impact strength was improved.

Malaiah, Sharma, and Krishna *et. al.* [18] worked on hybrid composite made up of Sansevieria cylindrica (Sc) and Sisal(Sl) hybrid fibers with the blend of composites followed by the synthesized and tested.Theobjective was focus on to estimate the mechanical performance (tensile, bending and impact strength) ofblended Epoxy (Ey) with Polyester (Pr) in proportion of 85/15(Wt./Wt.) filled with Sansevieria cylindrical (Sc) atdifferent compositions (3,5,10,20 and 30wt%). The extrusion and hot press molding technique was used for fabrication of samples. The outcome of thiswork representthat extrusion and hot press molding process could be used to fabricate the Sc short fiberEy/Pr blended composites havingamazing mechanical properties. It was clear that tensile properties decreased as the % of the filler increased.

Malaiah, Sharma, Krishna *et. al.* [19] was studied on wear study of 2%, 24% and 36% ofHybrid Fiber (Natural fiber- Sisal, Jute and Hemp) reinforced with polymercomposite material and can used as Bio-material. The characterization of 12%,24% & 36% of the natural fiber reinforced polymer composite materialContain the low density, economical for prosthetic bone in respectto bio-compatibility and the mechanical behavior of long humanbones, like as Femur Bone. The samples were prepared according to ASTM Standard G-99 by using resin- LY556 in the matrix and Hardener-HY 951 with the 12%, 24%and 36% of natural fibers (Sisal, Jute and Hemp) as reinforced material with fiber weight fraction, and randomlycontinuous long fiber orientation. The hand lay-upfabrication technique was used to prepared the specimen. The wear test was conducted using pin-on-disk apparatus with was issued under the standard having ASTM G- 99.

Srivastava and Choudhary *et. al.* [20] investigated the suitability of natural and synthetic fiber reinforced hybrid composite to replace the leaf spring used in automobiles. The jute and E-glass fiber woven, roving, and mats were applying as the reinforcing element and epoxy resin LY556 consider as the matrix material.Also, the UNIGRAPHICS NX6 were used to develop CAD models of leaf spring and ANSYS 14.5 used to finite element analysis (FEA) studied. This work outcome represents optimum condition for design variables of the hybrid composite leaf spring by FEA. The weight of leaf spring reduced by 55% in comparison of the steel leaf spring. It was also concluded that the Jute/E-glass/Epoxy hybrid composite leaf spring was moreeconomical than E-glass/Epoxy composite leaf spring.

Nitin and Singh *et. al.* [21] work focused on use of walnut particles filler as reinforcing element in epoxy based composite. In fabrication of composite material 10-40% weight of epoxy matrix was used. The density, Physical property, and Mechanical property had been estimated. After study, it was concluded, density reduces with increment in increment of reinforcement of shell particles. But, rate of increment decrease gradually after thirty percent of reinforcement by weight.

Miller, Lepech, and Billington *et. al.* [22] investigation on development and behaviour study of biobased composites. In this research work, biobased composites fabricated with different natural fiber reinforcement in a poly(b-hydroxybutyrate)-co-(b-hydroxyvalerate) matrix. These composite through experiments and environmental impact basis of life cycle assessments. It was observed, flexural properties and thermal conductivity of certain short-chopped glass fiber reinforced plastics be comparable with natural fiber based composites. Multi-criteria material assortment procedures were adopted to weigh favorite material properties. The Flexural testing represent that the highly treated hemp fibers providing, higher strength and flexural properties of biobased composites than the low processed hemp fibers.

Shankar and Rao *et. al.* [23] were study of tensile properties on bamboo/glass reinforced epoxy based hybrid composites. The property of bamboo fibers after alkali treatment analyzed. The outcome of his work represent that the tensile properties of hybrid composites increase respect of glass fiber content and higher than alkali treated bamboo fiber reinforced composite.

