Experimental study on the mechanical performance of sugarcane bagasse fiber reinforced epoxy composite

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ABSTRACT

This paper presents an experimental study on the mechanical performance of sugarcane bagasse fiber reinforced epoxy composite. Compression properties of the composites were investigated in this research. Different weightage of short fiber were utilized to study their effects on the mechanical performance of the composites in terms of compression properties to investigate its effect on the mechanical performance of the composites. Hand lay-up composite molding process was used to fabricate the composite samples. 0wt% of short fiber reinforced composite exhibits the highest compression properties among all the samples. Sugarcane bagasse particulates reinforced composites were shown to have better performance compared to short fiber reinforced composites when the wt% of the fiber increase.

INTRODUCTION:

These days, increase in sustainability and environmental concerns have evoked the interest in research and development of high performance and biodegradable composite. Efforts have been made to develop natural fibers and particulate reinforced composites as it is one of the most effective ways to satisfy the "eco-material" concept which serve as a basis to sustain the environment. One of the alternatives solution that attracts interest is utilization of abundantly natural fiber as reinforced materials in polymer matrix composite.

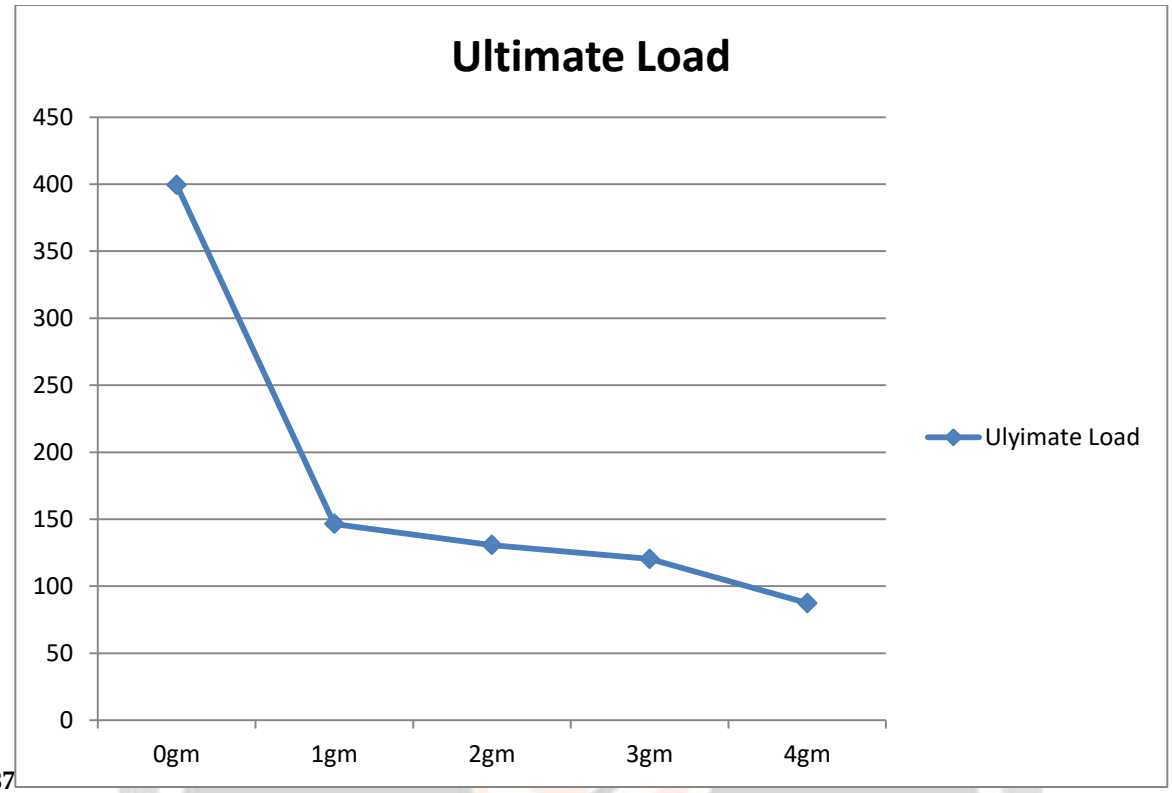
Composite is hybrid material which consists of two or more chemically distinct constituents. There is continuous phase which created by matrix and embedded by discontinuous phase, the reinforcement medium. The matrix phase is usually made up from fundamental material such as metals, ceramics and polymers. Meanwhile, the reinforcing phase is widely in the form of fibers, whiskers and particulates [1]. The reinforcing phase is usually stronger, lighter and stiffer than the matrix to enable the composites to possess better mechanical properties. Polymer matrix composites are utilized nowadays as they have good versatility, high performance and cost effective [2]. Epoxies are one of the most important matrices which are widely used for fiber-reinforced polymer due to its unique properties. Epoxy is relatively high strength, high modulus, low shrinkage, high chemical, heat and electrical resistance [3].As the awareness has greatly increased the world responsiveness towards natural fibers, an investigation has been carried out to study natural fiber reinforcements. These natural fibers which have been utilized in reinforcement can be found in numerous applications in various fields such as automobile, furniture, packing and construction. Besides, compared to conventional reinforcing fibers, the advantages of natural fibers are found out to be low density, fully biodegradable, environmentally friendly, renewable, non-toxicity, low cost, high toughness, good insulation against heat and noise, good thermal properties, reduced tool wear, reduced dermal and respiratory irritation, ease of separation and lower abrasiveness [4].

