

# Sound Absorption Test on Reinforced Hybrid Composite Material of Palmyra & Jute Fiber

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**ABSTRACT** :Natural fibres are those include those produced by plants, animals and geological process around the surrounding of living organisms. They are mainly biodegradable throughout their life cycle. The formers are mainly used in the process of the automobile manufacturing sector, which enhance the durability and life cycle with greater efficiency the main purpose of this paper is to overcome all the sound emission problem inside the automobile passenger compartment by finding the sound absorption coefficient of various sample by introducing a new range of combination of composites that are eco-friendly. In this study the Impedance Tube Method was used to measure sound absorption coefficient. The measurement was done in accordance with ASTM E1050-98 that is the standard test method for impedance and absorption of acoustical materials using a tube, two microphones and digital frequency analysis system.

**KEYWORDS:** Natural fiber, biodegradable, hybrid, efficiency, Sound absorption, impedance tube method, microphones, digital frequency.

## I. INTRODUCTION

### 1.1 Introduction of Fiber

Over the past two decennium, polymer-based materials reinforced with various natural fibers have been established everywhere from scholastic and industrial point of view. Environmental consciousness, legislation, and energy consumption have enthused academics and industrial researchers working in the area of cellulose fibers and fiber-reinforced composite. More than 1000 species of cellulose plants are being obtainable in fibers forms and few of them are investigated to plan the toughened composite. The natural fiber composites have attractive features likes low cost, light-in weight, moderated potency, high specific modulus, moderate mechanical properties, easy to handle, and lack of health hazards compared to synthetics fiber composite. Structure of the fiber is encased with natural chemicals such as cellulose, lignin, and wax. The cellulose fiber-reinforced composites have been extensively used for industrial components, construction material, automobile parts, and home appliances.

In latest years, the interest of scientists and engineers has bowed over on utilizing plant fibers as efficiently and inexpensively as possible to produce good quality fiber-reinforced polymer composites for structural, building, and other needs.

Many types of natural fibers have been explored for their use in polymer like wood fiber (Maldas et al 1995), kenaffiber (Rowell et al 1999), pineapple fiber (Mishra et al 2001), sisal fiber (Joseph et al 1999) jute fiber (Mohanty et al2006), banana fiber (Poathan et al 2003) and straw (Camel 2004).Bax and Mussig 2008 investigated the mechanical properties of PLA reinforced with cordenka rayon fibers and flax fibers, respectively.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 3, March 2017

A poor bond was observed using Scanning electron microscopy analysis. The highest impact strength and tensile strength were established for cordeno reinforced PLA at fiber proportion of 30%. Mwaikambo and Ansell 2003 evaluated the physical and mechanical properties of the natural fiber composites to review their serviceability. Treated fibers with highest might were used as reinforcement for cashew nut shell liquid matrix and determined tensile properties, porosity and also tested fracture surface topography of the composites. The objective was to maximize the amount of low cost natural fiber resource in the composite. They finished that the presence of lignin in the raw hemp fiber offers additional cross linking sites and the raw fiber surface is more compatible with CNSL (Cashew Nut Shell Liquid Resin) than alkali treated surface.

Natural fibers are consequent from plants, animals and mineral sources. They can be classified according to their origin as depicted. These of natural fibers as industrial components improves the environmental integrality of the parts being constructed, especially the moving market. In the building industry, the interest in natural fibers is mostly efficient and nominal; natural fibers allow insulation properties higher than current materials. Presents few of the most used natural fibers, family name and scientific name. Although, the annual production of natural fibers exceed that of animal or mineral fibers, all have long been useful to human. The properties of natural fibers depend mainly on the nature of the plant, vicinity in which it is grown, age of the plant, and the dissociation method used (Joseph et al 1999, Khandal et al 2011 and Kuchinda et al 2001). The physical properties of natural fibers were mainly resolved by their chemical and physical composition, such as, structure of fibers, cellulose content, and angle of fibrils, transaction and degree of polymerization (Idicula et al 2005).

## 1.2 Introduction of Composite Materials

The attention in natural fiber-reinforced polymer composite materials is hastily growing both in terms of their engineering applications and basic research.