Mosawi *et. al.* [24] investigated on mechanical properties of Palm-Kevlar fibers reinforced hybrid composites. Impact strength, tensile strength, flexural strength and hardness were studied. Fibers mixed with epoxy resin (LY 556) in different percentage of fibers (10%, 20%, 30%, 40%, 50%, 60%, 70%, & 80%). It was observed during experimentation mechanical property is higher with 50% of Kevlar and Palm fibers respectively, but at 70-80% mechanical properties of hybrid composites reduced due to lower wettability between fibers and resin.

Verma and Chariar *et. al.* [25] were researched on dry bamboo culms with epoxy resin to fabricate layered bamboo epoxy based composite laminates. Mechanical properties (Tensile, flexural, and screw holding capability) of fabricated composite material were determined. These material can be used in general application like as furniture, beam, and column, etc. Dry bamboo culms were used in processed into thin lamina and cold pressed by using epoxy resin. Tensile and compressive properties of LLBCs were decreases with increment in lamina angle.

Faruk, Bledzki, Peter, and Sain*et. al.* [26] researched on development of high-performance materials usingnatural resources. Bio-based composite material properties depend on various factor like as, type of fiber, processing methods, and modification of methods, etc. In this work, comprehensive reviewed on readily use of natural fibers and biopolymers. The complete features of natural fiber used in reinforcement in biocomposites, containing source, category, configuration, composition, as well as mechanical properties, also studied. The modification methods; like as, physical (corona and plasma treatment) and chemical (silane, alkaline, acetylation, maleated coupling, and enzyme treatment) was studied.

Singha and Rana *et. al.* [27] studied on natural fibers reinforced material used in fabrication of composite in polymer matrix. The Agave fiber used as discontinuous phase and polystyrene matrix. To explore the effectiveness of material, mechanical and morphology study be performed. The surface amendment of Agave fiber was carried out using graft co-polymerization (methyl methacrylate) in the presence of ceric ammonium nitrate (CAN) as an initiator. It was found that particle reinforced composite contain better mechanicalproperties in comparison of the short and long fiber reinforced composite materials. The fabricated composites were characterizedby Fourier transform infra-red (FT-IR) spectroscopy, Scanning electron microscopy (SEM) and TGA/DTA techniques.

Kumar and Reddy *et. al.* [28] used epoxy (LY-556/HY-951) as binder, fumed silica (FS) and modified clay (MC) for reinforcing element. Thermogravimetry study (TGA) representimproved thermal stability for epoxy with FS fillers in comparison of epoxy with MC fillers. Tensile, Impact and SEM test result examined. SEM result displays that addition of clay considerablychange the epoxy system from brittle to ductile nature. FTIR readingsshowed the formation of C-H bonds on the surface of the nanocomposites. It was observed during study natural frequency of nanocomposites is higher than that of pure epoxy polymer.

Chakradhar, Subbaiah, Kumar, and Reddy *et. al.* [29] focused on mechanical behavior analysis of inter cross linked network in unsaturated polyester with epoxy blend. He studied tensile strength, impact strength, shear strength, SEM. And TEM to characterize nanocomposite. Ultra sonication process used to mix homogeneously resin and nanoparticles. Thermogravimetry analysis (TGA) represent 15% weight loss and 10^0C rise in temperature for five percent weight of clay sample. SEM and TEM study indicate that excellent bonding between the matrices and clay is the main reason to improvement of properties. Application of these nanocomposite in field of automobile parts, transportation systems and consumer products.

Cerqueira, Baptistab, Mulinari *et. al.* [30] was studied on the composite material manufacturing using natural fiber as reinforce fibers. He was evaluated the effect of chemical amendment on mechanical behavior of sugarcane bagasse fiber reinforced in polypropylene based composites. The Fibers were treated with 10% sulfuric acid solution and followed by delignification by 1% NaOH solution. The tensile, flexural (3 – point bending), and impact test be studied of fabricated composites. The fracture analysis was performed using SEM (secondary electrons mode). The outcome of composite samples compares with pure polymer. This study shown cellulose based chemically modified from sugarcane bagasse has better property than chemically untreated fibre particle reinforced composites.