Sugarcane is one of the major crops in tropical region which has a total plantation area of 34500 acres in Malaysia [4] while the amount of sugarcane produced is approximately 1.3 to 1.6 million tons annually [5]. Bagasse fibers gathered through the sugarcane milling process after the extraction of the sugar-bearing juice from sugarcane. Sugarcane bagasse fiber-reinforced composites are found to exhibit better specific mechanical properties, such as

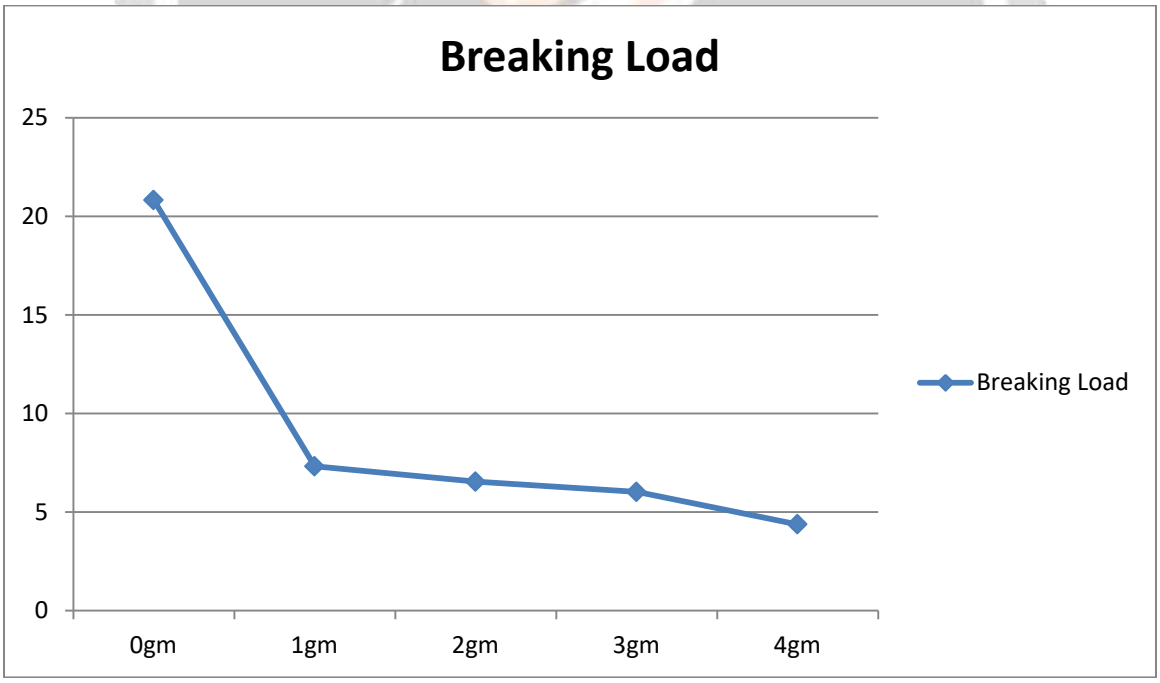
stiffness, flexibility, and modulus compared to those reinforced by glass fibers [6]. It can be perfect alternatives for reinforcing bio-composites as it is renewable and less expensive sources due to its abundance as well as low preparation cost of the fibers. [8]. The age of the fibers, the source of the fibers and different techniques of surface treatment of the bagasse fibers are the factors which will affect the mechanical properties of the sugarcane fiber. [9] Aspect ratio has a considerable effect on composite properties, hence it is important to conserve fiber length as much as possible during composite processing operations. Furthermore, the aspect ratio means an average length over diameter of the fibers is varied from plant species to species. [11]. They found that tensile strength and Young's modulus increase with an increase in the fiber length. Similar trend was reported by [12] in the case of short oil palm fiber with different lengths (2, 6, 10 and 14mm) into a natural rubber matrix. Tensile strength, elongation at break, and tensile modulus at 100% elongations were at a maximum when the length of the oil palm fiber was 6 mm. At higher fiber lengths, a decrease in the properties was found. This was due to the fiber entanglements prevalent at longer fiber length.[13]. They are generally organic polymer composites mostly filled with inorganic fillers, which combine the advantages of the inorganic filler material (i. e., rigidity, thermal stability) and of the organic polymer (i. e., flexibility, ductility, processability). There are different types of nanoparticles which have been developed and used in various areas due to their multifunctional properties, such as anti-bacteria, UV resistant, anti-wrinkle finishing and water repellent to fibers