They are sustainable, cheap, completely or partially recyclable, and biodegradable. Plants, for example flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, etc., as well as wood, used from time primeval as a source of lignocelluloses fibers, are more and more often applied as the reinforcement of composites. Their accessibility, sustainability, low density, and price as well as satisfactory mechanical properties make them a striking environmental alternative to glass, carbon and man-made fibers used for the manufacturing of composites. The natural fiber-containing composites are more ecological friendly, and are used in transportation, military applications, civil application, packaging, consumer products, etc.

The word “composite” means two or more divergent parts physically bounded together”. Thus, a material having two more distinct ingredient materials or phases may be considered a composite material. Fiber-reinforced composite materials contain fiber of high strength and modulus embedded in or bonded to a matrix with discrete interfaces (boundary) between them. In this form, both fiber and matrix keep their physical and chemical identity, yet they produce a combination of properties that cannot be achieved with either of the ingredient acting alone. In general, fiber are the principal load-carrying members, while the neighbouring matrix keeps them in the preferred location and orientation, acts as a load transfer medium between them, and preserve them from environmental damages due to elevated temperatures and humidity etc.

The properties that can be enhanced by forming a composite material consist of strength, stiffness, corrosion resistance; wear resistance, pleasant appearance, weight, fatigue life, temperature-reliant behavior, thermal insulation, thermal conductivity, acoustical isolating and electrical isolating. Naturally, neither all of the properties are improved at the same time nor is there usually any necessity to do so. Composite materials have a long history of usage. Their beginnings are unheard of, but all recorded history contains references to some form of composite material. For example, straw was used by the Israelites to toughen mud bricks. Plywood was used by the ancient Egyptians when they recognized that wood could be rearranged to achieve better strength and resistance to thermal expansion as well as to distension due to the presence of moisture. More recently, fiber reinforced resin composites that have high strength-

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Vol. 6, Issue 3, March 2017

to-weight and stiffness- to- weight ratios have become significant in weight- sensitive applications such as aircraft and space vehicles.

A variety of products around us are made from plastics. One of them is fiber-reinforced plastics (FRP). Advantages of FRP are that specific strength is superior than that of aluminum plate, and weight of FRP is lighter than that of aluminum plate, etc. Therefore, FRP are used in ample range of fields, for example, automobile field, aerospace field, games field, and so on. Glass-fiber reinforced plastic (GFRP) inside FRP has a lot of excellent functions such as high-strength, weightlessness and chemical stability. But, this GFRP has a serious environmental fault that disposal and recycling are tricky after usage there is an increase demand for environmental friendly materials such as natural fiber composites to replace the conventional fiber (i.e. carbon, glass, and aramid fiber) composites.

The reasons are biodegradability, less emissions to the atmosphere, plentiful, renewable, user-friendliness, and can be produced at low cost in many parts of the developing world. Recently there is study of “green” composites (the biodegradable composite materials or eco-composites). Composed of a eco-friendly resin and high strength natural fibers have been developed. Advantages of natural fiber are low heaviness, they are recyclable and ecological. They are also renewable and have relatively high strength and stiffness.

On the other part, there are also some disadvantages: moisture uptake, quality variations and thermal stability. And in actual fact, the mechanical property of natural fiber was much more inferior to that of glass fiber. Therefore, necessary functional strength for structural materials or upgrading of strength and toughness of green composites and securement of dependability are not enough. Because it is necessary that the mechanical property of natural fiber move toward that of glass fiber, and natural fiber have the elective functions.

## II. MATERIALS AND EXPERIMENT

### 2.1 Extraction of fiber

#### 2.1.1 Palmyra fiber

Palmyra fiber is a natural fiber that derives from treatment of the leaf seats of the Palmyra Palm and is produced. The matured Palmyra were collected from Palmyra trees and immersed in water for two days. The flush which was bonded with the fibers absorb water and the steep of the same started. The flush lost its bonding strength at this stage.

Now the leaf stems were taken out of water and thoroughly washed in running water. During the washing process the leaf stems were gently pressed for the removal of the retted flush. The leaf stems were then immersed in water for one day and the process was repeated for the removal of remaining flush. The fibers were taken out and allowed to dry in the shadow for a pair of days. The fibers were then dried in sunlight for half an hour and extracted.



Figure 1. Palm fiber

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## 2.1.2 Jute Fiber

Jute is ready to harvest in four to six months, after the flowers are shed. The plant stems are then about 2.5 to 3.5 meters tall and as thick as a finger. Jute fields may be under water at the time of harvest and the workers often need to wade in the water to cut the stems at ground level or to uproot the plants.