Rodriguesa, Maiaa, and Mulinari *et.al.* [31] was studied the impact on property of chemical modification of sugarcane bagasse fibers processed by estherification over anhydrideMethod to use as reinforcement in polyester matrix. The scanning electron microscope (SEM) and X-ray diffractometer (XRD) used in analysis of modification in fibers. The SCB fibers mixedwith polyester resin, and compression molding used to fabricate the sample according to ASTM D-3039 standards for tensile tests. The tensile test was carried out using EMIC machine according to ASTM D-3039.

Goulart, Oliveira, Teixeira, Miléo, and Mulinari *et. al.* [32] researched on natural fiber reinforced composites. Natural fibers having better mechanical properties than glass fibers like as, stiffness, impact strength, flexibility, and modulus. Tendency to form aggregates in time of processing, poor moisture resistance, and mismatch between fibers and polymer matrices problems comes with natural fibers reinforcements in polymer matrix. The effect of coupling agent with palm fibers/ PP composites were estimated. Outcome of this work represent that the addition of coupling agent in the composites, significantly enhance the flexible strength and modulus, when compared with the pure polymer.

Sarkia, Hassana, Aigbodiona, and Oghenevweta *et. al.* [33] was examined the morphology and mechanical behaviour of coconut shell particles reinforced filler with epoxy based composites be evaluated. The Coconut shell filled composites fabricated with epoxy polymer matrix having up to 30 wt.% of the coconut shell fillers. The Scanning electron microscopy (SEM) of composite surfaces were shown that, there are good interfacial contact with coconut shell particles and epoxy matrix. It was observed after experimentation that, the value of tensile modulus and tensile strength increased as per increment of coconut shell particles content. The impact strength was slightly decreased as compared with pure epoxy resin.

Ku, Wang, Pattarachaiyakoop, and Trada *et. al.* [34] reviewed on the tensile behavior of natural fiber reinforced polymer composites. From past few decades, natural fibers drawn attention by researchers, engineers and scientists as an alternative source of reinforcing materials in manufacturing of the composites. Abundant availability, ease in processing and low cost is the main issue of attraction and interest to use as reinforced material in development of composites. It was revealed that, the rule of mixture (ROM) predicted and experimentally obtained tensile strength of different natural fibers reinforced HDPE composites were very close to each other and the Halpin–Tsai equation was used to predict the Young's modulus of composite materials made of different types of natural fibers.

Smrutisikha *et. al.* [35] worked on CNT's reinforced epoxy based composites. Fabrication of sample completed at room temperature. Flexural moduli, electrical conductivity, and glass transition temperatureof epoxy resin and nanocomposite samples had been determined. SEM used to study distribution behavior of carbon nanotubes in the epoxy matrix. Theincrease in glass transition temperature represent the strong interaction existing with MWNTs itself and epoxy chains, limiting themovement of polymer chains.

Samanta, Maity, Dalai, and Banthia et. al. [36] were investigated on toughness of the triethylene tetramine cured diglycidyl ether of bisphenol-A (DGEBA) by using modifier with and without red mud waste particles. The unfilled and red mud waste filled modified epoxy were tested with impact, adhesive, tensile, flexural, and thermal properties by differential scanningcalorimetry (DSC), Thermogravimetry (TG) and dynamic mechanical analysis (DMA). The investigation of effect on modifierconcentration and red mud waste particles on toughening property was done.

Luz, A Gonc¸ Alves, and Arco *et. al.* [37] fabricated composite samples by compression and injection molding processes using fiber (sugarcane bagasse, bagasse cellulose and benzylated bagasse) and polypropylene matrix. The flexural and tensile properties were studied. Scanning electron microscope used in analysis of the fracture surface. The fabrication of samples completed by injection molding under vacuum process. The outcome of study represent that the mechanical properties did not have good adhesion between fiber and matrix.

