iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 Issue: V Month of publication: May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5208

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Comparative Study of Tensile and Flexural Properties and Rainwater Treatment of Coir Fiber and Coconut Wood Chips Reinforced Polyester Composites

Mr. Prashantha
Department of Mechanical Engineering, MIT, Kundapura, Udupi, Karnataka, India

Abstract: The coir fiber used for the study is untreated brown fiber extracted from mature coconut fruit husk. Coir fiber and coconut wood chips composites were prepared by different filler and reinforcement concentrations by hand layup technique. The fiber length taken is of 10 mm in average for both the reinforcement materials. According to ASTM standards specimen for tensile and flexural test where cut from the fabricated laminate. Experimental results shows that mechanical properties of composites were greatly influenced by fiber and filler percentages. By comparing two materials viz. coir fiber and coconut wood chips composites the second one shows good tensile and flexural behavior. Rain water treatment will greatly reduce both tensile and flexural properties of coir fiber and coconut wood chips composites. Coconut wood chips are found to be used as reinforcement material for structural applications.
Keywords: Coir, Coconut wood chips, Polyester resin, rain water treatment

I. INTRODUCTION

Composite material is turning into a more focused in market, organizations all around to build their productivity, i.e. mechanical properties or physical properties of the material. The increasing material expenses in many industrialized nations, and decreasing and controlling material expenses, are only a couple of reasons organizations discover various composite material sources. "Composite material of polyester resin as matrix plus coir fiber as reinforcement plus coconut shell powder as filler material is compared to polyester resin as matrix plus coconut wood chips as reinforcement plus coconut shell powder as filler material."
Composites consist of two components, one is matrix or base material and other is reinforcement for strengthening the matrix material. Matrix material holds reinforcement and supports fiber or reinforcement material by preventing from mechanical damages.

A. Polymer Matrix Composites

Polymer composites are utilized in light of the fact that general properties of these composites are better than those of the individual polymers. The flexible modulus is more noteworthy than that of the flawless polymer yet isn't as weak as ceramics.
Polymer composites are classified as follows.

1) Fiber reinforced polymer (FRP)
2) Particle reinforced polymer (PRP)
3) Structural polymer composites (SPC)

B. Natural fiber

The natural fiber reinforced composites are being developed to save environment. Objective of natural fiber composites development was to evaluate the physical property-density and mechanical property-tensile and flexural properties. The major problem in composite materials is the strength is less dependent on the matrix properties [6].

II. MATERIALS AND METHOD

A. Unsaturated Polyester resin

Unsaturated polyester resin (USP) is the most well-known kind of resin in the marine business. It's ideal for minimal effort repairs and new development parts. Polyester resin is good on vertical surfaces and furthermore works incredible for quick glass wet out due to its low consistency. This resin must be catalyzed with Methyl Ethyl Ketone Peroxide (MEKP) to appropriately cure. General purpose polyester resin is good for a wide assortment of utilizations including, hand layup by brush or roller, spray on applications, marine, transportation, auto body, aviation, universally useful covering, FRP parts and other types of composite material applications.

B. Coir fiber

Coir fiber (CF) separated from the husk of coconut after long stretch of retting is essentially lignocellulosic fiber. They are brilliant to dull darker in shading. These lignocellulosic fibers are shaped by covering of cellulose chains of lignin. In any case, the drawback is that the lignin part makes the fiber firm. The higher the lignin content stiffer is the fiber. As a result of the nearness of higher level of lignin particularly at first glance the coir looks dull and dim.

Fig.1. Raw Coir fiber

C. Fiber extraction

Mature coconut fruit husk is retted in water for two weeks so that the fibers become loose and smoother then this is defibered with the defibering machine. After defibering the fiber become loose, then it is fed into a final defibering machine in that the fibers are cleaned and impurities are removed for some extent. The clean fiber are then dried in sunlight for two days and cleaned manually to remove any dirt or impurities and again dried in sunlight for one day to remove moisture content. At this state the maximum moisture content will be less than 15%. The selection of fiber has been done manually to get good quality fibers. Quality in the sense clean, golden brown coloured and thick fiber. The selected fibers then cut into 10 mm length with scissors [13] [14].

D. Fiber Properties (quality)

The different fiber extraction processes yield different but also varying qualities of fibers: generally 56-65 percent long fibers of over150 mm (up to 350 mm staple length) and 5-8percentshort fibers of under 50 mm length. The fiber thickness varies between 100µm and 450µm[1]. In some case the fiber thickness will be narrower than 100µm [4].The fibers are composed of individual fiber cells of about 1 mm length and 12-24 µm diameter[9].

Table.1 Chemical Compositions of various natural fibers [3]

Fiber	Cellulose	Hemicellulose	Pectin	Lignin	Extractives	Fats
Cotton	91.8	6.3	-	-	1.1	0.7
Flax (bast)	71.2	18.5	2.0	2.2	4.3	1.6
Hemp(bast)	78.3	5.4	2.5	2.9	-	-
Jute (bast)	71.5	13.3	0.2	13.1	1.2	0.6
Coir (brown)	35.6	15.4	5.1	32.7	3.0	-
Coir (white)	36.7	15.2	4.7	32.5	3.1	-
Coir pith	19.9	11.9	7.0	53.3	0.3	-
Sisal	73.1	13.3	0.9	11.0	1.3	0.3
Abaca	70.2	21.7	0.6	5.6	1.6	0.2

E. Coconut Shell Powder

Coconut shell is the hardest outer shell of ripe coconut fruit seed. After breaking the coconut manually it can be separated by removing the meat from the inner shells of the coconut. The shells are dried in the sun light for three successive days to remove moisture content in the shell. After drying in the sunlight the shell outer surfaces are cleaned by scrapping using knives and emery paper. After cleaning the coconut shells, it is crashed into smaller pieces of about 10 sq. mm. size using hammer. Then again by manual impact crushing, the shell pieces are crushed into further smaller size.