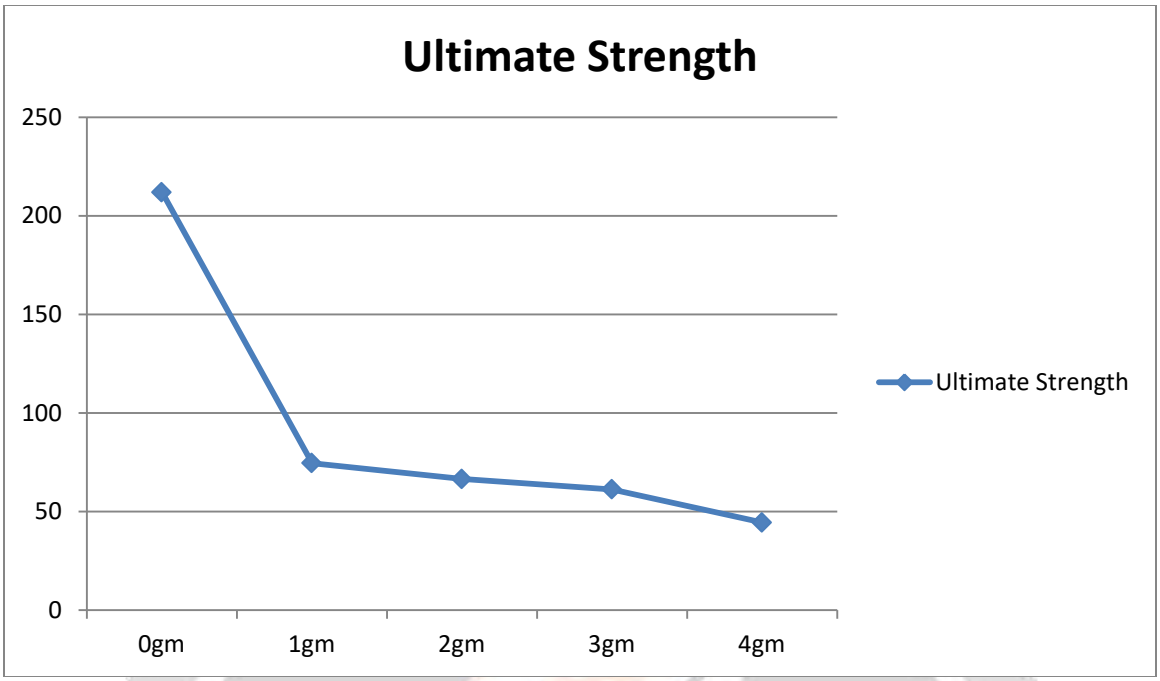
RESULTS:

Properties	0gm	1gm	2gm	3gm	4gm
Ultimate Load(KN)	399.30	146.39	130.72	120.31	87.30
Breaking load (KN)	20.82	7.32	6.54	6.02	4.37
Ultimate Stregth (N/mm Sq)	211.93	74.53	66.55	61.25	44.44
Breaking Strength (N/mm Sq)	10.60	3.73	3.33	3.06	2.22


Ultimate Load
450
400
350
300
250
200
150
100
50
0
0gm
1gm
2gm
3gm
4gm
Ulyimate Load

87


Breaking Load
25
20
15
10
5
0
0gm
1gm
2gm
3gm
4gm
Breaking Load


Ultimate Strength
250
200
150
100
50
0
0gm
1gm
2gm
3gm
4gm
Ultimate Strength

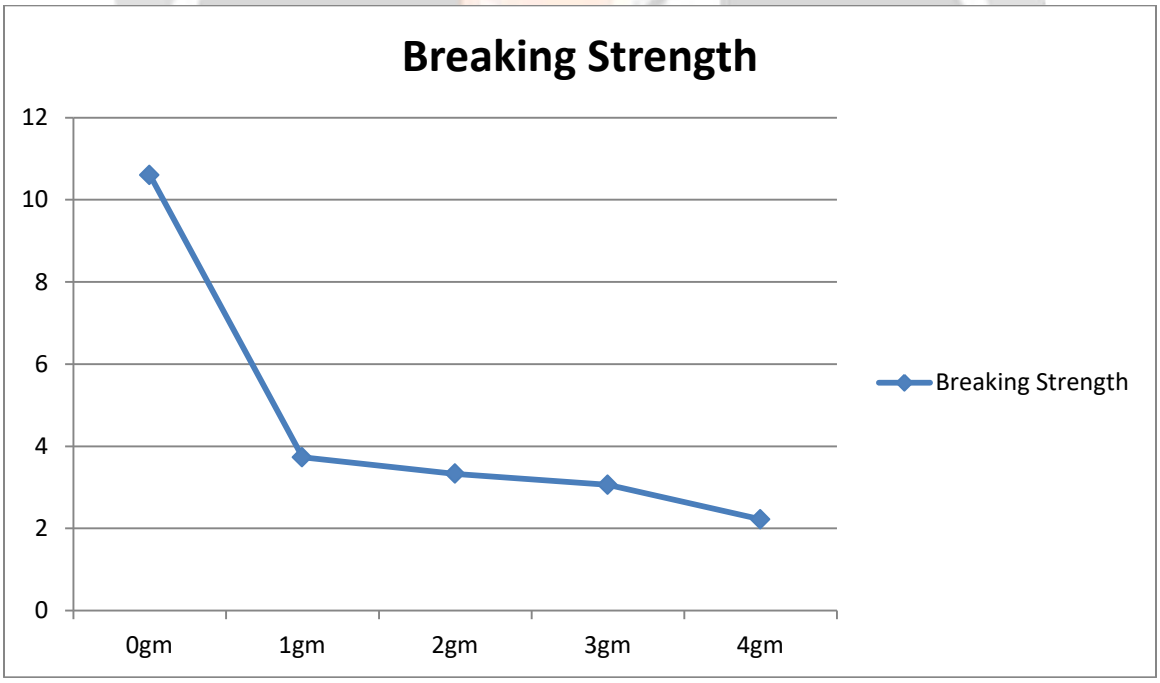

Breaking Strength
12
10
8
6
4
2
0
0gm
1gm
2gm
3gm
4gm
Breaking Strength

Fig. Different Composion Composites

Fig. Universal Testing Machine

Fig.Different composition composite after testing

CONCLUSION:

The summarization of the findings from the study on the mechanical performance (Compression properties) of the sugarcane short fiber reinforced epoxy composites Among all the sugarcane short fiber composites, 0wt% of sugarcane short fiber composite exhibits the highest compression properties compared to 1wt%, 2wt% 3wt% and 4wt%.

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