Sun, Sun, Zhao, and Su *et.al.* [38] were study comparatively with three processes for isolation of cellulose from sugarcane bagasse (SCB). The Consecutive extractions of dewaxed SCB in water with or without ultrasonic irradiation and different concentrations of alkali and alkaline peroxide generated 44.7 and 45.9% cellulose preparations. It contained 6.0 and 7.2% hemicelluloses and 4.4 and 4.9% bound lignin.

Franco and Gonzalez *et. al.* [39] was investigated on mechanical behaviour of natural fiber reinforced composite. In this study, high density polyethylene (HDPE) used as matrix material and henequen fibers used as reinforcing element. For enhancing bonding behaviour between fibre and matrix, fibre surface modification completed using alkaline treatment with silane coupling agent. The usage of silane coupling agent to support a chemical interaction for improved the degree of fibre-matrix joining. The elastic modulus of the composite did not improve with the fibre surface modification. The tensile and flexural was carried out using 5000 kN. load cell according to standard D 638 and D 790.

1998 Gautam and Pathak *et. al.* [40] was reported on fabrication and evaluation/testing of the fibre reinforced corrugated sheet. The flexural test completed on 4-point bending on UTM. Computational modelling and analysis was completed on ANSYS using finite element method approach. Also, the experimental and theoretical approach was compared and evaluated.

Assarudeen and kumar *et. al. [41]* studied on analysis between conventional steel, E-glass/Epoxy composite, E-glass/jute/Epoxy and E-glass/Banana/Epoxy based hybrid composite leaf spring. He used LY 556 and Hardener HY 951 as resin and matrix material respectively for composite fabrication. The CAD models of Leaf spring were developed in CATIA V5 R20 and imported in ANSYS 15.0 workbench where finite element analysis (FEA) was performed. The hybrid composite leaf spring is found 81% weight reduction, lower cost, lower stresses, higher strain energy.

Mahindra, Srividya, Reddy, and Kavitha *et. al. [42]* worked on degradation of property having epoxy based composite material. For this study Araldite LY 556 and HY 951 used as resin and hardener respectively. In this research he finds durable life of composite structure under moisture gain trends with various temperature with respect to time function. It was observed, hot setting laminate had good strength comparing with cold setting laminate.

Rao, Madhusudan, Raghavendra, *et. al.* [43] researched on the evaluation of the wear property of treated and untreated coir (Coconut) dust particle filled epoxy resin based composites. The concentration of coir is taken 10%, 20%, and 30% for fabrication of composites. Also, variation of loads (10, 20, and 30 N) and varying velocities (300, 400, and 500) were considered to study of abrasive wear rate. The pin-on-disc machine against 400-micron grit size of abrasive used to investigate wear rate behavior of composite. To minimize the experimental time and cost of investment by using Taguchi model L9 were selected.

Kumar, Chandan, and Ramamoorthi*et. al.* [44] researched on utilization of the bio-fiber based reinforced polymer composites. In his work banana, bamboo and pineapple fibers use to develop composite. By the amalgamation of all three fibers fabricate bamboo/banana/pineapple reinforced hybrid composites. The maximum weight of reinforcing element used in composite is 30% and other is matrix material. The developed samples were subjected with mechanical tests as per ASTM standards and best arrangement is recommended for the manufacturing of automobile applications.

5. OBJECTIVE OF THIS INVENTION

There are following silent observations are made from the literature review.

Sugar cane bagasse fiber (SCBF) used as reinforcing element in fabrication of Polymer composite.It is observed Hand lay-up methods used widely in fabrication of Polymer composite. Also, some researcher used Centrifugal molding, Pultrusion molding, etc.Inorganic filler used as reinforcing particles in development of natural filler reinforced epoxy based composite.Cost and quality control of natural filler reinforced composite is the major stone to use as alternative material by product designer and manufacturers.Application of natural filler reinforced composite is very wide like as aerospace, automobile, construction, decking, etc.The review on natural filler reinforced reveals that SCB dust particle has never been used in fabrication and application of epoxy based composite at low cost.

