International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 9, September-2018

Evaluation of Mechanical, chemical, Properties of Arhar filled Composites

[1]L.SUDHEER KUMAR REDDY, [2] Dr.B.CHANDRA MOHANA REDDY, [3]K.MANOHAR REDDY

[1]PG Research Scholar, Product design, Mechanical Engineering, JNTUA College of Engineering, Ananthapuramu, Andhra Pradesh, India

[2]Assistant Professor of Mechanical Engineering, JNTUA College of Engineering, Ananthapuramu, Andhra Pradesh,

[3]Research scholar of Mechanical Engineering, JNTUA College of Engineering, Ananthapuramu, Andhra Pradesh,

Abstract—Polymers providing their service to the society with their remarkablefeatureslike low-density, resistance to oxidation which leads to corrosion, low coefficient of friction, good mould capability&inexpensive. In the existing work epoxy resin ispreferred as matrix, Arhar flakes is preferred as reinforcement. Arhar is taken in the form of flakes & mixed with epoxy by using mechanical shear mixer, then placed in ultrasonicator for better scattering of Arhar flakes in the matrix. After this the composite is cured at room temperature. Different weights of Arhar flakes (5,10,15,20 gm wt.) has been to prepare the composite samples & same samples tested for mechanical properties. From the results of the mechanical properties, the Arhar flakes with 15gms epoxy composite samples showing the better values.

Key words: Arhar fiber (filler type), Epoxy Resin AW106, Stress and strain

I. INTRODUCTION

There is always a demand to develop new materials to match the developing industrial needs. Composite materials are mostly used in different industrial applications due to its lightweight and high-strength properties [1-4]. Polymer Matrix composites (PMC) mostly used in aerospace and automobile applications [2-6] due to its properties like wear resistant, high hardness, corrosive resistance and better formability.

The basic difference between blends and composites is that the two main constituents in the composites remain recognizable while these may not be recognizable in blends [8]. The predominant useful materials used in our day-today life are wood, concrete, ceramics, and so on. The most important polymeric composites are found in nature and these are known as natural composites. The connective tissues in mammals belong to the most advanced polymer composites known to mankind where the fibrous protein, collagen is the reinforcement [4]. It functions both as soft and hard connective tissue, composites are combination of materials differing in composition, where the individual constituents retain their separate identities. These separate constituents act together to give the necessary mechanical strength or stiffness to the composite part. Composite material is a material composed of two or more distinct [5] phases (matrix phase and dispersed phase) and having bulk properties significantly different from those of any of the constituents. Matrix phase is the primary phase having a continuous character and is usually more ductile and less hard phase [6]. It holds the dispersed phase and shares a load with it. Dispersed (reinforcing) phase is embedded in the matrix in a discontinuous form [6-10]. This secondary phase is called the dispersed phase. Dispersed phase is usually stronger than the matrix therefore, it is sometimes called reinforcing phase.

II. EXPERIMENTAL WORK

Polymers owing their service to the society with their outstanding characteristicsLike low density, good corrosion resistance, low coefficient of friction, good mould ability and economical. The products produced with polymeric materials have good surface finish, transparent and can be produced with close dimensional tolerance. These superior properties of polymers are finding various applications in our life. Even though the polymers have the good characteristics, but their mechanical properties are poor and also, they have poor temperature and polymer composites are produced. The fiber reinforced as well as filler added polymers composites have remarkably the mechanical and thermal properties. In the current work epoxy resin AW106 in choose as matrix, (Arhar fiber) fiber as filler are chose as reinforcement.

Arhar is taken in the form of flakes and mixed with epoxy by using mechanical shear mixer, then kept in ultrasonicator for better dispersion of Arhar flakes in the matrix. After this the composite is curved at room temperature. Different weights of Arhar flakes (5,10,15,20 gm wt) has been to prepare the composite samples and same samples tested for mechanical properties.