Fig.2. Coconut shell

After getting smaller sized shell pieces about 3 to 4 sq.mm. it is ground into fine powder by using mixer grinder [11]. The Powder obtained from the above process is filtered for desired grain size. The desired grain size is 200 to 800 microns [12], this filtering is done by using sand sewer of desired size.

F. Coconut Wood Chips (CWC)

Use of coconut is from ancient times coconut wood is a very hard and durable material for many household applications. Coconut wood section gives different characteristics at different positions, where outermost part is the hardest part. The lumber of coconut has different grades, the grades of the lumber varies as the thickness of the lumber varies. Hardest part of wood is found on the outer perimeter of the trunk and the hardness decreases towards the center of the trunk.

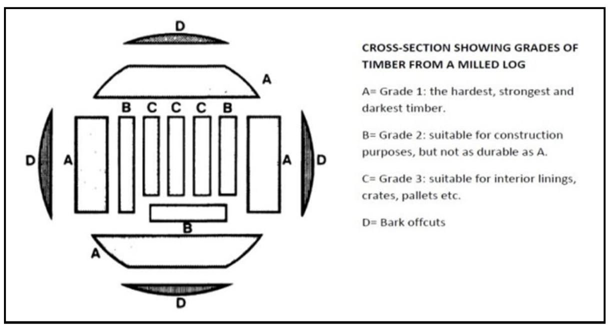


Fig.3. Grades of Timber log.

While machining this coconut tree trunk coconut wood chips are formed. The size of chips varies from 0.5mm to 2mm in thickness and length varies from 5mm to 20mm approximately. These chips are used in this work as reinforcement material with unsaturated polyester resin matrix. The most advantageous property of these coconut wood chips as reinforcement is it adheres to the matrix very well. The machined chips of coconut wood are collected from local woodturning shop. These chips are then dried in the sunlight for three successive days to remove moisture content in the wood chips. These dried wood chips are then separated from impurities manually and the desired sized coconut wood chips are separated manually. Approximately 10 mm length chips are selected for the experimentation [15]. After separating the selected coconut wood chips again dried in sunlight for one day and stored in an airtight container to avoid moisture contamination.

Fig.4. Coconut wood chips

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

III. MOLD PREPARATION AND TEST SPECIMENS

A. Mold Preparation

Mold preparation is very essential part in composite material testing. Hence we considered hand layup process for specimen preparation since it is the most economical and easier process of all [8].

Fig.5. Wooden mold

Wooden mold of dimension 175mm x 80mm are prepared for individual samples of different compositions. The molds are prepared on a laminated wooden board for easier removal of the composite specimen after curing. The figure 5 shows the wooden mold used to prepare the samples. To maintain same environmental condition, same curing time and temperature all the specimens are molded on a single ply board.

B. Composition Details of the Specimen

Composition percentage range of test specimens were considered by referring journal papers, where they discussed about optimum percentages of compositions for maximum strengths and modulus. Coconut shell powder percentage range for optimum strengths is 5% to 25% by volume [5]. Coir fiber percentage for optimum strengths is about 20% by volume[7]. Up to 20% of coir fiber fraction by weight shows increase in strengths and decreases as the fiber percentage increases [10]. Density of coir fiber is about 1.2g/cm^3 and density of coconut shell powder is about 1.05 to 1.2g/cm^3[1], hence in this study it is considered that optimum range of percentage of coir fiber and CSP as filler material for experimentation are 15% to 25% and 0% to 10% respectively. Same range of weight fraction as coir fiber is considered for CWC also. The detailed percentages of composition are given in Table 2.
For different samples the desired quantity of resin, catalyst, filler and reinforcement fibers are measured by weight. Each sample of different composition are prepared separately and molded in separate molds.

Table 2. Composition of Test Specimens

Material 1 (Coir fiber composite)				
Specimen No.		% of Resin (Matrix)	% of Coir (Reinforcement)	% of CSP (Filler)
Untreated	Rain water Treated			
C15	C15-R	75	15	10
C20	C20-R	75	20	5
C25	C25-R	75	25	0
Material 2 (Coconut wood chips composite)				
Specimen No.		% of Resin (Matrix)	% of CWC (Reinforcement)	% of CSP (Filler)
Untreated	Rain water Treated			
W15	W15-R	75	15	10
W20	W20-R	75	20	5
W25	W25-R	75	25	0

Resin and catalyst of desired proportion are mixed in a clean plastic container to avoid any contamination into the solution. Immediately after mixing fiber and filler material is added to it and mixed well. The viscous solution obtained is kept stirring to get homogenous mixture and poured into the mold already prepared. The mold size is so made that testing specimen for different kinds of tests will be cut from the same molded sheet of composite to ensure that all specimens will have same quality composition.
The viscous solution poured into the mold is leveled to get uniform distribution of resin and fibers throughout the mold surface. The mold is kept in a controlled environment for 24 hours to cure.