There is still scope found on tensile and flexural behavior on SCB dust particle reinforced polymer composite.There is definite scope on study of mechanical behavior under different testing conditions of SCB dust reinforced polymer composite.Besides all these, the main motive is to fabricate a economic natural fiber based composite material for commercial usage.

7. CONCLUSION

Researchers done a lot of research on natural fiber reinforced polymer composites but SCB dust particle has never been used in fabrication and application of epoxy based composite at low cost. There is definite scope on study of mechanical behavior under different testing conditions of SCB dust reinforced polymer composite. Cost and quality control of natural filler reinforced composite is the major stone to use as alternative material by product designer and manufacturers. Besides all these, the main motive is to fabricate a economic natural fiber based composite material for commercial usage.

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REFERENCES

[1] J Jayaramudu, S C Agwuncha, S S Ray, E R Sadiku, A. V Rajulu. Studies on the chemical resistance and mechanical properties of natural polyalthia cerasoides woven fabric/glass hybridized epoxy Composites. Research Article Adv. Mater. Lett. 2015, 6(2), 114-119.

[2] B Chanda, R Kumar, K Kumar and S Bhowmik. Optimisation of Mechanical Properties of Wood Dust-reinforced Epoxy Composite Using Grey Relational Analysis. © Springer India 2015 K.N. Das et al. (eds.), Proceedings of Fourth International Conference on Soft Computing for Problem Solving, Advances in Intelligent Systems and Computing 336, DOI 10.1007/978-81-322-2220-0_2.

[3] T E Motaung, R D Anandjiwala. Effect of alkali and acid treatment on thermal degradation kinetics of sugar cane bagasse. Industrial Crops and Products 74 (2015) 472–477.

[4] R C Mohapatra, A Mishra, B B Choudhury. Experimental Study on Thermal Conductivity of Teak Wood Dust Reinforced Epoxy Composite Using Lee’s Apparatus Method. International Journal of Mechanical Engineering and Applications. 2014; Vol. 2, No. 6, pp. 98-104. doi: 10.11648/j.ijmea.20140206.14.

[5] K R Dinesh, S P Jagadish, A Thimmanagouda. Characterization and analysis of wear study on sisal fibre reinforcement epoxy composite materials used as orthopedic implant. International Journal of Advances in Engineering & Technology, Jan. 2014.

[6] L k rout, S S sahoo. Study on erosion wear performance of jute-epoxy composites filled with industrial wastes using Taguchi methodology. Proceedings of second IRF international conference, 30th november-2014, mysore, India, ISBN: 978-93-84209-69-8.

[7] F A Raju, K B kumar. Design and Analysis of Horizontal tail of UAV using Composite materials. International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 7–July 2014.

[8] A K Rout, S S Sahoo. Study on erosion wear performance of jute-epoxy composites filled with industrial wastes using taguchi methodology. Proceedings of Second IRF International Conference, 30-11-2014, Mysore, India, ISBN: 978-93-84209-69-8.

[9] D J O Brien, W K Chin, L R Long, E D Wetzel.Polymer matrix, polymer ribbon-reinforced transparent composite materials. Composites: Part A 56 (2014) 161–171

[10] Qinglin Wu, Kai Chi, Yiqiang Wu, Sunyoung Lee. Mechanical, thermal expansion, and flammability properties of co-extruded wood polymer composites with basalt fiber reinforced shells. Materials and Design 60 (2014) 334–342.

[11] Y Karaduman, M M A Sayeed, L Onal, A Rawal. Viscoelastic Properties of Surface Modified Jute Fiber/ Polypropylene Nonwoven Composites, Composites: Part B (2014), doi: http://dx.doi.org/10.1016/j.compositesb.2014.06.019.

[12] R Kumar, K Kumar, P Sahoo and S Bhowmik. Study of Mechanical Properties of Wood Dust Reinforced Epoxy Composite. Procedia Materials Science 6 (2014) 551 – 556.