2.1 MATERIALS:

Mechanical properties like Flexural strength, Tensile strength and compression strength of the composites are studied by UTM (Universal Testing Machine) and the change in weight is calculated by chemical treatment process. In the present work, Epoxy resin (AW106) Thermo setting polymer is used as a Matrix, Epoxy is the most common Thermo setting polymer used as matrix in the polymer composites. It is obtained from Araldite (AW106) Huntsman, Ciba- Geigy India Ltd Company. Epoxy is a clear liquid with viscosity at 25^0 C. Epoxies are used by the plastic industry in several ways. Epoxy is in combination with Arhar fiber to produce High- strength composites or reinforced plastics that provide improved Mechanical, Chemical properties and heat resistance. Hardener is used as reaction agent. It acts as catalyst. It is added to the resin in 0.9:0.1 proportions to get harden. In the recent work Araldite (HV953) is used as hardener in the Epoxy resin (AW106). It has a shelf pot life 2 years when it is stored in a dry place in a temperature range of 18-25^0C, while for achieving higher pot life, lid should be closed after using the material.

2.2 MOULD PREPARATION:

Moulds of prepared for different samples that are made from resin as for ASTM standards. A glass mould of 130*130*3 mm^3 is used to prepare specimen for tensile test and Flexural test and 10*10*10 mm^3 glass mould is used to prepare the specimen for compression test. In the present work glass moulds are used to prepare Arhar flakes reinforced composite with adequate and appropriate amount of epoxy resin. Below figure shows the moulds used in the preparation of Arhar reinforced composite.

Figure1. Glass Moulds

2.3 METHODOLOGY:

The pre-calculated amount of Arhar flakes, Epoxy resin and hardener is mix together in suitable breaker. Arhar flakes is mixed with suitable quantity of resin based on the predetermined ratio and mixed thoroughly with Mechanical shear mixing for about 1 hour at ambient temperature conditions. Then the mixture is carried out a high intensity ultra sonicator for one and half hour with pulse mode (50_s on/ 25_s off). Hardener is added to modified epoxy in the nature of 0.9: 0.1 parts by weight. A glass mould with required dimensions is use for making sample as per the ASTM standards as it is coated with wax releasing agent enabling in easy removal of the sample.

Now the mixture (the combination of an Arhar flakes, epoxy and hardener) is poured into the glass mould spread equally on the all sides of the mould by applying pressure against the mould. Brush and roller are used to impregnate fiber. The closed mould is kept under the pressure for 24 hours at room temperature. To ensure complete curing the composite samples are post cured at 70^0C for one hour and the test specimens of the required size is cut out from the samples. The removed samples are cut in to specimens in according to ASTM standards for further testing. The testing of Tensile, Flexural, Compression for all specimens was conducted in Universal Testing Machine

Table 1 List of raw materials used in the present work

Description	**Raw materials**
Matrix	Epoxy resin (AW106)
Hardener	Hardener (HV953)
Reinforcing agent	Arhar filler
Mould releasing agent	Polyvinyl alcohol (PVA)/ Wax
Casting	Glass moulds.

Table 2. Combinations of Weights for preparing specimens

Sl. No.	***Arhar flakes (*in weights)**
Specimen 1.	5
Specimen 2	10
Specimen 3	15
Specimen 4	20

Fig 2. Testing Specimens for Tensile, Compression, Flexural

Table 3: specimen specification

Name of the Test	ASTM Standard	Specimen size (mm^3)
Tensile Test	ASTM D638	120*20*3
Compression Test	ASTMD642	10*10*10
Flexural Test	ASTMD618	120*20*3