Fig.6. Composite sheets molded

After curing the composite sheet is removed from the mold and given numbers to identify the composition. The sample is later marked for cutting off desired sized samples for both tensile and flexural tests. Two samples of each test are cut from the molded sheet.

Fig.7. C25, C20 and C15 Composite sheets

C. Specimen Preparation

The prepared sheets of composite are of size 175mmx x 80mm x 5mm approximately. These are then marked for cutting the specimens. The specimen for tensile test is prepared as per the standard ASTM D638 Type I [17] specifications and flexural test specimen is prepared as per standard ASTM D790 [18] specifications. The same dimensions are marked on all the composite sheets prepared. On each sheet of composites two tensile specimens and two flexural specimens are marked for cutting.

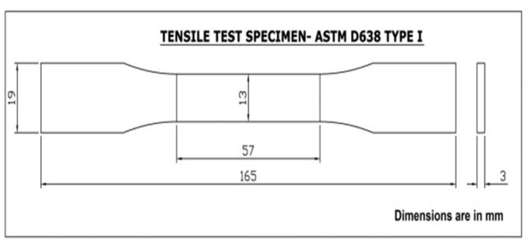


Fig.8. Tensile test specimen dimensions as per ASTM D638 Type-I

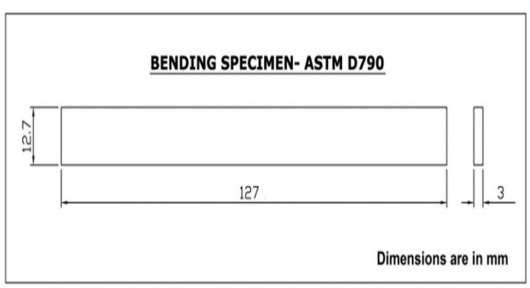


Fig.9. Bending test specimen dimensions as per ASTM D790

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

The marked composite sheets are cut as per the dimensions and finished by hand filing operation to avoid any damage or straining. For tensile specimen filing a low carbon steel die is prepared as per ASTM D638 Type-I specifications. By using this die finishing of tensile specimens are done.

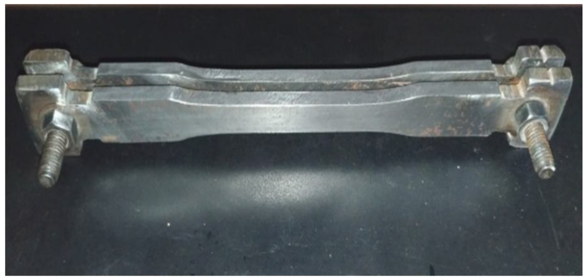


Fig.10. Steel die for Tensile test specimen

Flexural test specimens are filed manually for desired dimensions. Both tensile and flexural test specimens are polished in direction along the length of specimen as per ASTM preferred method [17] [18]. While filing the specimens are hold with wooden fittings to avoid any damage and strain on the specimen.

Fig.11(a). Coir fiber composite tensile test specimens before testing

Fig.11(b). Coir fiber composite tensile test specimens after testing

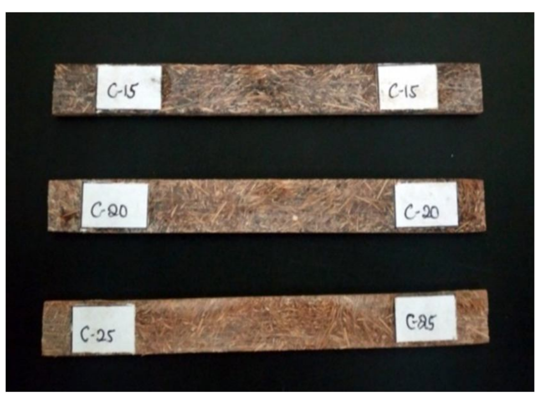


Fig.12(a). Coir fiber composite bending test specimens before testing

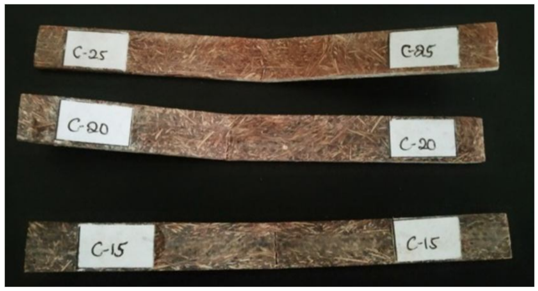


Fig.12(b). Coir fiber composite bending test specimens after testing

D. Rain water treatment of Composites

One set of all specimens are treated in rain water for 15 days and 15 nights to study about mechanical behavioural changes in the materials of different compositions. The specimens are kept in collected rain water in open space. After 15 days in rain water the specimens are dried in shade for about 24 hours to remove excess water content. Then the dried specimens are kept in air lock pouches and taken for testing.

In this study we considered only 15 days of water immersion treatment just to investigate about the mechanical properties changes like tensile and flexural properties due to water absorption and other effects of water on components of specimens [14] [16].