[13] K K Kumar, P R Babu and K R N Reddy. Evaluation of Flexural and Tensile Properties of Short Kenaf Fiber Reinforced Green Composites. International Journal of Advanced Mechanical Engineering. ISSN 2250-3234 Volume 4, Number 4 (2014), pp. 371-380.

[14] G. Rathnakar, H. K. Shivanand. Fibre Orientation and Its Influence on the Flexural Strength of Glass fibre and Graphite fibre reinforced polymer composites. International Journal of Innovative Research in Science, Engineering and Technology. 2013; Vol. 2, Issue 3, ISSN: 2319-8754.

[15] Aarthi S and Velmurugun T. Investigation of Impact Performance of Glass/Epoxy Laminates. International Journal of Innovations in Engineering and Technology. 2013; Vol. 2, issue 1, ISSN: 2319-1058.

[16] V P Kommula, O R Kanchireddy, M Shukla, and T Marwala. Tensile Properties of Long Untreated and Alkali Treated Napier Grass Fiber Strands/Epoxy Composites. International Conference on Chemical, Mining and Metallurgical Engineering (CMME'2013) Nov. 27-28, 2013 Johannesburg (South Africa).

[17] G Venkatesha Prasanna and K V Subbaiah. Hardness, tensile properties, and morphology of blend hybrid biocomposites. Scholarly Journal of Engineering Research Vol. 2(1), pp. 21-29, May 2014. ISSN 2276-8955 © 2013 Scholarly-Journals.
[18] S Malaiah, K V Sharma, M Krishna. Investigation on Effect of Fiber and Orientation on the Properties of Bio-Fibre Reinforced Laminates. International Journal of Engineering Inventions e-ISSN: 2278-7461, p-ISSN: 2319-6491 Volume 2, Issue 2 (January 2013) PP: 65-70.
[19] K R Dinesh, S P Jagadish, A T gouda, N Hatapaki. Characterization and Investigation of Tensile and Compression Test on Sisal Fibre Reinforcement Epoxy Composite Materials Used as Orthopedic Implant. International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 2, Issue 12, December 2013 ISSN 2319 – 4847.
[20] A Srivastava and S Choudhary. Design and Structural Analysis of Jute/E-glass Woven Fiber Reinforced Epoxy Based Hybrid Composite Leaf Spring under Static Loading. International Journal of Mechanical Engineering and Research. ISSN 2249-0019, Volume 3, Number 6 (2013), pp. 573-582© Research India Publications.
[21] S Nitin, V K Singh. Mechanical behaviour of Walnut reinforced composite. J. Mater. Environ. Sci. 4 (2) (2013) 233-238.
[22] S A Miller, M D Lepech, S L Billington. Application of multi-criteria material selection techniques to constituent refinement in biobased composites. Materials and Design 52 (2013) 1043–1051.
[23] P. H. Sankar, H. R. Rao. Chemical resistance and tensile properties of bamboo and glass fibers reinforced epoxy hybrid composites. Advances in Polymer Science and Technology: An International Journal. 2012; 2(3): 27-29.
[24] Al-Mosawi Ali. Mechanical Properties of Plants - Synthetic Hybrid Fibers Composites. Research Journal of Engineering Sciences. 2012; Vol. 1(3), 22-25.
[25] C S Verma, V M Chariar. Development of layered laminate bamboo composite and their Mechanical properties. Composites: Part B 43 (2012) 1063–1069.
[26] O Faruk, A K Bledzki, H Peter, F M Sain. Biocomposites reinforced with natural fibers: 2000–2010. Progress in Polymer Science 37 (2012) 1552– 1596.
[27] A S Singha, R K Rana. Natural fiber reinforced polystyrene composites: Effect of fiber loading, fiber dimensions and surface modification on mechanical properties.Materials and Design 41 (2012) 289–297.
