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Effect of fiber ratio/fiber volume fraction on physical and mechanical properties of medium-density particleboard –A Review

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ABSTRACT

Natural fibers are getting attention from researchers and academicians to make of use in polymer composites due to their ecofriendly nature and sustainability. This review article aims to provide a comprehensive evaluation of the foremost appropriate as well as widely used natural fiber composites material and their applications. Besides, this review paper provides suitable fiber length as well as suitable fiber ratio or fiber volume fraction.

Keywords: - Fiber length, Fiber volume fraction, Mechanical properties

INTRODUCTION

The growth in environmental awareness and society interest, the new environmental ordinance, and the insupportable consumption of petroleum led to thinking of the application of environmentally friendly materials. The natural fiber is considered one of the environmentally friendly materials which have good properties compared to synthetic fiber.

Definition of composite material

A composite material is a material that is produced from two or more than two materials with substantially different chemical and physical properties that when they combined, fabricate a material with a different attribute from the individual materials.

Classification of composite material

1. **Based on the matrix material**
   a) Metal matrix composites
   b) Ceramic matrix composite
   c) Polymer matrix composite
2. **Based on reinforcement**
   a) Particle reinforced composites
   b) Fiber-reinforced composite

Merits of composite material

Some advantages of composite material over the conventional one are as follows:

1) The tensile strength of the composite is three to six times greater than that of aluminum or steel (depending on the reinforcement).
2) Improved impact properties and torsional stiffness.

3) Composite is less noisy while in operation and provides lower vibration transmission than metals.
4) Composite enjoy reduced life cycle cost compared to metal.
5) Outstanding electrical insulation.
6) High impact resistance.
7) Lower material cost.
8) Corrosion resistance.
9) Molded-in color.
10) Arc and track resistance.

Application of composite material

1) In aircraft, it is used in the door skin on the stabilizer box fin, in elevators.
2) In automobiles, it is used to make body frame, chassis components.
3) In electrical it is used to make a printed circuit board.
4) It is used to make pipe and water tanks.
5) It is also used for making furniture.
6) It is also used for making particleboard.

LITERATURE REVIEW

This chapter outlines the recent work done in the field of mechanical properties of natural fiber composites. For a composite material, its mechanical properties depend upon many aspects such as fiber ratio, fiber orientation, fiber length.

C. Capela et al (1) investigated the effect of fiber length on the mechanical properties of high dosage carbon-reinforced by using short carbon fibers reinforcements by taking 2, 4 and 6 mm fiber length with 60% wt fiber fraction. The conclusion of this research was stiffness increases to 25% when fiber length increases from 2mm to 4mm but afterward decreases from 6mm fiber length composite.

Himanshu Bisaria et al (2) investigated the effect of fiber length on mechanical properties of randomly oriented short jute fiber composite by taking 30% wt fraction with various fiber lengths of 5, 10, 15, and 20mm. The conclusion of this research is at 15mm fiber length tensile and flexural properties were found maximum and impact properties were found maximum ate 20mm fiber length with 30% wt fraction.

Hari Om Maurya et al (3) study on the mechanical properties of the epoxy composite using short sisal fiber. In this research, composite were prepared with various fiber lengths (5, 10, 15, and 20mm) with a 30% fiber ratio. The conclusion of this research was at 15mm fiber length flexural strength improved 25% and at 20mm fiber length, impact properties improved.

Wim Nhuapeng et al (4) study about the mechanical properties of Hybrid composites by taking various fiber ratios that are as follows 25wt%, 30wt%, 40wt%, and 50wt%.

The conclusion of this research was the sample of 25wt% and 30wt% show the best mechanical properties whereas the 40wt% showed excellent sound properties.

Prakash Marimuthu K et al (5) investigated the characterization of mechanical properties of the composite material by using coconut and glass fiber.

The sample prepared by taking 10% glass fiber, 30% coconut fiber, and 60% epoxy resin. The conclusion of this investigation was some of the mechanical properties like density, tensile strength, and microhardness are affected when coconut fiber is added but impact strength increased. The hardness of the composite material increased.

J.A. Flores et al (6) investigated pressure impact on common reed particleboard manufacturing using shredding blades. Urea-formaldehyde resin use as adhesive. This research concludes that when pressure varying 3N/mm^2 to 25N/mm^2. The result allowed us to state that pressure and the Particle size play an important role in improving the mechanical properties of the particleboard.

Ashish Kumre et al (7) investigated the change in mechanical properties of sisal glass fiber reinforced composite by replacing synthetic fiber to natural fiber by taking fiber various lengths (5, 10, 15, and 20mm). The conclusion was the tensile strength not increased but tensile modulus, impact properties were improved.

Sunil Singh Rana et al (8) investigated the effect of variation on mechanical properties in the reinforced composite. The composite prepared by hand lay-up method by using the various fiber lengths (5, 10, 15, and 20mm) by fixed fiber ratio that is 30wt%. The results indicate the storage modulus and are found high at 15mm fiber length.

F. Rezaei et al (9) investigated the effect of the length of fiber on the thermo-mechanical characteristic of carbon fiber composites by preparing the sample by hot pressing technique. The conclusion came out by performing thermal gravimetric analysis and dynamic mechanical analysis and results show that when fiber length increased thermal stability increased and damping properties improved.

Tiesong Lin et al (10) investigated the effect of fiber length on mechanical and fracture behavior of geopolymer matrix composite by taking various fiber lengths (2, 7, and 12mm). After investigating by three points bending test, optical microscope, and scanning electron microscopy the result shows that at 7mm fiber length show as maximum flexural strength as well as the highest work of fracture.

CONCLUSION

After the whole study, there are some conclusion came out that are as follows:

1) The mechanical and physical properties depend on fiber length and fiber ratio.
2) The mechanical and physical properties also depend on the way of manufacturing the composite material.
3) At 12mm fiber length with a 35% fiber ratio, the composite material shows the maximum mechanical and physical properties.

FUTURE WORK

After study the conclusion of this research there is some future work came out which are as follow:

1) We can replace epoxy resin to urea-formaldehyde resin as well as phenol-formaldehyde resin.
2) We can fix the fiber length and varying the fiber ratio.
3) We can fix the fiber ratio and varying the fiber length.
4) We can change the orientation of the fiber.

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