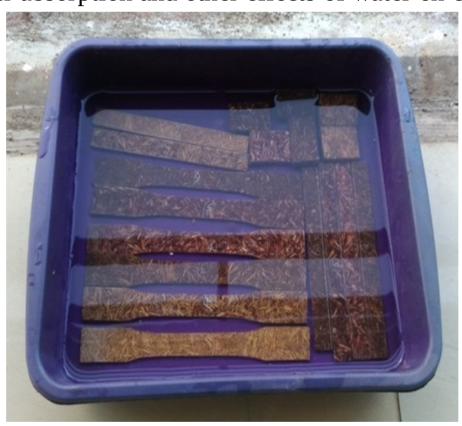


Fig.13(a). Specimens kept in collected rain water

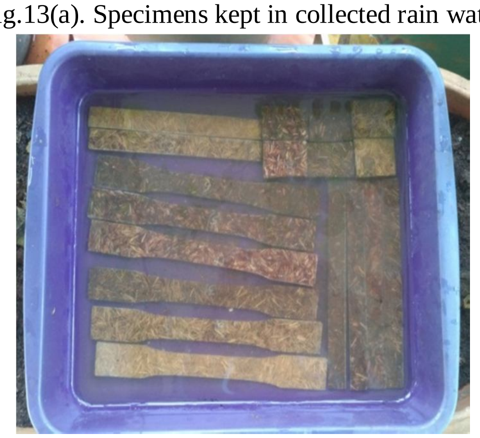


Fig.13(b). Specimens in rain water after 15 days

IV. RESULT AND DISCUSSIONS

This section focuses on presenting all the results, properties, observations and behaviours collected in the course of experimentation. The data analysis gives us the source and validation for the conclusion reported in this study. Here two types of experimentations were carried out viz. tensile and bending tests on two types of composite materials such as coir fiber reinforced and coconut wood chips reinforced composites. These tests are carried out on two specimen conditions which are rain water treated specimens and specimens kept in room temperature for a specific period of time.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

A. Mechanical Properties of CF Composites

The figure 14 and table 3 shows the details of tensile properties of coir fiber reinforced composites with fiber length 10mm, weight fraction of reinforcement changing from 15% to 25% and weight fraction of filler material (CSP) ranging from 0% to 10%.

Table 3. Tensile properties of C15, C20 and C25 specimens.

Specimen	F Max N	Tensile Modulus MPa	Tensile Strength MPa	Strain at Yield %	Strain at Break %
C15	425	603	11.6	1.2	1.5
C20	554	559	14.4	1.5	1.5
C25	562	450	14.5	1.8	2.9

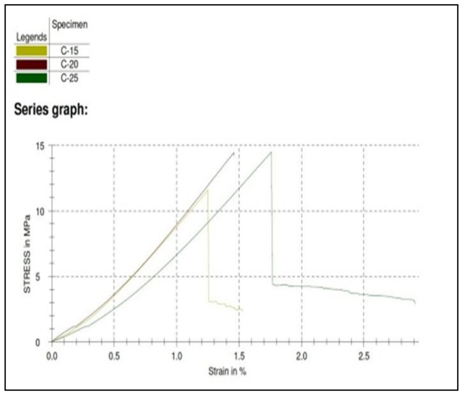


Fig.14. Tensile behavior graphs of C15, C20 and C25 specimens.

From the result it has been found that the tensile modulus decreases and tensile strength increases as the fiber percentage increases. Decrease in modulus is because of poor bonding between resin and fiber in higher weight fraction and effect of filler material. Coconut shell powder as reinforcement increases the tensile modulus of the composite due to its better bonding with resin. Due to high strength of the coir fiber tensile strength of composite increased in higher fraction. Strain at break is increased as percentage of fiber increases due to the toughening property of coir fiber [2].

The figure 15 and table 4 shows the details of bending properties of coir fiber reinforced composites of compositions same as in tensile test results.

Table 4. Flexural properties of C15, C20 and C25 specimens

Specimen	Flex. Modulus MPa	Flex. Strength MPa
C15	2770	44.6
C20	2900	42.0
C25	2210	40.9

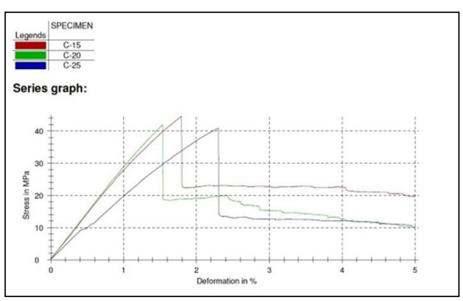


Fig.15. Flexural behavior graphs of C15, C20 and C25 specimens

The result from this test shows that flexural strength of the composite decreases as the weight fraction of reinforcement increases and filler decreases. This is due to the poor bending strength of coir fiber. Bending strength increased as filler percentage increased because of its good hardness and bonding with resin. Furthermore it can be seen that due to good flexibility of coir fiber flexural modulus is highest at 20% weight percentage composition. Hence the same percentages of coir fiber and CSP filler can be considered as optimum percentages of composition for good flexural modulus.

B. Mechanical properties of CWC Composites

Table 5 and Figure 16 shows the results of tensile test of CWC reinforced composites of reinforcement percentages 15%, 20% and 25%.

