Influence of Nano Silica on Improvement of Mechanical Properties of Banana- Sisal Fibre Epoxy Hybrid Composites

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Abstract:

Natural fibre based composites are the promising materials. They are gaining a lot of attention in modern research due to the environmental concern and vast applications in automotive parts . In this work sisal fibres and banana fibres which are natural fibres have been used as reinforcing materials in epoxy composites. Nano silica was used to improve the effectiveness of the natural fibres .The physical and mechanical properties of the natural fibre based composites have been studied and reported.

Introduction:

An investigation on natural fibres is one of the flourishing areas in nowadays. The Biodegradable material is viewed as supportable and exceptionally solid materials. It has been the subject of present research endeavours for a considerable length of time. Every part of the natural fibres are eco-accommodating, recyclable, nonabrasive nature for quick handling and essentially have less wellbeing risks [1-4] .The interest for these items has been expanding over the course of the last years, with customer's acknowledgment over new and imaginative items, which prompts gain effective market open doors [5]. Natural fibres provide excellent mechanical, thermal and physical properties

The principal focus of the fiber-supported polymeric composites is that they are less expensive and light in weight. Outstanding the natural fibre based polymer composites have a lot of advantages over synthetic fibre based polymeric composites. Banana fibre is one among the agriculture waste ,these fibres are the these fibers are the waste materials from banana cultivation .The pseudo-stem is round and hollow in shape, where the leaf tail bases are in bunched collection. Banana fiber is awesome among different other fibres and has great mechanical properties. The particular strength properties of banana fibres are superior to other traditional fibres. Banana fibres have light weight, fire opposition quality, high strength, more modest stretching, biodegradability, extraordinary possibilities and powerful dampness ingestion quality. Banana fibres are additionally used for assembling paper sacks, channel making , paper light stands, beautifying things, composite stuffs, welcoming cards, pen stands, rope and mats and so on [6-9].

The Life length of banana fibres is around 100 years and it's the most grounded of throughout the entire different fibres. The sisal plant is a wide range of shrub(perennial) that fills in the equatorial jungle area and subtropical zone of the globe. Sisal fiber is a leaf fiber separated from the plant Agave sisalana and these are broadly developed among the world. Agave sisalana (American aloe) plant is filled in hard soil where some other ordinary plants can't be developed. The typical temperature ranges between 28°C to 20°C

Agave sisalana plants are packed in high temperatures. Roughly after decortications only 5% of sisal leaf is utilized and remaining 95% of leaf build-up is frequently utilized for manure creations, creature feed and age of bio energy [7]. The fibres without any debasements and no harms are outwardly chosen for the drying system. The dampness and residue are not consumed by sisal fibres as they are hostile to static [6-11]. The aim of this paper is to take maximum advantage of banana and sisal fibres based polymeric composites which can be further applied in automotive parts .

Materials and Method:

In this research sisal fibre and banana fibres used as strengthening fillers were obtained from Chennai. Araldite Epoxy resin with hardener was procured from local market was used to manufacture hybrid biodegradable composite. Nano silica was kindly supplied by sigma Aldrich .At first the sisal fibre and banana fibre were washed thoroughly with distilled water three times and dried in an oven for 24 hours then after the fibres were chopped and grinded and 0.5 wt.% of nano silica was added in to the epoxy resin and sonicated for one hour and after mixing it properly fibres were laid on the greased mould and epoxy resin mixed with nano silica was poured on to it and kept in the hydraulic press of 100 ton for 24 hours and then after the sheet was sliced in to the desired shape for mechanical testing .
Samples are named as follows (Table 1)

Table 1

Weight Ratio				Sample designation
Banana Fibre	Sisal Fibre	Nano Silica	Epoxy resin	
20	20	0.5	60	EBS1
10	30	0.5	60	EBS2
40	0	0.5	60	EBS3
0	40	0.5	60	EBS4

Result and Discussion:

Density :

Density of the composites was recorded as follows (Table 2):

Table 2

S.No.	**Samples**	**Density (g/Cm^3)**
1	EBS1	1.421
2	EBS2	1.422
3	EBS3	1.431
4	EBS4	1.434

Mechanical Properties

Flexural strength

Flexural strength is defined as the modulus of rupture or modulus of bend strength in which a material experiences the stress just before it yields in a flexural test . Flexural strength of the polymeric composites is very much influenced by the presence of the fillers in it. Table 2 shows the values of Flexural strength of EBS 1, EBS2, EBS3 and EBS 4 .