On average, jute yields four times more fiber per acre than flax. The fibers lie beneath the bark around the woody core or 'hurd'. To extract the fiber, the jute bundles are submersed in water and left for a few days until the fibers come loose and are ready for stripping from the stalk, then washed and dried. The raw jute fiber as shown in fig 2



Figure 2. Jute Fiber

## 2.2 FIBER PROPERTIES

### 2.2.1 Fiber Density

The water displacement method was employed to find the density of the fiber. The weighed quantity of fiber was completely immersed in water and the volumetric displacement was observed. The weight to volume ratio yielded the density value.

### 2.2.2 Wax Content

The wax content was measured with the help of Soxhlet apparatus. Petroleum benzene liquid was heated to 70°C and one gram of fiber was immersed in the liquid. The 1-hour reflux time was provided and the fiber sample was dried. After drying the fiber, it was weighed and weight difference confirmed the wax content.

### 2.2.3 Moisture Content

The weighed quantity of fiber was placed in an oven at the temperature range of  $105 \pm 2^\circ\text{C}$  for 4 hours. The stress-strain curves were plotted during the test for the determination of ultimate tensile strength and elastic modulus. The weight of the fiber taken from the oven was measured and the difference in weight accounts for the moisture content present in the fiber.

### 2.2.4 Cellulose Content

The weighed quantity of fiber was immersed in a mixture of sodium chloride 1.72%, and three drops of sulfuric acid in water. One hour soaking time was provided. Then the excess fluid was taken away by suction process and ammonia was added. The percentage of cellulose was noted by the ratio of the residue weight to the dry sample weight.

Table 1. Properties of Palmyra and Jute Fiber

S.No	Properties	Palmyra Fiber	Jute Fiber
1.	Cellulose content, %	69.3	50-57
2.	Lignin content, %	22.62	8-10
3.	Wax content, %	0.24	0.3
4.	Moisture content, %	8.15	1.5
5.	Density, g/cc	1.4012	1.4
6.	Young's modulus, GPa	12	30
7.	Tensile strength, MPa	421	700-800

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Vol. 6, Issue 3, March 2017

## 2.3 MATRIX PREPARATION

Epoxy is the thermosetting polymer that cures when mixed with hardener. Epoxy resin of grade LY556 with density of  $1.16 \text{ g/cm}^3$  was prepared with a mixture of epoxy and hardener at a ratio of 4:1

## 3. SPECIMEN PREPARATION

Palmyra and jute fibers of 30-50 mm length were cut for mixing with epoxy to prepare test bars of ASTM D 638. These fibers were further crushed to particle sizes. The particles of different diameters have been selected passing it through sieve shaker.

The compounding process was performed in a dispersion mixer at  $180^\circ\text{C}$  which follows the standard of thermoplastic temperature with rotating speed of 50 rpm and PFB particles were poured into the mixer after 20 min. Compounding process is continued further at same speed for 10 to 15 min, to ensure the PFB particles mix thoroughly with the matrix before the compound was poured in a box type steel die of size  $250 \times 250 \times 6 \text{ mm}$  plates were prepared by compression moulding technique as per ASTM standard. The composite fabricating equipment of compression Moulding Machine as shown in fig. 3. The composite sheet was prepared after curing at room temperature for three days.



Figure 3. Compression moulding machine

Composites in form of plates were fabricated on pure epoxy resin with non-alkali treated natural fibers as reinforcements under random orientation. For experimentation three set of different ratio of plates were prepared. The ratio of fiber with resin as shown in Table.2

Table 2. Ratio of Fiber and Resin

S.No	Ratio	Fiber (%)		Resin (%)
		Jute	Palmyra	
1.	70:30	35	35	30
2.	60:40	30	30	40
3.	50:50	25	25	50

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After that these composites were cut using a saw cutter to get the required dimension as per ASTM specimen standard for testing polymer composites.

## IV. RESULT

The composite of Palmyra and jute fiber combination with epoxy resin has been made in plate shape, by the compression moulding machine and the sound absorption test on the reinforced composite material of the Palmyra and Jute fiber has been made by using impedance test tube method.

## V. CONCLUSION

In this project, an attempt was made to study the physical, chemical properties of Palmyra and Jute fiber and sound absorption test on Palmyra and Jute fiber reinforced epoxy composite with the volume fraction of 50-50 and 60-40, 70-30 has been made.

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