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# Effects of Fiber Length and Loading on the Qualities of Fiber Reinforced Epoxy Composites from Schumannianthus Dichotomus (Murta)

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***Abstract***— *Composite isn't a new word, it's a long time around. Due to its usage in several applications, it has risen in prominence over the last four to five decades. **T**he main aim of the study is Effects of Fiber Length and Loading on the Qualities of Fiber Reinforced Epoxy Composites from Schumannianthus Dichotomus (Murta)**.** The polymer matrix is made of Araldite AW106 epoxy resin and HV953U hardener. Bisphenol A Diglycidyl Ether with the same epoxy weight as 214 – 221 g eq-1 is included in Araldite AW106. The HV953U hardener includes 1,3-propylenediamine N-(3-dimethaminopropyl)-. Composite materials have a very adaptable component lay out above normal materialsdue to their clear strength, strength, and exhaustive characteristics.*

***Keywords***— ***Composite, Fiber, Reinforced, Strength, Adaptable.***

## I. INTRODUCTION

Composite isn't a new word, it's a long time around. Due to its usage in a number of applications it has risen in prominence over the last four to five decades. In 10000 BC the pavement brichs had been a prominent building composite material. Fibrouscomposite material was then used in preparing written materials in Egypt about 4,000 BC, and these papyrus plant laminated written material was produced. In addition, Egyptians made containers and tins from heat softened glass made of raw fibers.

The Mongolians used composites again about 1200 BC. The Mongols have created the so-called contemporary composite arch. The oldest proofs of the presence of composite bows, according to Angara Dating, date from 3000 BC. The bow was constructed of various materials such as wood, horn, sinew (tendon), leather, bamboo and antler. Since horn and antler are very flexible and robust, the primary body of the bow has been made. For connecting and covering the horn with the antler, sinews were employed. Clue is formed of a fish's bladder and serves as a holding unit. Sinew,horse hair, and silk were fashioned of the bow string. It was anticipated that the composite bow would last over a year. The bows were so strong that over 1.5 kilometres from the arrows could be fired. The composite bow was a highly deadly weapon before the discovery of gunpowder since it was short and convenient.

### 1.1 COMPOSITE MATERIALS

Due to developments in the next generation, the need for technology has risen in recent days. A good product which fulfils customers' requirements should thus be of excellent quality and affordable pricing. The industry now dominates engineering materials such materials, intelligent materials, and materials. In recent years, a multitude of novel materials have developed. Examples of these include polymers, metals, ceramics and composites. In the area of materials science significant progress has been achieved. The latest developments in material technology are composite materials, which show substantial progress. They are regarded highly and have a great influence on industry. Their strength and matrix characteristics are both. A hybrid construction has many more benefits and is lightweight, sturdy, and ecological. Polymers are utilised in a broad variety of applications including aramid fibers, glass, and carbon. The fibers are usually uniformly, bi- and multi-directionally arranged.The main classification of polymers is two kinds. They are plastics for thermoplastics and plastics for thermoplastics. Thermoplastic materials have been used in various areas because of their significant structural characteristics. Examples include acrylics, nylons, polycarbonates, polyvinylchloride, etc. Examples of such products include polyester, phenolics, polyamides, vinyl esters, bismaleimides, epoxies, etc.

### 1.1.1 Composites Classification

Composites are ranked based on pure reinforcement geometry, whether inparticles, flakes or fiber materials – polymers, metal, ceramics or carbon, in a matrix type. Particulate composites consist of particles submerged in matrices like metals or ceramics. Due to random particle accumulation, they are typically isotropic. The benefits of certain composites include greater strength, higher working temperature, resistance to oxidation, and so on. Examples include the application of rubber aluminium particles, the use of gravel, sand and cement in aluminium particles and the use of cement. Flake composites consist of flat reinforcements of matrices. The common materials include glass, mica, aluminium and silver. The high outdoor bending module, high strength and cheap cost outcomes of flake composites offer excellent performance. Flakes cannot, however, be organised readily, and only a few elements may be utilised. In fiber composites, matrix reinforcement may be short or long (discontinuous) or long.

