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A REVIEW ON NATURAL FIBRE REINFORCED POLYMER COMPOSITES

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ABSTRACT

Natural fibres will take a major role in the emerging 'green economy' based on the energy efficiency in using of polymer products as renewable materials. These fibres are completely renewable, environmental friendly, high specific strength, non abrasive, low cost and bio-degradability. Natural fibres are rich in cellulose and they are cheap and available in abundant for polymer reinforcement and it is also a potential alternative to the fibers of glass, carbon and other synthetics materials used for the manufacturing of composites. This review paper summarizes the hybrid composites of natural fibre reinforced polymer characteristics and its applications.

KEYWORDS: Natural fibres, Cellulose, Renewable source, Potential alternative.

INTRODUCTION

Natural fibres are increasingly gaining attention as their application is diversified into engineering fields such as automobile structural parts, building materials where light weight is required. The physical and mechanical characteristics of composites can be modified by adding a filler phase to the matrix body during the composite preparation. The incorporation of filler in composites is to improve its mechanical properties. Low cost and less tool wear during its machining process are among the known advantages of plant fibres and ease of recycling makes them eco friendly.

Classification of fibres:

Fibres are a class of hair – like material that are continuous filaments or in discrete elongate pieces, similar to pieces of thread. They can be spun into filaments, thread or rope. They can be used as a component of composite materials. They can also be matted into sheet to make products such as paper or felt.

The principle in fibre composites is to utilize fibres as reinforcement in matrix of resin. Fibres usually provide the greatest share of strength while resin provides binding to the fibres. Fibres by themselves cannot be used to sustain actual loads. Therefore, resin is used to bind and protects the fibres. Depending on the type of fibres, type of resin, the proportion of fibre-resin and the type of manufacturing process, the properties of fibre composites can be tailored to achieve the desired end product, natural fibres can also be used to produce fibre composites. Due to the need for more environment friendly materials, natural fibre composites are regaining the attention that once has been shifted to synthetic products. The first know utilization of natural fibre composites was straw reinforced clay for bricks and pottery. Many of the early research and development in fibre composites are dominated by the use of synthetic fibres. Although synthetic fibre composite materials such as glass fibres, carbon fibres and aramid are possessing high performance, they are less biodegradable and are sourced from non renewable resources .Therefore, the use of natural fibres may bring environmental benefits as well as cost benefits

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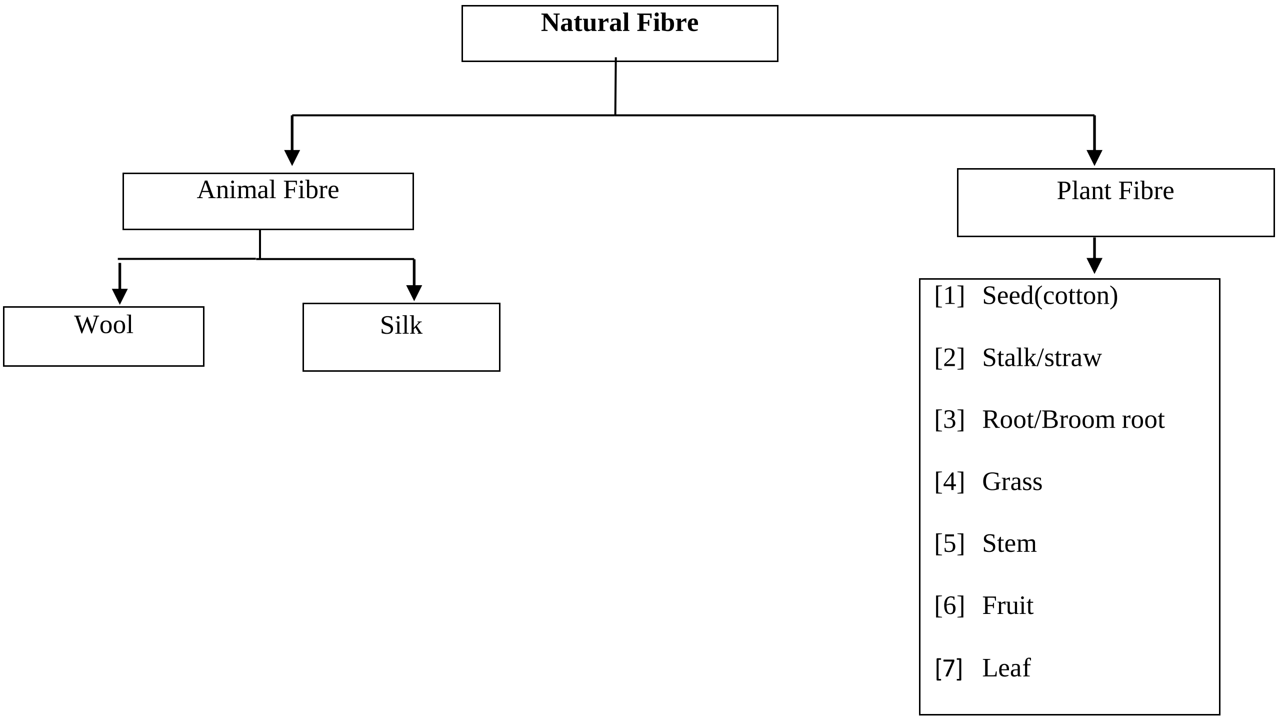