Table 5. Tensile properties of W15, W20 and W25 specimens

Specimen	F Max N	Tensile Modulus MPa	Tensile Strength MPa	Strain at Yield %	Strain at Break %
W15	491	637	13.2	1.1	1.1
W20	636	795	16.6	1.2	1.2
W25	571	647	14.1	1.0	1.0

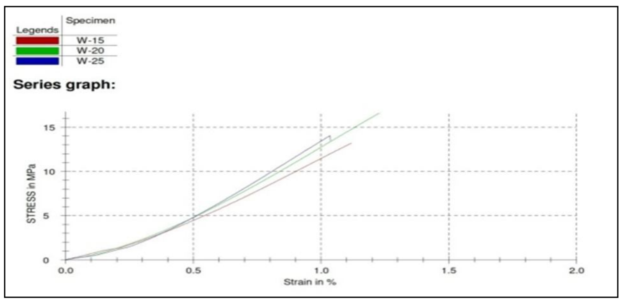


Fig.16. Tensile behavior graphs of W15, W20 and W25 specimens

From the figure 5.3 it has been found that at 15% fiber reinforcement and 10% filler percentages shows minimum tensile strength and tensile modulus. This is because of brittleness of filler material. Whereas maximum tensile modulus and tensile strength are found in composition 20% reinforcement and 5% filler material. This high strength is because of good tensile properties of coconut wood and adequate bonding between resin, reinforcement and filler material. Strain at breaking is also more in the same composition. Hence it can be considered that 20% reinforcement and 5% filler is optimum composition for tensile behavior of coconut wood chips composite. After increasing reinforcement percentage it shows lower properties than 20% weight fraction specimen. This is due to the poor bonding between wood chips and resin and absence of filler material. Hence filler contributes more in deciding the tensile properties of coconut wood chips reinforced composite.

The table 6 and Figure 17 shows the details of flexural tests conducted on CWC composite specimens with 15%, 20% and 25% weight fractions of reinforcement. It has been found that flexural behavior also similar to the tensile behavior of the specimen. The details discussed below.

Table 6. Flexural properties of W15, W20 and W25 specimens.

Specimen	Flex. Modulus MPa	Flex. Strength MPa
W15	2660	22.8
W20	4230	60.9
W25	3640	36.6

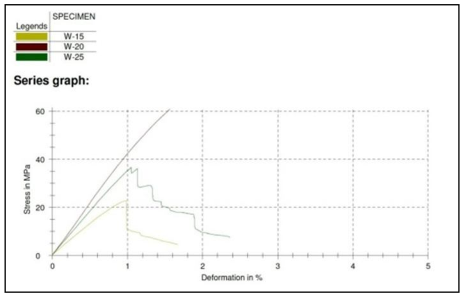


Fig.17. Flexural behavior graphs of W15, W20 and W25 specimens.

Both tensile test and flexural tests shows least modulus and strength in 15% fiber specimen and maximum flexural modulus and flexural strength in 20% reinforcement composition. This is because of good bonding between reinforcement and resin and excellent bending property of coconut wood chips.

C. Mechanical Properties of rain Water treated CF Composites

The specimens kept in rain water are tested for tensile and flexural properties. The rain water treated composite specimens with varying fiber and filler percentages have been studied. In the study it can be seen that treatment of rain water influences to change mechanical properties of composites. If the material is good water absorbent then effect of water treatment on the properties will be more and it is seen that coconut wood chips are more prone to water compared to coir fiber. Hence CWC composite shows poor characteristics when treated with rain water.

The Table 7 shows test results of tensile test of rain water treated coir composite with fiber percentages 15%, 20% and 25%.

Table 7. Tensile properties of C15-R, C20-R and C25-R specimens.

Specimen	F Max N	Tensile Modulus MPa	Tensile Strength MPa	Strain at Yield %	Strain at Break %
C15-R	585	690	15.2	1.4	1.4
C20-R	486	892	13.0	1.1	1.5
C25-R	482	596	12.5	1.5	2.0

The tensile and flexural strengths of coir fiber reinforced specimen shows reduction in strengths when prepared without filler material. With maximum filler material percentage the composite shows 14% increase in tensile strength and with decrease in filler material it shows 12% to 14% increase in tensile strength. This is due to poor water absorption property of coir fiber and good water absorption property of coconut shell powder.

The Table 8 shows test results of flexural test of rain water treated specimens with coir fiber reinforcement percentages 15%, 20% and 25%.

Table 8. Flexural properties of C15-R, C20-R and C25-R specimens.

Specimen	Flex. Modulus MPa	Flex. Strength MPa
C15-R	2850	38.8
C20-R	2820	37.8
C25-R	2710	29.3

As observed in this test results flexural strength is decreased 10% to 13% because of higher brittleness of CSP after water treatment. CSP becomes more brittle after treating with water. Hence the flexural strength decreased after rain water treatment.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

D. Mechanical Properties of rain water Treated CWC Composites

The Table 9 shows the test result of tensile test of rain water treated specimens with CWC reinforced composite of different compositions. Here the fiber material CWCs are very prone to moisture and exhibits poor strength and modulus.

Table 9. Tensile properties of W15-R, W20-R and W25-R specimens.