## II. LITERATURE REVIEW

Mr. Tolessa Berhanu (2020) The industrial methods of reducing carbon emissions and recyclable materials that limit waste play a significant significance in natural fibers. Added flexibility may be achieved in fiber composites by producing hybrid composites, when more than one kind of fiber is used. Cost efficiency may be improved by employing various reinforcing types carefully and selectively to get the greatest strength in highly stressed places and orientations. The cost of hybrid composites may be reduced by decreasing the amount of carbon fiber while optimum positioning or orientation of the fiber maximises performance. As an alternate approach for fiber reinforced composites, natural fibers have lately become interestingfor researchers due to their properties. This study reviewed the uses and different characteristics of natural fibers such as hemp, jute, sisal kenaf and was used for glass fiber replacement.

Bhattacharya Somnath (2020) For researchers in recent years, polymer composites have become one of the most significant fields. It is because polymer composites havea higher resistance to weight ratio than most traditional metals and composites now used for structural purposes. In addition, the researchers are also developing new hybrid composites to attain the mechanical characteristics required. This review of hybrid polymer composites therefore focuses on mechanical properties such as impact, bending and tensile strengths of hybrid polymer composites in order to show that their mechanical behaviour, influenced by crucial factors such as type selection, orientation and the arrangement of reinforcement in polymer matrix composites, is essential. This comprehensive study is an attempt to reveal the key elements of this field as unexplored research gaps. The research indicates that there is a restrictedusage of fillers in hybrid polymer composites (such as red mud and fly ash) and natural fibers (abaca, bamboo, ramie and coir). The study also reveals a lack of research that has been carried out in order to model, forecast and optimise mechanical features such as hardness, bending strength, tensile strength and impact strength of hybrid composites. It also reveals that

Brostow Witold (2020) Although universities and industry concentrate mostly on material characteristics, wear generates losses in the industry at least not less than mechanical deformation fractures. We talk about the significance of polymer based materials for tribology (PBMs). For at least two reasons, traditional tribology initially established for metals could not be used to PBMs. Their characteristics — unlike to metals and ceramics – vary on time, and PBMs are viscoelastic. Second, PBMs readily absorb external liquid lubricants, which are successful for other types of materials; the consequence is swelling. Taking into account viscosity, materials fragility defined in 2006 and the linkages between frailty and recuperation when determining sliding wear, the relation of friction and surface resistance to scratch tension and the impacts of magnetic fields on polymer tribology, both of us develop tribology of PBMs. Traditional wear assessment techniques based on the quantity of debris produced do not work for PBMs since often there is no debris - yet the material movement is considerable (top ridge formation, densification). There is discussion about more suitable test methods. Computer simulations of scratching polymers are also addressed in the results of molecular dynamics. In addition, we explore techniques for improving scratch and wear resistance to PBMs. The above-mentioned techniques include modification of surface pressure, microhybrid creation, forming of nanohybrids and irradiation. Based on the overall findings and ideas and models from experiments and simulations, several suggestions have been given for addressing PBM tribology, both in instructional and industrial as well as research environments.

Huang Ming (2020) - Composites are materials composed of two single components at least. While polymers relate to various materials it will be possible to enhance the characteristics of each polymer, such as the mechanical strength, surface quality and biocompatibility. The composites are normally used in the aerospace, car, military, and sports industries, and are used in biomedicine gradually in tissue engineering, wound dressings, drug release, regenerative treatment, composites in the dental pitch, and operations. The research topics in this area include specific questions on how best various materials and material characteristics may be coordinated.

Isiaka Oluwole Oladele et al (2020) - Isiaka Oluwole Oladele et al. Polymer materials have directly been found to be helpful for many purposes from the earliest days, but their usage has not been fully understood. Nevertheless, polymer materials havegradually dislodged other materials in a number of applications by adjusting this pattern. Polymer-based materials are the best choice for a few applications recently, thanks to better inspection and information, and are now supplying various materials rapidly. Even in areas where polymers have been deemed not to be suitable inprevious times, more materials from polymers are cultivated each day as a replacement for other materials. Most of the time in industries like building, aircraft, cars and medical, polymers are used to substitute metals and ceramics. It is no doubt that due of the innate characteristics of polymers and the management capacity, this pattern will continue. Today, in the composite materials strategy, most of the limitations of polymers are addressed. Researchers and analysts are also responsible for the transition to positive ecological effect. This study now unlocks the areas in which polymer-based composites are used and the significance of these materials for human progress.