Fig 1: Classification of Natural Fibres

LITERATURE REVIEW

Budrun Neher et.al [1] studied the mechanical and physical behavior of palm fibre reinforced acrylonitrile butadiene styrene (ABS) composites for three different percentage of weight and revealed that the tensile strength (TS) and flexural stress (FS) were decreased with increasing fiber contents in the PF-ABS composites except 10%fiber content. Physical properties as water absorption property showed that with the increase of fibre content in the composites, water absorption increases.

Pradeep.P et.al [2] investigated the extraction of various fibers that are available from various portions of the palm tree; the density of palm fibre is significantly lower than glass fibre, carbon fibre, and also gives 20% better specific strength. The tensile strength of palm petiole is higher than other parts of palm tree. The high cellulose content and lower lignin content ensure better mechanical strength.

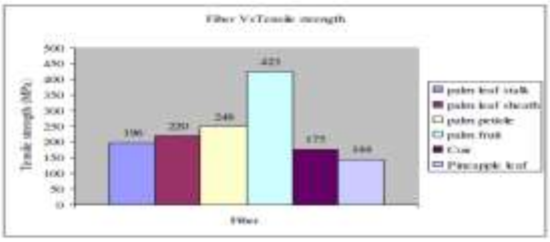

Fig 2: Tensile strength of palm fibers and other fiber.

N.Maheswaran et.al [3] investigated the Composites which are fabricated by using chemically untreated coconut and palm fibre with epoxy resin and chemically treated coconut and palm fibre with epoxy resin. The specimens were fabricated in thickness of 3mm and 5mm. chemical treatment(5% of sodium hydroxide) of fibres results the significant increase in tensile strength , Flexure strength , Impact strength .

Saira Taj et.al [4] studied the technologies of the future that incorporate natural fibre composite materials for injection moulded products (32%) ,bio plastic matrix (19%) and modified fibres for use in advanced applications (19%). Several natural fibre composites reach the mechanical properties of glass fibre composites,

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and they are already applied, e.g.in automobile and furniture industries. The most important natural fibres are Jute, flax and coir. Natural Fibres are renewable raw materials and they are recyclable.

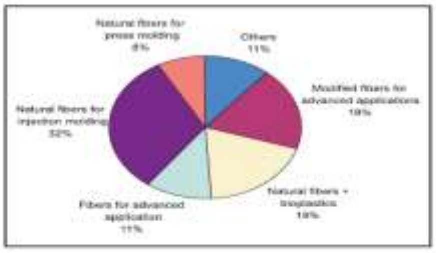

Fig 3: Forecast of natural fiber usage in future.