Specimen	F Max N	Tensile Modulus MPa	Tensile Strength MPa	Strain at Yield %	Strain at Break %
W15-R	504	683	12.7	1.0	1.0
W20-R	563	769	13.8	1.1	1.1
W25-R	283	680	7.18	0.8	1.0

It has been seen that as observed in CF composites CWC 15% fiber content specimen also shows 12% increase in tensile strength and about 11% decrease in tensile strength in 20% and 25% fiber content specimens after the specimen is treated with rain water. The decrease in strength is due to water absorption property of fiber material CWC. When compared to coir fiber CWC has greater water absorption property.

Table 10 illustrates the test results of flexural property investigation of coconut wood chips reinforced composite after treating with rain water. In this test it is observed that there is up to 30% increase in bending strength of 15% fiber content specimen.

Table 10. Flexural properties of W15-R, W20-R and W25-R specimens.

Specimen	Flex. Modulus MPa	Flex. Strength MPa
W15-R	3410	35.5
W20-R	3830	39.3
W25-R	3770	36.8

E. Combined Effect Of Reinforcement Fiber And Csp Filler Percentages: Tensile Strength Comparison

The figure 5.9shows detailed comparison of tensile strengths of CF and CWC composites. In tensile strength comparison it is observed that tensile strength of CWC composite is 8% to 14% more than that of CF composite in the specified range of fiber percentage. When fiber percentage increased the tensile strength of CWC composite reduced in comparison with CF composite. By overall results maximum tensile strength can be seen in 20% fiber percentage CWC composite specimen.

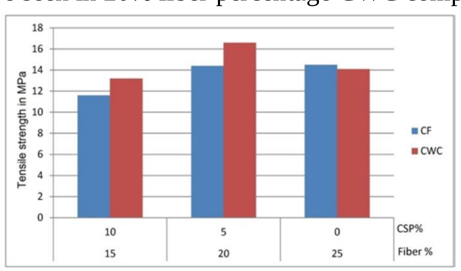


Fig.18. Tensile strength comparisons chart of CF and CWC composites.

F. Flexural Strength Comparison

The figure 5.10 provides details about comparison of flexural strengths of CF and CWC composites. It shows that flexural strength of CWC composite is about 45% more than that of CF composite only in 20% fiber composition. But CF composite shows more flexural strength in 15% and 25% fiber composition specimens. Maximum flexural strength can be seen in 20% composition CWC specimen.

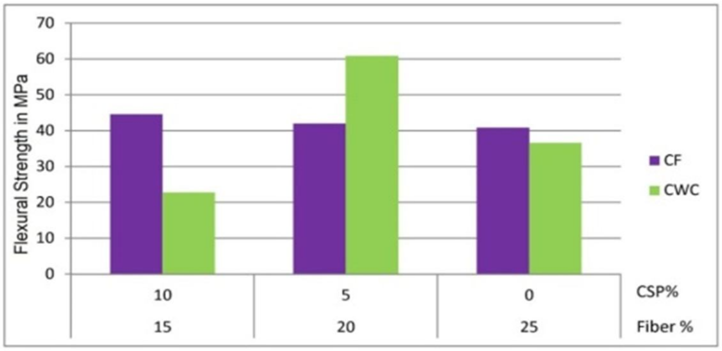


Fig.19. Flexural strength comparisons chart of CF and CWC composites.

G. *Comparison Between Untreated And Rain Water Treated Composites*

From the results it is observed that rain water treated specimen shows reduced strengths than untreated specimens. Tensile and flexural strengths of CF and CWC composites reduced in the range of 1% to 50% in different fiber fraction specimens after treating with rain water. The result shows us that rain water will reduce the strength of coir fiber and coconut wood chips composites and is discussed in detail below.

H. *Coir fiber Reinforced Composites*

The figure 5.11 and 5.12 shows tensile and flexural test results of CF and CF-R specimens respectively. Here CF composite shows 10% to 14% reduction in tensile strength and 10% to 28% reduction in flexural strengths after treating with rain water. This shows that rain water treatment affects more on flexural strength of CF composites, since rain water makes CF to lose its flexural and tensile strengths.

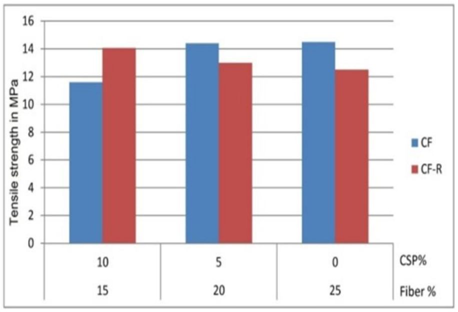


Fig.20(a). Tensile strength comparisons chart of CF and CF-R composites.

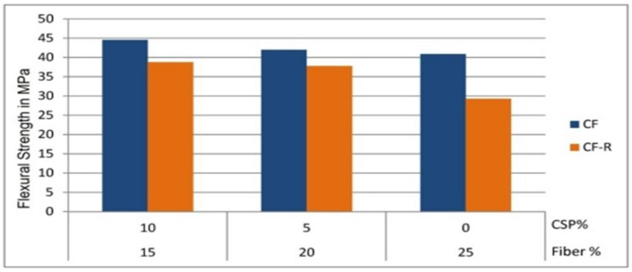


Fig.20(b). Flexural strength comparisons chart of CF and CF-R composites.