## III. METHODOLOGY

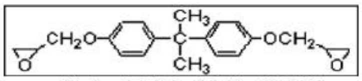
### PROPOSED METHODOLOGY

The study has been divided into following sections:

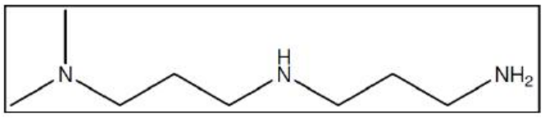
Part A - Impact of Fiber Length and Loading on the Properties ofSchumannianthus Dichotomus (Murta) Fiber Reinforced Epoxy Composites

- **Materials**

The polymer matrix is made of Araldite AW106 epoxy resin and HV953U hardener. Bisphenol A Diglycidyl Ether with the same epoxy weight as 214 – 221 g eq-1 is included in Araldite AW106. The HV953U hardener includes 1,3-propylenediamine N-(3-dimethaminopropyl)-. Figure 3.1 shows BADGE's molecular structures and hardeners. The resin and hardener were purchased and used as required by a local supplier. The NaOH grade laboratory reagent has been used for the treatment of fibers(S. D. Fine Chemicals, India).



Bisphenol A diglycidyl ether (BADGE)



N-(3-dimethaminopropyl)-1,3-propylenediamine

*Fig.3.1 Molecular structures of BADGE (top) and the hardener (bottom)*

## IV. RESULTS

### 4.1 DATA ANALYSIS ON PART A

Natural fiber reinforced polymer composites are being discovered as a result of the increasing environmental impact, energy shocks and production pricing issues as increasing uses in most manufacturing industries such as automotive components, sports systems, electrical components and packaging materials. The most utilised natural polymer enhancement fibers, such as bamboo, wood, cotton, coir, sisal, flax, kenaf, hemp and jute. Other natural Lignocellulosic Fibers were alsoutilised, such as curaua, nettle, aloevera, abaca, palm oil, wheat straw, banana, bagasse, pine aple, rice husk, olive shell, henequen, etc. The research has continuously being evaluated to enhance the quality of natural fiber-reinforced polymer composites. Natural fibers gain from the easy accessibility of their components, the renewability of them, their biodegradability, their light density, their considerable strength (force/density ratio), their minimum cost and their non- corrosive nature. The main disadvantage in the usage of natural fibers is that it is not compatible with polymer matrix because of hydrophobicity and polymer fibers which,however, may be addressed by chemical treatments modifying the areas of the fibers.

This chapter continues to make use of the polymer composite in which a novel naturalfiber is used from a plant whose scientific name really is Schumannianthus dichotomus Gagnep. Murta is grown in western Bengal and assam India and Bangladesh's northeast regions. In Myanmar, Thailand, Cambodia, Vietnam, the Philippines and Malaysia, murta plants are found on the basis of the Wikipedia. Figure 4.1 shows the image of murta plant life. Many handcraft items such as mat (sometimes called local sitalpati), handbag, cap, handfan, etc., are produced from murta fiber, which means that many typical people in BangLadesh and India survive on it. This means that they are made of murta fiber. Details of the murta plant and of small-scale murta fiber companies are registered. There is just one study on the analysis of the polyster composite reinforced murta mat. The inner (so-called maji) portion of the murta stem was used in the existing work for reinforcement of the polymer matrix and this interior part of the murta stem was often thrown during the creation of the murta mat.

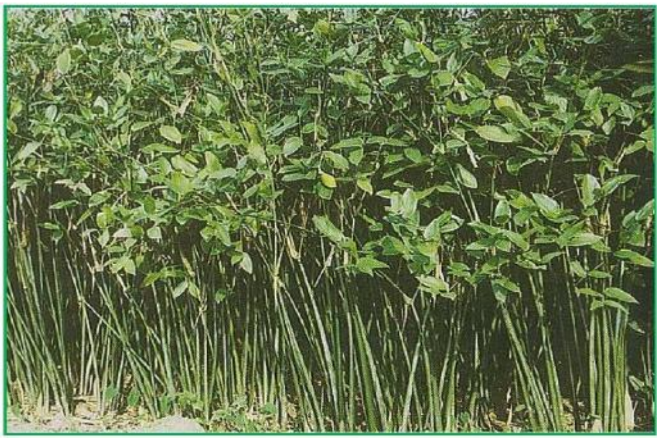


*Fig.4.1 Murta plants*

#### 4.1.1 Characteristics of Fiber, Density, SEM images and IR spectra

Table 4.1 records the characteristics and chemical makeup of the murta central element. Table 4.1 also gives comparisons of the characteristics and chemical compositions of a number of realised natural fibers. 29 The fiber's typical diameter and density have been calculated to be 0.14 ± 0.01 mm and 0.94 ± 0.01 g cm-3, respectively. The density of the polymer matrix exploratory value is 1.05 ± 0.01 g-cm and that of the composites is shown in Figure 4.2