P.N.E.Naveen et.al [5] investigated that the effect of fibres volume on mechanical properties of composite and the results were found that the mechanical properties have a strong association with the volume fraction of the fibre. The tensile strength and Young's Modulus were found to be decreased with incorporation of coir fibres which again points to the ineffective stress transfer between fibres and polyester resin. The increase of coir fibres will make the composite tend to have low stiffness and ductility.

Alagarsamy.S.V et.al [6] investigated that high Tensile strength and high Impact strength is 48 KJ/mm2 is 11.5 Mpa (fig 4) obtained for specimen which contain 4% weight of chicken feather , 26% weight of coir and 70% weight of resin, because the coconut coir fibre percentage is more than chicken feather has good tensile properties. For high Flexural strength is 43.2 Mpa (fig 5) obtained for specimen contains 20% weight of chicken feather, 10 % weight of coir and 70% weight of resin, because the chicken feather percentage is more than coconut coir fibre has good flexural properties.

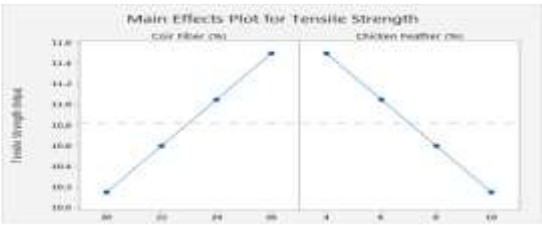

Fig 4: Effect of Tensile Strength

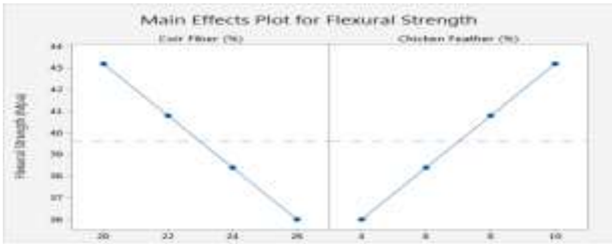

Fig 5: Effect of Flexural Strength

Naveen et.al [7] experimented that the mechanical properties of the composites such as micro-hardness, tensile strength, flexural strength, impact strength, of the composites are also greatly influenced by the fibre lengths. Dynamic characteristics such as natural frequency of the composite can be predicted by analyzing the mechanical properties. The tensile strength of composite was found to be a linear proportional to natural frequency. Moreover, the damping ratio was found to be increased by incorporation of coir fibres which giving an advantage to the structure in reducing the high resonant.

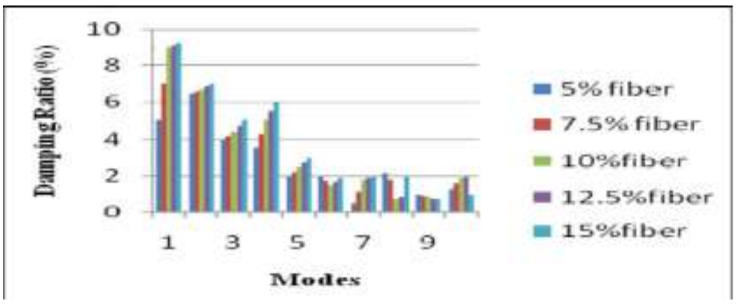

Fig 6: Damping ration of coir percentage

D.R.Mulinari et.al [8] experimented that the Fatigue behavior in composites presented a decrease in fatigue life when was applied greater tension. It was observed some failure mechanism as fractured fibres and presence of pull out and poor bonding interfacial between fibre and matrix. This fact occurred due to the treatment suggested on fibres surface. Of this form will be necessary improve the treatment on fibres surface to obtain improve results.