I. *Coconut wood chips Reinforced Composites*

The figure 5.13 and 5.14 shows comparative tensile and bending strengths of CWC and CWC-R composites. Once again it can be observed that rain water treated composite shows lower strengths compared to untreated composite specimens. When CWC composites treated with rain water its tensile strength reduced up to 50% in 25% fiber percentage specimen and reduced up to 17% in other specimens. Flexural strength of CWC specimens shows unconditional variation after rain water treatment. In 20% fiber content specimen flexural strength decreased about 35% after rain water treatment.

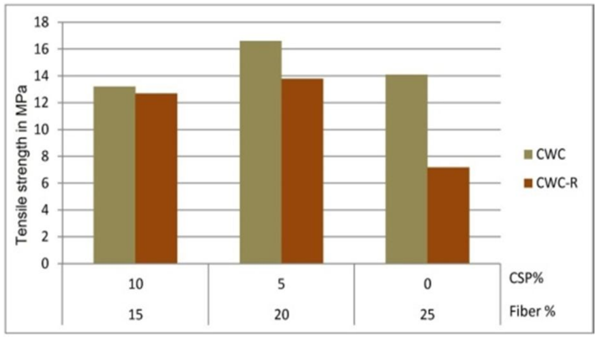


Fig.21(a). Tensile strength comparisons chart of CWC and CWC-R composites.

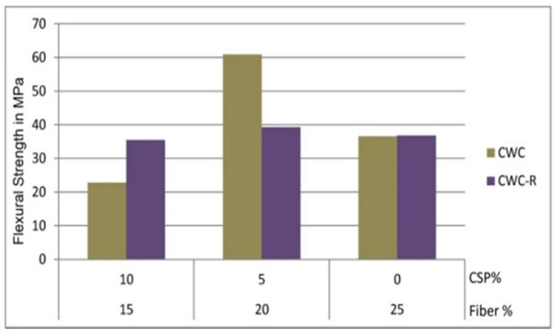


Fig.21(b). Flexural strength comparisons chart of CWC and CWC-R composites.

V. CONCLUSIONS

This work has been carried out with an objective to study the mechanical properties of coir fiber and coconut wood chips reinforced composites with coconut shell powder as filler material and polyester resin as matrix. This work focused on tensile and flexural behaviors of both the composites and at providing knowledge to enhance further research on coconut wood chips composite. From the analysis of result and discussion in this study, conclusions can be made as below.

A. In comparison of coir fiber and coconut wood chips composites it was observed that coconut wood chips composite shows greater tensile and flexural strengths in composition 20% of CWC as reinforcement and 5% of CSP as filler by weight.
B. Furthermore as observed in the study it shows that failure strain is more in CF composite than CWC composite, hence the major drawback in CWC composite is its brittleness in tensile application.
C. When comparing the same composites with rain water treated specimens of same compositions it gives the poor result after the treatment. Hence water contamination and moisture will affects negatively on the mechanical properties of both the materials.

REFERENCES

[1] Udhayasankar, R., and B. Karthikeyan. "A Review on Coconut Shell Reinforced Composites." International Journal of ChemTech Research 8.11 (2015): 624-637.
[2] Naveen, P. N. E., and M. Yasaswi. "Experimental analysis of coir-fiber reinforced polymer composite materials." International Journal of Mechanical Engineering and Robotics Research 2.1 (2013): 10-18.
[3] Verma, D., et al. "Coir fibre reinforcement and application in polymer composites: A." Journalof Material & Environment Science 4.2 (2013): 263-276.
[4] Wollerdorfer, Martina, and Herbert Bader. "Influence of natural fibres on the mechanical properties of biodegradable polymers." Industrial Crops and Products 8.2 (1998): 105-112.
[5] Agunsoye, J. Olumuyiwa, Talabi S. Isaac, and Sanni O. Samuel. "Study of mechanical behaviour of coconut shell reinforced polymer matrix composite." Journal of minerals and materials characterization and Engineering 11.8 (2012): 774-779.
[6] Waigaonkar, Sachin, B. J. C. Babu, and Amit Rajput. "Curing studies of unsaturated polyester resin used in FRP products." (2011).
[7] Venkatesh, B. "Fabrication and testing of coconut shell powder reinforced epoxy composites." IJAERD: International Journal Of Advanced Engineering And Research Development 2.02 (2015).
[8] Srivastava, Anshuman, and Madhusoodan Maurya. "Preparation and mechanical characterization of epoxy based composite developed by biowaste material." IJRET: International Journal Of Research In Engineering And Technology 4.04 (2015).
[9] Harish, Sivasankaran, et al. "Mechanical property evaluation of natural fiber coir composite." Materials characterization 60.1 (2009): 44-49.
[10] Mastan V., JeevanKumar N., HarishKumar A., "A Review Paper on Tensile Properties of Natural Fiber Polymer Matrix Composites." IJEAS: International Journal Of Engineering And Science 4.12 (2014): 60-63

[11] Vasu, Aradhyulathirumala, et al. (2015). "Coconut Shell Powder For Composite To Improve The Mechanical Properties." IJMPE: International Journal Of Mechanical And Production Engineering 3.09 (2015):

[12] Bhaskar, J., and V. K. Singh. "Physical and Mechanical Properties of Coconut Shell Particle Reinforced-Epoxy Composite." J. Mater. Environ. Sci 4.2 (2013): 227-232.