*Table 4.1 Composition and properties of murta and other fibers*

| Fiber | Cellulose (%) | Hemicellulose (%) | Lignin (%) | Density (g cm$^{-3}$) | TS (MPa) |
|---|---|---|---|---|---|
| Murta core fiber | 38 | 26 | 22 | 0.94 | 242 ± 24 |
| Jute | 71 | 20 | 13 | 1.30 | 393 - 773 |
| Sisal | 65 | 12 | 10 | 1.50 | 511 - 635 |
| Coir | 43 | 0.3 | 45 | 1.20 | 175 |
| bamboo | 26 - 43 | 30 | 21 - 31 | 0.80 | 140 - 230 |
| Flax | 71 | 21 | 2 | 1.50 | 345 - 1035 |
| Kenaf | 72 | 20 | 9 | 1.20 | 930 |

There has been discovered that the density of composites is unimportant dependent onthe fiber's length, but the fiber's weight percent has grown. Composites have a greater density than polymers and fibers and the most notable density is 1.22 g cm-3, which is 35 percent weight. Density expansion indicates that there is no void and that composites are minimum because to strong connections between the fibers and polymers. The fiber's antiacide treatment should result in a particularly strong link between the fiber and the polymer. Figure 4.3 shows the SEM images of the non- treated and processed fiber and it is very obvious that the external side of the treatment fiber with fillers and splitting is uneven and unpleasant. The hard surface of the processed fibers is used to limit the fiber to the polymer.

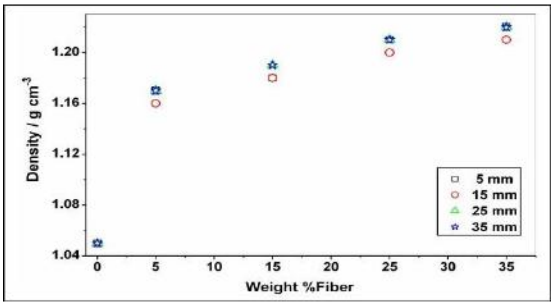



*Fig.4.2 Density (± 0.01 g cm$^{-3}$) of the polymer composite as a function ofweight %of fiber of different lengths*

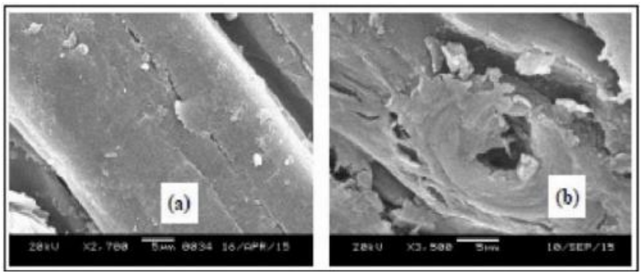



*Fig. 4.3 SEM images of (a) untreated fiber and (b) treated fiber.*

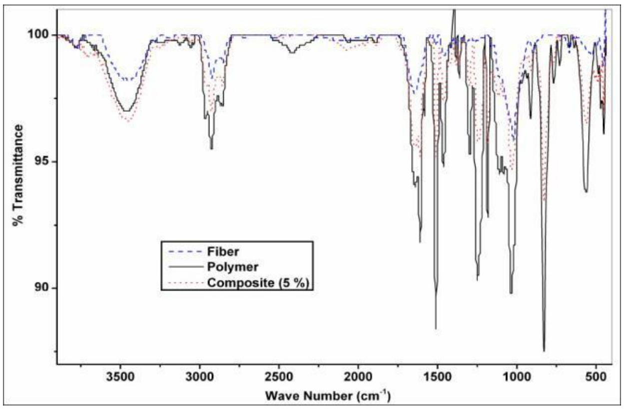



*Fig.4.4 FTIR spectra of the fiber, polymer and composite (containing 5weights %fiber). The inset shows expanded view of the band near 3460 cm$^{-1}$*

The strong partnership of the fiber and the polymer from the IR spectrum in Figure 4.4 is also apparent. The IR band in the fiber is 3450 cm-1 with the OH band while the IR band in the polymer is 3 460 cm-1 with the OH band exactly as the NH band isin the polymer. In addition, the IR belt with 3455 cm-1 compared to the OH and NH extension in the polymer composite. The expanded and expanded belt force in the composite polymer shows that hydrogen retention between fibers and polymers is improved throughout the composite development.

