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# Experimental Investigation of Hardness Value of Coir Fiber/Epoxy Resin Composite

**Bochare R. H**
*SVERI's COE, Pandharpur*
ramdasbochare123@gmail.com

**Prof. Gidde R. R**
*SVERI's COE, Pandharpur*
rrgidde@coe.sveri.ac.in

***Abstract: Composite materials are emerging chiefly in response to fulfilling demands from technology due to rapidly advancing activities in aircraft, aerospace, and automotive industries. Natural fibers have recently attracted the attention of scientists and technologists because of the advantages that these fibers provide over conventional reinforcement materials, and the development of biofiber composites has been a subject of interest for the past few years. The present work focuses on the investigation of hardness value of coir fiber/epoxy resin composite at 10%, 15% and 20% volume fractions of coir fiber and different fiber lengths 10 mm, 20 mm and 30 mm. Initially, alkalization process consisted of immersing coir fibers in a 1% (v) NaOH aqueous solution for 6 hrs to improve physical properties of coir fiber. The test specimens were prepared and tested according to ASTM standards for microhardness testing. The experimental results show that with an increase in volume fraction and fiber length, the hardness of composite increases and better hardness value is obtained at 20% volume fraction and 20 mm fiber length.***

***Keywords: Hardness, Coir Fiber, Volume Fraction, Epoxy Resin, NaOH.***

## 1. INTRODUCTION

A lot of research is going on to make use of natural fibers as a reinforcing material in the polymer matrix composites. There are a lot of challenges faced by the researchers to make the natural fiber suitable for their needs due to its hydrophilic nature, thermal and chemical instability. But nowadays natural fibers can replace synthetic fibers to some extent by making them compatible.

Coconut coir is the most interesting product as it has the lowest thermal conductivity and bulk density. The mechanical properties of coir toughened unsaturated polyester with different reinforced body forms, namely; choir on- woven needle mat, coir mesh, and coir rope etc.

Natural fiber polymer composites have recently gained attention due to several reasons, among which are cost effective and environment-friendly. Hand lay- up method of fabrication of composite which does not require expensive tooling, it can be adopted as an alternative to the injection molding method using suitable polymers for this method, like epoxy resin and coir fiber with very cheap, available and renewable natural fibers.

In this work, Hardness of coir fiber/epoxy resin composite is evaluated experimentally at different volume fraction as 10%, 15% and 20% at the different fiber length of coir fiber (10 mm, 20 mm and 30 mm). The experimental results show that with an increase in volume fraction and fiber length, the hardness of composite increases and better hardness value (Hv = 24.73) is obtained at 20% volume fraction and 20 mm fiber length.

## 2. MANUFACTURING OF COMPOSITE

Overall the composite materials are produced through a large number of processes. The choice of a specific production method strongly depends on chemical attributes of the matrix and also the nature of final product's shape. Thermoset composites are fabricated either using "wet-forming" processes, or processes which used premixes. In wet-forming processes, the resin in a fluid state is used while forming the final product. The resin gets cured in the product while the resin is "wet". This curing may be aided by application of external heat and pressure. Mostly "hand layup method" of the wet forming process is preferred.

 

*2.1 Material Selection:*
Materials selected for manufacturing of composite are coir fiber, epoxy resin, and hardener. Basically, coir fiber is selected and cut in 10 mm, 20 mm and 30 mm length. These segregated fibers are kept under alkalization process consisted of immersing coir fibers in a 1% (v) NaOH aqueous solution for 6 hrs to improve physical properties of coir fiber. Epoxy resin LY 556 and hardener HY 951 is selected as per convenience manufacture composite.

*2.2 Manufacturing of Specimen:*
A mold of dimensions 300mm×150mm×4mm is used. The manufacturing of plates is carried out at three different percentage of volume fraction 10:90, 15:85 and 20:80 respectively by volume fraction. Wax as a releasing agent applied on the mold for easy removal of plates, then segregate the coir fiber for spreading in the mold. The epoxy resin and epoxy hardener were mixed in the ratio of 10:1 by the weight as suggested. Pour the prepared solution into the mold, after this spread the detached coir fiber in the mold by hand. Press the coir fiber by the flat plate with hand for compacting it. After pressing the coir fiber to repour the solution in the mold for proper bonding of coir fiber with the epoxy resin solution.To acquire strength to the plate applying the weight up to 50kg for 24 hrs. Then these plates are removed from mold and cut into the dimensions of specimen for hardness test as per ASTM D 384 is 20X20X4 mm3