[13] Nazeer, Abdul. "To Study the mechanical properties of coconut coir fiber reinforced with epoxy resin AW 106 & HV 953 IN." International Journal of Modern Engineering Research (IJMER) 1.4 (2014): 38-47.

[14] Zaman, Haydar U., and M. D. H. Beg. "Preparation, structure, and properties of the coir fiber/polypropylene composites." Journal of Composite Materials 48.26 (2014): 3293-3301.

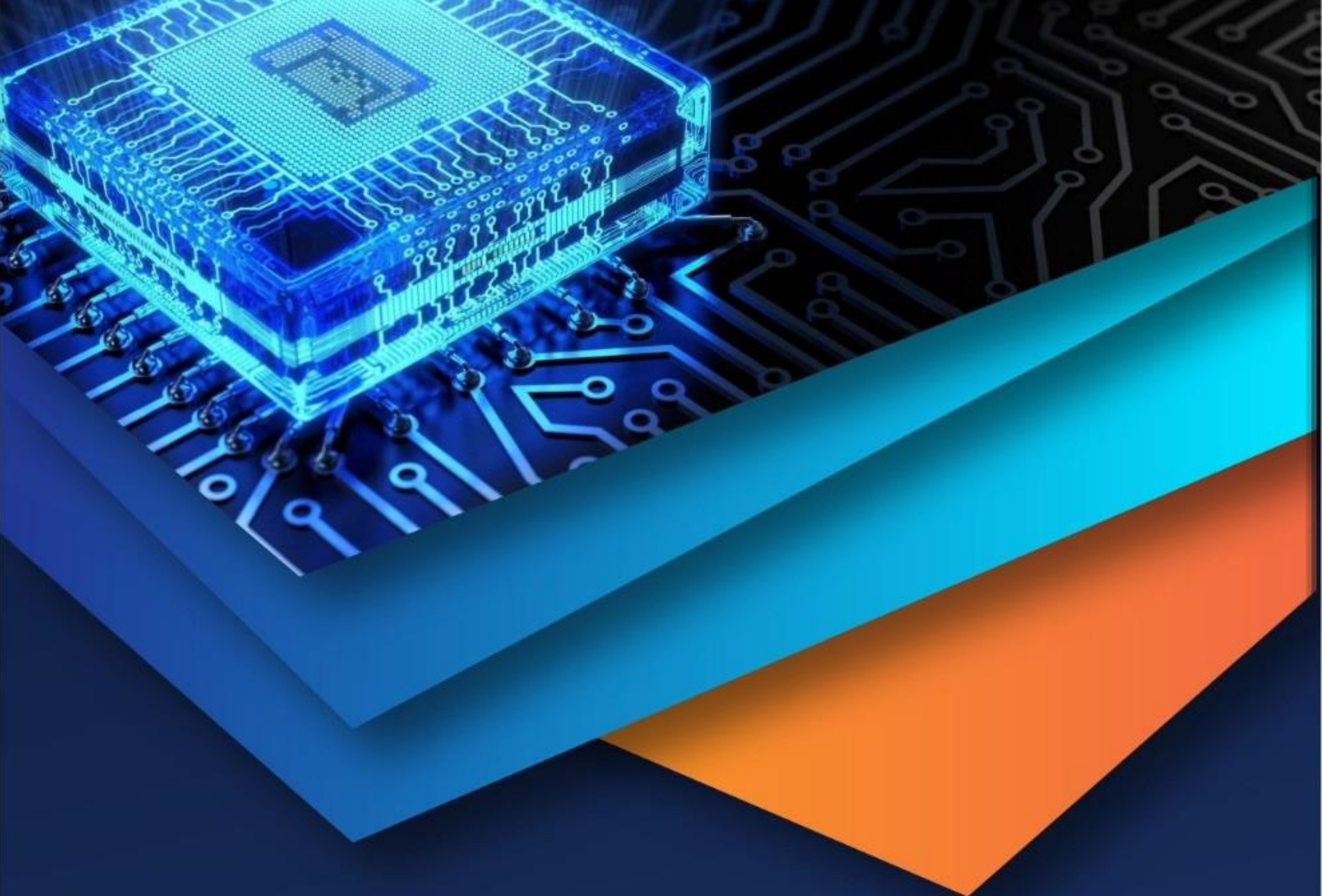
[15] Kuburi, L. S., et al. "Effects of Coir Fibber Loading on the Physio-mechanical and Morphological Properties of Coconut Shell Powder Filled Low Density Polyethylene Composites." Procedia Manufacturing 7 (2016): 138-144.

[16] Assarar, M., et al. "Influence of water ageing on mechanical properties and damage events of two reinforced composite materials: Flax–fibres and glass– fibres." Materials & Design 32.2 (2011): 788-795.

[17] A. S. T. M., Standard "Standard test method for tensile properties of plastics." ASTM International. Designation: D 638-02a (2003): 1-13.

[18] ASTM, Inernational "Standard test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials." ASTM D790-02 (2003).

Mr. Prashantha, has bachelors degree B.E. in Mechanical Engineering, Masters Degree M.Tech. in Computer Integrated Manufacturing and Presently working as Assistant Professor in Department of Mechanical Engineering, MIT Kundapura.
Experiences: 2 years of industrial experience and 6+ years of teaching experience in MIT Kundapura.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)