### 4.1.2 Thermal Behaviour

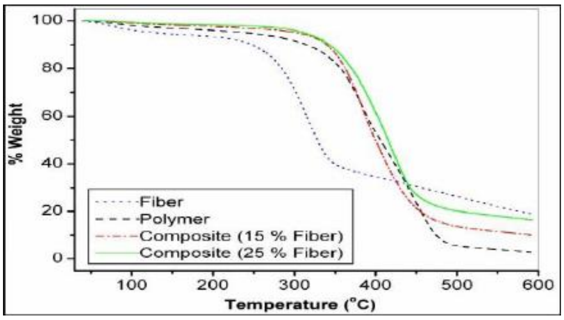



*Fig.4.5 Thermograms of the fiber, polymer and composites obtained from theTGA*

Figure 4.5 displays the thermograms of the TGA-acquired fiber, polymer and composites. Two stages of thermal fiber corruption occur. The main decay of fiber occurs rapidly and starts from 228 °C to 357 °C. 62% of the fiber weight at this stage is corrupted, due to cellulose, hemicellulose and less lignin thermal degradation. The second phase is a result of the slow thermal degradation of hemicelluloses and lignine,which begins when temperature exceeds 357 °C. At 6000C the fiber corruption is 80 percent in weight. This debasement is a little bit lethargical. Somewhere between 293 and 485°C, the polymer corruption occurs in one rapid step. The amount of polymer corrupted at 485 °C is 93 percent weight. The concept of composite thermograms resembles that of the polymer and the bulk of the corruption occurs quickly. The bribery starts at approximately 305°C and continues to 460°C in both compositional products with 15 and 25 percent fiber. Therefore the composite is slightly more thermal than the polymer. The thermal sounds of the polymer matrix may thus be improved by murta fibers; in the present instance, 293 to 305°C. The heat degradationis almost insignificant in the composites above 460 °C because of the polymer. As the fiber weight percentage increases, in general the composite decrease is because the lignin total increases in a composite with the expanding fiber.

### 4.1.3 Tensile Strength

The intentional strength of the fiber's tensile strength (TS) is equal to 242 ± 24 MPa and the strength of the polymer and composites in Table 4.2 are shown in Figure 4.6. Figure 4.6 shows that both the fiber length and the measurement of the TS in the composite are susceptible. TS is common in natural fiber-reinforced composites witha fiber total and length. The composite TS is administered by a couple of variables such as matrix fiber selection, the matrix fiber orientation, fiber length measurement, fiber matrix adhesion measurement, and so on. The sum, length, and compatibility of the fiber surface are thus restricted to these amount of variables in order to ensure homogeneous compound and advancement of the fiber-matrix-Interfaces pressuremove instrument. The largest TS is achieved with a fiber load of 25 percent weight and a fiber length of 25 mm on the composite being investigated. The highest extreme of the TS is 57.6 MPa, an expansion of 145% compared to the clean polymer TS. At 25% fiber loads, the growth of TS is about 19% by extending the fiber length from 5to 25 mm, while by increasing the fiber longitudinal from 25 to 35 mm TS has decreased by roughly 14%. The base fiber length is 25 mm along these lines and the main fiber charge for the present composite is 25 percent by weight. At the time of theexpansion of fiber load above 25 percent TS the load started to decrease. This is attributed to fiber aggregation creating interruptions in fiber adhesion and weakening. The SEM photos in Figure 4.7 show that the fibers are more than 25 weights percent agglomerated.

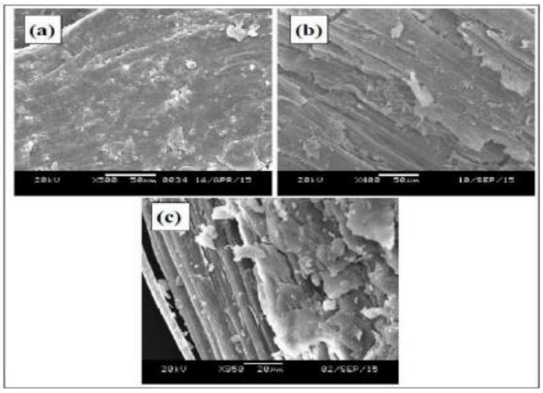



*Fig.4.6 SEM images of (a) neat polymer, (b) 5 % fiber composite and (c) 35 % fibercomposite*