[28] A kumar, R reddy, k. V. P. Chakradhar. Hydrophilic fumed silica/clay nanocomposites: Effect of silica/clay on performance. International Journal of Nanomaterials and Biostructures 2011; 1 (1) 1-11.
[29] K V P chakradhar, K V subbaiah, A kumar and G R reddy. Epoxy/Polyester Blend Nanocomposites: Effect of Nanoclay on Mechanical, Thermal and Morphological Properties. Malaysian Polymer Journal, Vol. 6, No. 2, p 109-118, 2011.
[30] E F Cerqueira, C A R P Baptistab, D R Mulinari. Mechanical behaviour of polypropylene reinforced sugarcane bagasse fibers composites. Procedia Engineering 10 (2011) 2046–2051.
[31] E F Rodrigues, T F Maia, D R Mulinari. Tensile strength of polyester resin reinforced sugarcane bagasse fibers modified by estherification. Procedia Engineering 10 (2011) 2348–2352.
[32] S A S Goulart, T A Oliveira, A Teixeira, P C Miléo, D R Mulinari. Mechanical Behaviour of Polypropylene Reinforced Palm Fibers Composites. Procedia Engineering 10 (2011) 2034–2039.
[33] J Sarkia, S B Hassana, V S Aigbodiona, J E Oghenevweta. Potential of using coconut shell particle fillers in eco-composite materials. Journal of Alloys and Compounds 509 (2011) 2381–2385.
[34] H Ku, H Wang, N Pattarachaiyakoop, M Trada. A review on the tensile properties of natural fiber reinforced polymer composites.Composites: Part B 42 (2011) 856–874.
[35] Smrutisikha bal. Dispersion and reinforcing mechanism of carbon nanotubes in epoxy nanocomposites. Bull. Mater. Sci., vol. 33, no. 1, february 2010, pp. 27–31. © Indian academy of sciences.
[36] B. C. Samanta, T. Maity, S. Dalai, and A. K. Banthia. Toughening of Epoxy Resin with Solid Amine Terminated Poly (ethylene glycol) Benzoate and Effect of Red Mud Waste Particles. J. Mater. Sci. Technol., Vol.24 No.2, 2008.
[37] S M Luz, A R Gonc¸alves, A P Del Arco Jr. Mechanical behavior and microstructural analysis of sugarcane bagasse fibers reinforced polypropylene composites. Composites: Part A 38 (2007) 1455–1461.
[38] J X Sun, X F Sun, H Zhao, R C Su. Isolation and characterization of cellulose from sugarcane bagasse. Polymer Degradation and Stability 84 (2004) 331-339.
[39] P J H Franco, A V Gonzalez. Mechanical properties of continuous natural fibre-reinforced polymer composites. Composites: Part A 35 (2004) 339–345.
[40] C K Gautam and R. C. Pathak. Analytical evaluation of fibre-reinforced plastic corrugated sheet. Defence science journal, vo148, no 1, January 1998, pp. 105-113(c) 1998.
[41] H Assarudeen, G anandkumar. Structural analysis of banana/e-glass woven fiber reinforced epoxy based hybrid composite on mono leaf spring using FEA. Journal of chemical and pharmaceutical sciences www.jchps.com ISSN: 0974-2115.
[42] G Mahendra, K Srividya, C K Reddy and E Kavitha. Hygrothermal Degradation Studies on E-Glass Woven Rovings-Epoxy Composite. International Journal of Engineering Sciences & Research Technology.
[43] C H Chandra Rao, S Madhusudan, G Raghavendra, E Venkateswara Rao. Investigation in to Wear behavior of coir Fiber Reinforced Epoxy Composites with the Taguchi Method. International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622.
[44] R P Kumar, G Kumar Chandan, R Ramamoorthi. Fabrication and Testing of Natural Fiber Hybrid Composites. International Journal of Engineering Research, Volume No.5, Issue No.4, pp: 285-288. Doi: 10.17950/ijer/v5s4/414.