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Influence of Fiber Percentage on Mechanical Properties of Hybrid Composite Materials

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Abstract—*Composite is a material in which two or more constituent materials are combined and produce single material. The composite material provides the required physical and/or chemical properties. Moreover, composite materials are stronger, lighter, and less expensive than traditional materials. Therefore, the use of composite in engineering field is increasing day by day. Composite consists of mainly two phases i.e. Fiber and Matrix. The fibers may be polymers, ceramics, metals, Jute, Coir, Silk, Banana, Bamboo fibers and animal feathers. Matrix is durable glue that provides a high level of bonding between fibers. In the present work, epoxy is used as matrix and Banana and Sisal fibers were used as fibers for preparing the composites. During preparation of specimens, the fiber was taken as a continuous one. The fiber as treated with NaOH and* H_2O *solutions. The specimens were prepared by varying the weight percentage of fiber (5% to 35%). The mechanical properties of composites such as tensile strength, impact strength and hardness have been evaluated. The effects of stress, strain and displacement variations under various volume fraction of fiber have also been analyzed.*

Keywords: Natural fibers, Mechanical properties, volume fraction, hardness.

1. INTRODUCTION

In recent days, one of the highest attractive research line is development of natural fiber reinforced composite. Composites have been developed to meet several industrial demands such as (i) need for easier processing, (ii) light weight etc. One of the famous natural fiber based composites is, the combination of banana and Sisal fiber based hybrid composite. However, the limited published research work is available on mechanical behavior on banana and sisal fiber composites as follows.

Chandramohan et al [1] reported that natural fibers are obtained from natural resources. Natural fibers have many advantages such as low density, high biodegradability, reasonable specific strength properties, good sound abatement capability, low cost, and existence of vast resources. Furthermore, at the end of their life cycle, these fibres can be incinerated for energy recovery. Because it has good calorific value [1]. Ranjan et al [2] have worked in the reinforcement flax, hemp and jute for developing thermoplastic and thermoset composites. These composite materials have been successful in semi-structural as well as structural applications [2]. Some of the bio-based composites are used in car door trim, seat-back trim, dashboard supports, rear shelves and also exterior parts, such as transmission covers [3]. Banana fibers are obtained from the dried stalk of banana trees. Shashi Shankar [4] reported that banana fiber possesses good specific strength comparable to those of conventional materials, like glass fibers. Furthermore, this material has a lower density than glass fibers [5]. However, banana fibers possesses some challenges such as high moisture uptake, low thermal stability and low bonding with polymers [6].

Therefore, it is concluded that with appropriate surface treatments are required to improve the mechanical properties such as tensile strength, impact strength and hardness. An alkali treatment is the effective method to (i) remove the impurities from the fiber, (ii) decrease moisture absorption, (iii) enable mechanical bonding, and (iv) improve the matrix-reinforcement interaction [7]. Sisal fiber urea formal dehyde composites show good flexural strength and utilized in future fiber board applications [8]. Jarukumjorn et al[9] investigated about tensile and fracture toughness properties of woven sisal textile based on epoxy and vinyl-ester and reported that mechanical properties considerably affected by water absorption cycles.

Jun et al [10] reported that sisal fiber has high tensile strength and short renewable times. It is obtained from the leaves of the sisal plant (Agave sisalana). Brazil and India are the main producers of sisal fiber. Many studies have been done on the development of new composite materials using sisal fiber [11]. Recent literatures reveal that sisal fibers have the potential to be used for the production of cellulose nano particles such as nano whiskers [12]. Significant improvements in the mechanical and thermal properties were observed by incorporating sisal nano whiskers into these polymer matrices. Moreover, the reinforcing capability of sisal nano particles can be improved by chemical modification. Due to this, mechanical and thermal properties can be improved [12].