*Table 4.2 Tensile strengths of the composite as functions of fiber load and fiberlength*

| Weight % Fiber | Fiber length (mm) | | | |
|---|---|---|---|---|
| | 5 | 15 | 25 | 35 |
| | Tensile Strength (MPa) (TS of Neat Polymer = 23.5 MPa) | | | |
| 5 | 35.6 | 37.6 | 36.6 | 34.9 |
| 15 | 39.5 | 40.0 | 41.5 | 41.7 |
| 25 | 48.3 | 52.6 | **57.6** | 49.6 |
| 35 | 41.5 | 45.6 | 48.6 | 42.6 |

### 4.1.4 Strength

Like TS, when the composite includes 25 percent weight of

25mm fiber it is anything but an important factor to get a flexural strength (FS) of the polymer by constructing the fiber (Table 4.3 and Figure 4.8). As with TS, therefore, the optimal FS for the polymer composite is both the length and the fiber measurement. The highest FS value is 64.8 MPa, which is around 126% more than the FS of clean polymer. FSstarts to decrease by about 25 percent, and by around 6 percent, the fiber load falls at 35 percent of FS of the composite. In Figure 4.9, the FS-Ts ratio (force ratio) was compared to the fiber total. Most FS is greater than TS, such that the bending force is larger than the extending force. The FS comes out to not be precisely the TS if the fiber length exceeds the basic length which shows that the characteristics of the stacked fiber below or below the base length are differentiated. The SEM images in Figure 4.7 show the buildup of 35 mm long fibers effectively revealed.

*Table 4.3 Flexural strengths of the composite as functions of fiber load and fiberlength*

| Weight % Fiber | Fiber length (mm) | | | |
|---|---|---|---|---|
| | 5 | 15 | 25 | 35 |
| | Flexural Strength (MPa) (FS of Neat Polymer = 28.7 MPa) | | | |
| 5 | 42.7 | 45.5 | 46.3 | 30.0 |
| 15 | 45.6 | 50.6 | 48.6 | 36.3 |
| 25 | 49.3 | 53.6 | **64.8** | 44.5 |
| 35 | 44.6 | 52.3 | 60.6 | 40.5 |

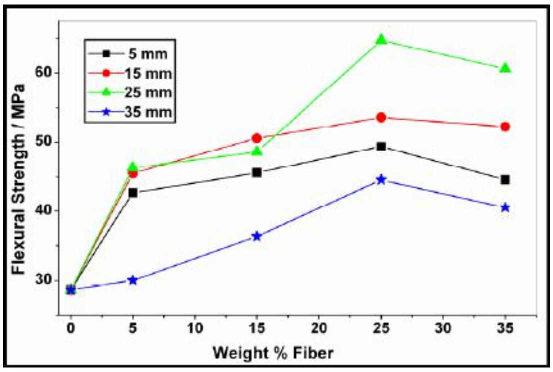



*Fig.4.8 Variation of flexural strength of the composite with weight % of fiberat fixed fiber lengths*

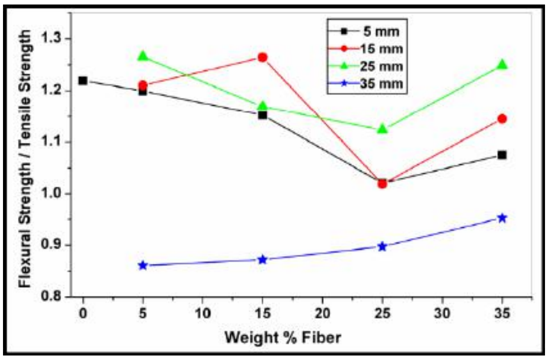



*Fig.4.9 The ratio of flexural strength to tensile strength as a function of fiber amount at fixed fiber lengths*

## V. CONCLUSION

Composite materials have a very adaptable component lay out above normal materials due to their clear strength, strength, and exhaustive characteristics. Composite materials consist of at least two components having truly split phases. However, it is regarded as comparable to a composite material only when composites exhibit significantly distinct real characteristics.

Composites are materials that include material with solid loads (known as supports) (known as matrix). Composite materials, plastics and ceramics were the predominant materials over the past thirty years. Composite material volume and quantity of applications have continuously evolved, entering and overcoming new economic areas. Current composite materials provide a wide rise from common goods to refinedspecialised applications on the designed material market. While composites haveproved their worth as weight saving materials, they are financially knowledgeable. The present test. Several innovative assembly methods have lately been used for the composite industry in the attempts to create financially attractive composites.

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