S.No.	Samples	Flexural strength (MPa)
1	EBS1	106 MPa
2	EBS2	118 MPa
3	EBS3	125 MPa
4	EBS4	121 MPa

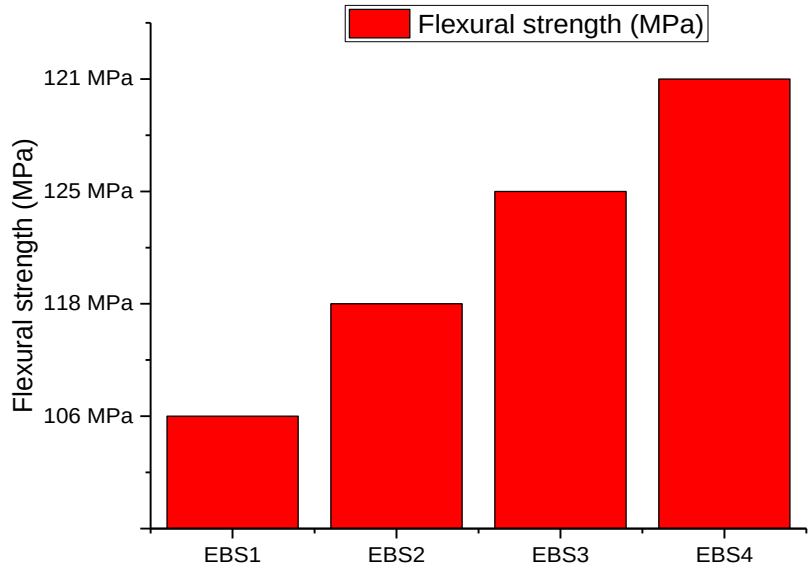

Fig. 1

Electrical Properties

Fig 2 shows the variation of dielectric constant with log frequency for the samples EBS 1to EBS 4 and it was observed that the dielectric constant Ɛ' declined suddenly on the rise in frequency . This is because of the lessening of space charge polarization. After that it remain steady on the other hand, at small frequency the dielectric constant was elevated.

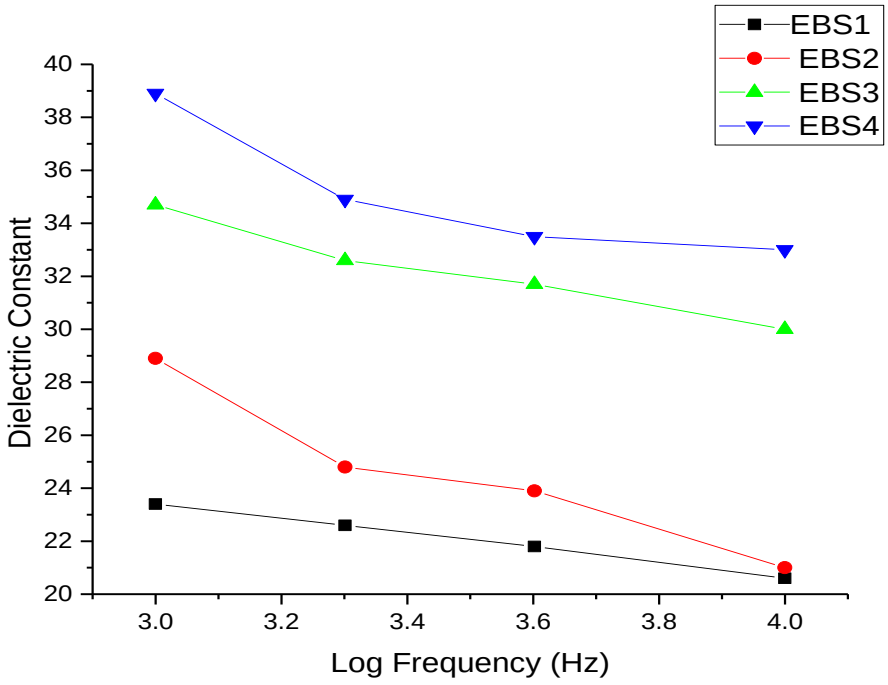

Fig 2

Conclusions:

- Composites of banana sisal fibre with nano silica reinforcement was successfully developed
- Density of the composites increased with the increase in banana fibre content.
- Flexural strength value of sample EBS 3 is maximum, from these observations it can be concluded that addition of nano silica improved the properties of banana –sisal fibre based epoxy composites and these materials can be used in automotive parts.

Acknowledgement

Financial support to Dr Archana Nigrawal by the DST Project (DST/WOS-B/AFE-5/2021) is gratefully acknowledged .

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