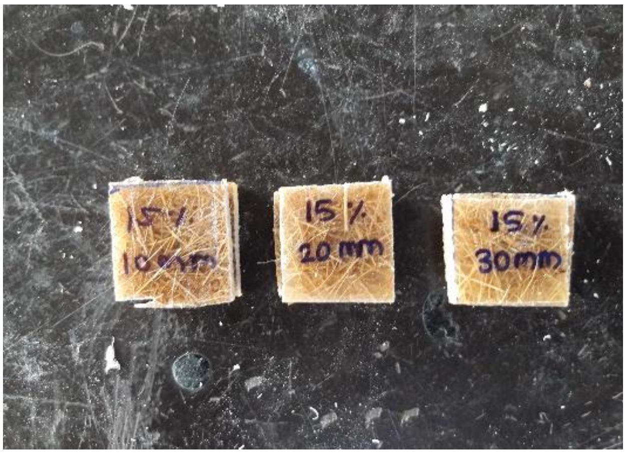


**Figure2.1: Specimen for Hardness Test**

## 3. EXPERIMENTATION

Micro Hardness Testing of metals, composites, and ceramics are employed where a 'macro' hardness test is not usable. Microhardness tests can be used to provide necessary data when measuring individual microstructures within a larger matrix, or testing very thin foil-like materials, or when determining the hardness gradient of a specimen along a cross section. The term Micro Hardness Testing usually refers to static indentations made by loads of 1kgf or less. The Baby Brinell Hardness Test uses a 1mm carbide ball, while the Vickers Hardness Test employs a diamond with an apical angle of 136°, and the Knop Hardness Test uses a narrow rhombus shaped diamond indenter. The test surface usually must be highly polished. The smaller the force applied the higher the metallographic finish required. Vickers and Knoop hardness test are defined by standards ASTM E 92 (for indentation forces of 1 kgf. to 120 kgf.) and ASTM E 384 (for indentation forces below 1 kgf.), while ASTM E 10 is the standard for Brinell Hardness Testing. Mostly, it is used for very small and thin components because very small impressions are produced by small loads.

**Figure 3.1: Specimen after Hardness Test**

## RESULTS

*4.1 Result:*
Following table shows hardness test results of various specimens with different volume fraction (10%, 15%, and 20%) and fiber length (10 mm, 20 mm and 30 mm)

 

**Table 4.1 Hardness Test Results**

| Sr. No. | Composition | Fiber length (mm) | Hardness (Hv) |
|---|---|---|---|
| 1 | 10/90 | 10 | 8.9 |
| 2 | 10/90 | 20 | 11.015 |
| 3 | 10/90 | 30 | 13.035 |
| 4 | 15/85 | 10 | 13.295 |
| 5 | 15/85 | 20 | 19.47 |
| 6 | 15/85 | 30 | 20.525 |
| 7 | 20/80 | 10 | 21.56 |
| 8 | 20/80 | 20 | 24.73 |
| 9 | 20/80 | 30 | 21.585 |

Following graph indicates the effect of fiber length and volume fraction of fiber on hardness value.

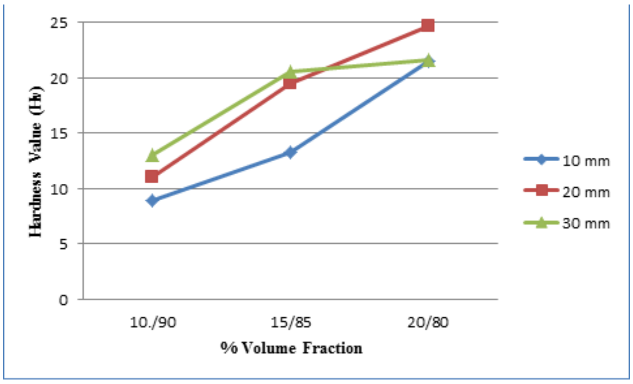


**Figure 4.1 Comparison of hardness Value for different volume fraction and fiber length.**

## CONCLUSION

Above experimentation is carried out to investigate hardness of coir/epoxy composite on the basis of different volume fraction (10%, 15%, and 20%) and fiber length (10 mm, 20 mm and 30 mm). This study led to the conclusions that Hardness Value of composite increases with increase in coir percentage and it is obtained maximum at the composition of 20% volume fraction and 20 mm fiber length and its value are 24.73.

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