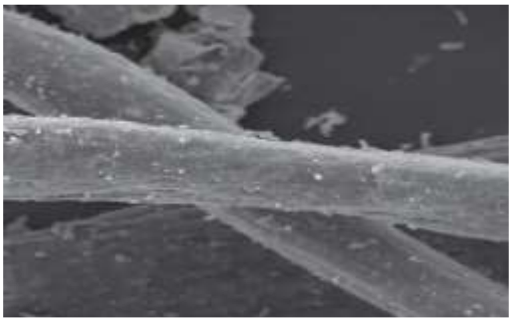

Fig 7: SEM of coconut fibres: untreated

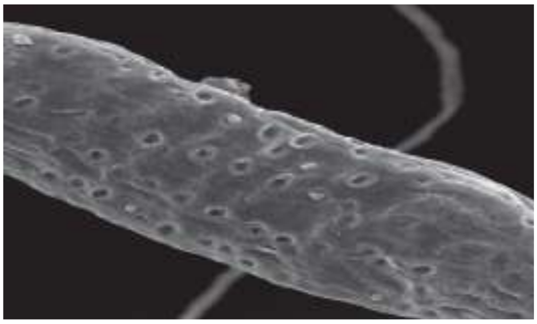

Fig 8: SEM of coconut fibres: treated

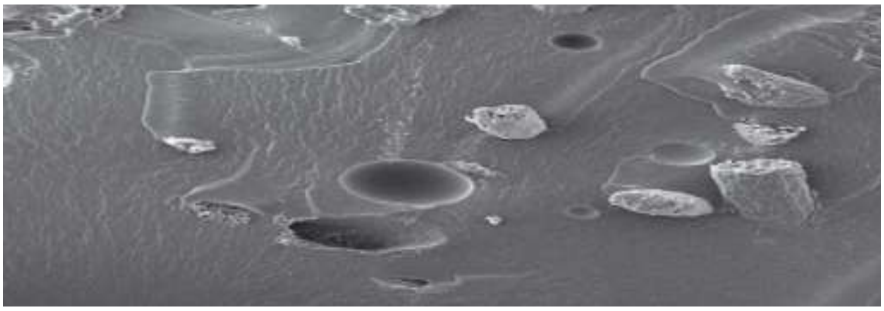

Fig 9: SEM of fracture surface of composites

Muthukumar .V. et.al [9] investigated micro mechanics assessment and statistical analysis the strength. Determining factors such as ultimate breaking load, ultimate stress, displacement at maximum force and impact strength are being determined for the parent fibres banana, Palmyra, sisal, jute and hybrid combinations. The comprehensive mechanical properties are increased to different extents compared with those of parent fibres and hybrid composites.

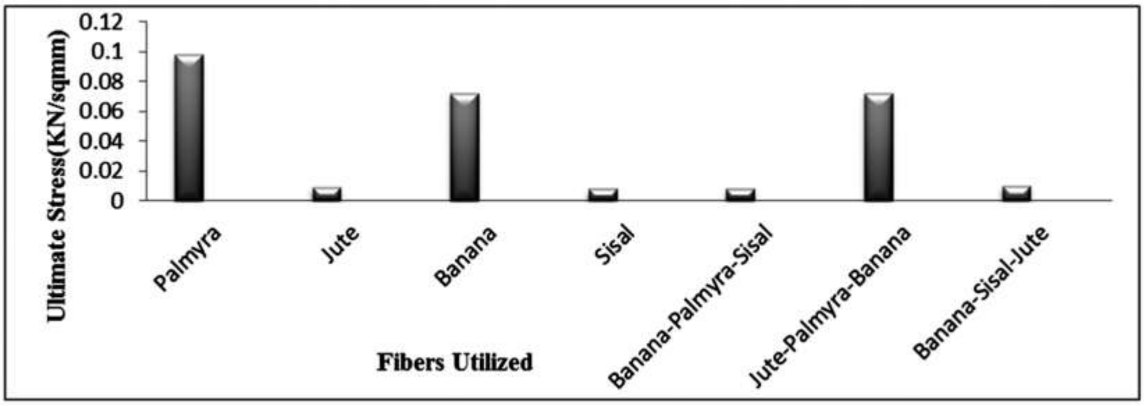

Fig 10: Comparison of the Ultimate Tensile Stress Under Flexural Test

Daniella R Mulinari et.al [10] experimented alkali treatment of palm fibres surface was effective for removing extractives and increasing the roughness, crystallinity and functional groups. The effects of modification of the fibres were assessed on the basis of morphology, infrared spectra and X-Ray diffraction.

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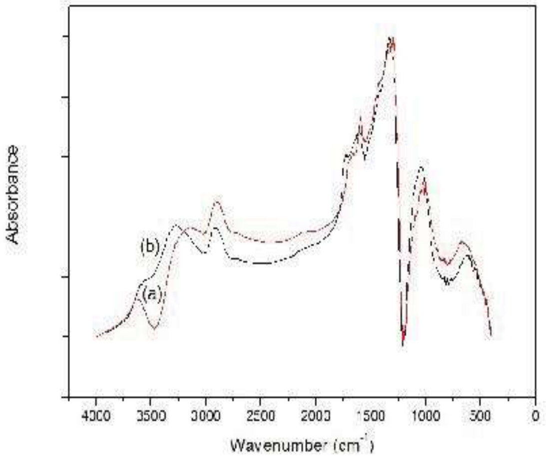

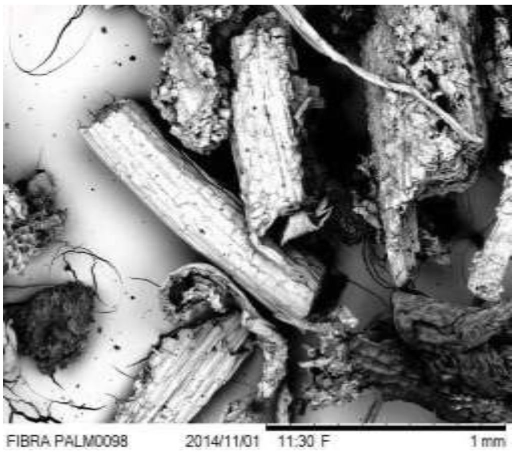

Fig 11: FTIR spectra of palm fibres treated and untreated   ***Fig 12: SEM of the in nature fibres 100X***

The addition of fibres in HDPE matrix was found to increase strength and modulus flexural as well as tensile strength. The modified fibres reinforced composites exhibited higher flexural modulus and tensile strength if compared to the pure HDPE and in nature fibres reinforced composites.

Dr. Shajan Kuriakose et.al [11] investigated tensile strength is higher for treated woven coir composites. This showed 56% and 6% increase compared to polyester and untreated woven coir composites respectively. The treated woven coir composites exhibited 34% and 43% increase in flexural strength compared to neat polyester and untreated woven composites. But treated non woven composites showed only 9% and 25% increase in flexural strength compared to neat polyester and untreated non woven composites, due to the poor compatibility between the fibre and matrix. Adhesion at fibre-matrix interface can be improved by chemical modification (sodium hydroxide treatment - mercirization) of the fibres. This makes them more porous leading to a rough surface texture allowing the coir fibres to reinforce strongly with polyester matrix.

Fig 13: Flexure tested specimen

Girisha K G et.al [12] determined tensile, flexural and impact properties of jute and hemp reinforced epoxy and polyester hybrid composites for 30^0, 45^0 and 90^0 fibre orientations. Composites with polyester resin as matrix give more tensile, flexural and impact strength than epoxy based hybrid composites. The tensile, flexural and impact strength is observed to be maximum at 900 orientations in both epoxy and polyester based composites. Diagonal inclinations of the reinforcing fibres gives poor mechanical properties as observed in 30^0, 45^0 oriented composites.

CONCLUSION

Comparing natural fibre and other reinforced composites found that natural fibres were superior in industrial application. Moreover, due to the usage of natural fibres in different engineering application and construction industries, it provides way for economic development in rural areas. The results in the investigation indicate that, there is a possibility to enhance the properties of coconut fibre and palm fibre reinforced composites. But very few investigations carried out on combination of natural fibre reinforced epoxy composites and properties. Literature showed that there was no much information available on combination of coconut fibre and palm fibre to find the dynamic properties of the composites. Development of a suitable hybrid with a known stacking sequence will have applications in automotive industry for weight and cost reduction; this leads way for the investigation on mechanical properties of coconut fibre and palm fibre reinforced epoxy hybrid composites by using hand layup method.

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