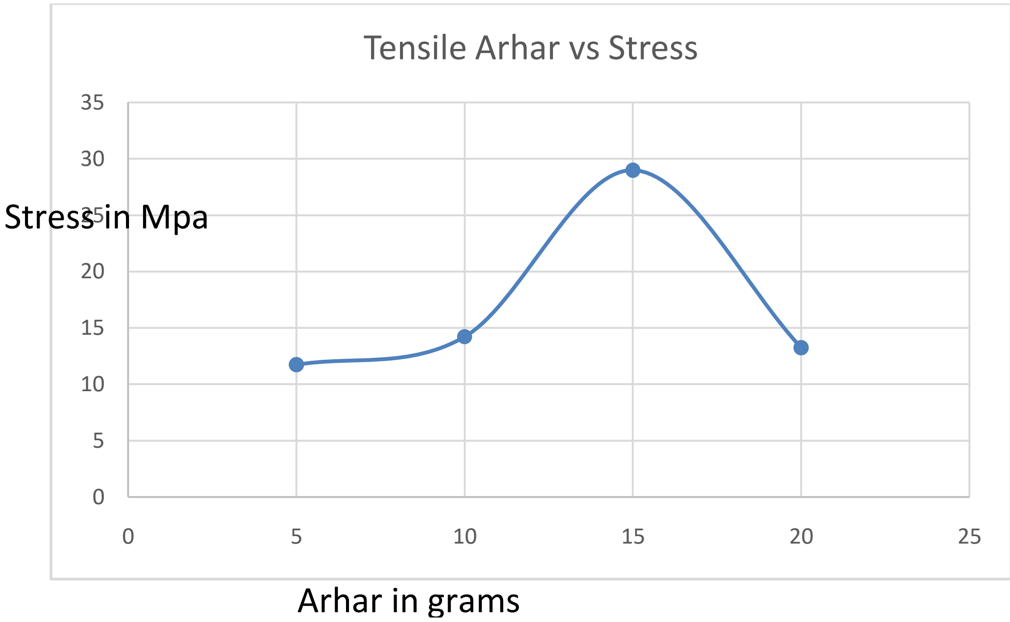
III.RESULTS AND DISCUSSIONS

3.1 TENSILE TEST RESULTS:

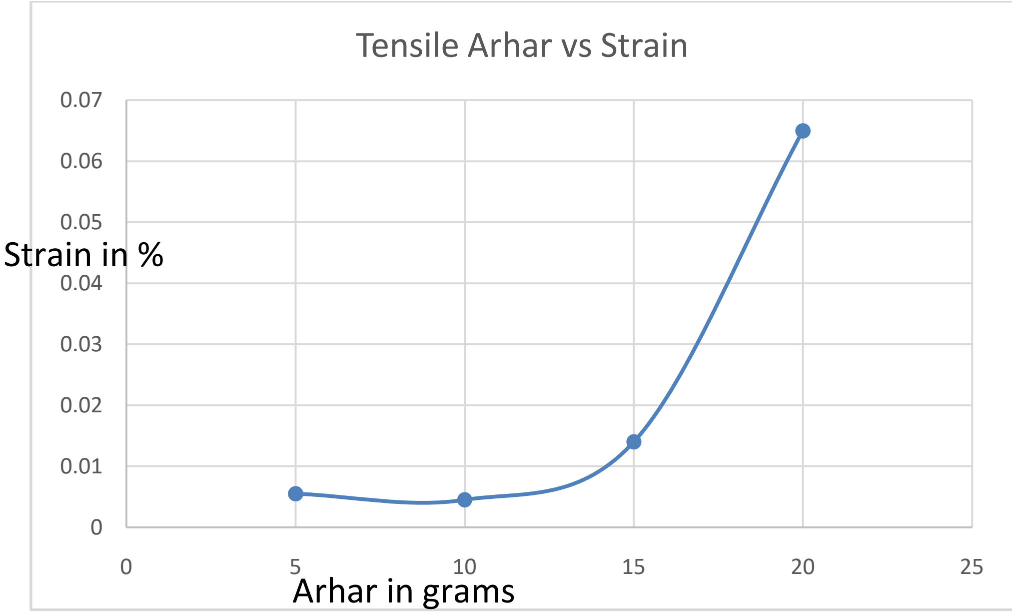
In the present work, the testing of all the specimens was conducted in Universal Testing Machine. The result of UTM, Maximum Load at where the specimen breaks was noted and the corresponding stresses, strain and young's modulus are calculated & listed in the below table.

Table 4. Variations in Tensile Test Results

Specimen	Max. load or load at break (N)	Max. tensile stress at maximum load (Mpa)	Young's modulus (Mpa)	Tensile strain at break (mm/mm)
Specimen 1	258.51	11.74	2650.15	0.0500
Specimen 2	640.22	14.23	3559.52	0.0500
Specimen 3	1304.60	28.99	2778.66	0.01500
Specimen 4	595.64	13.24	2430.55	0.06500



Graph 1. Variation of stress for different specimens at Maximum Load



Graph 2. Variation of Tensile Strain at Break for different specimens

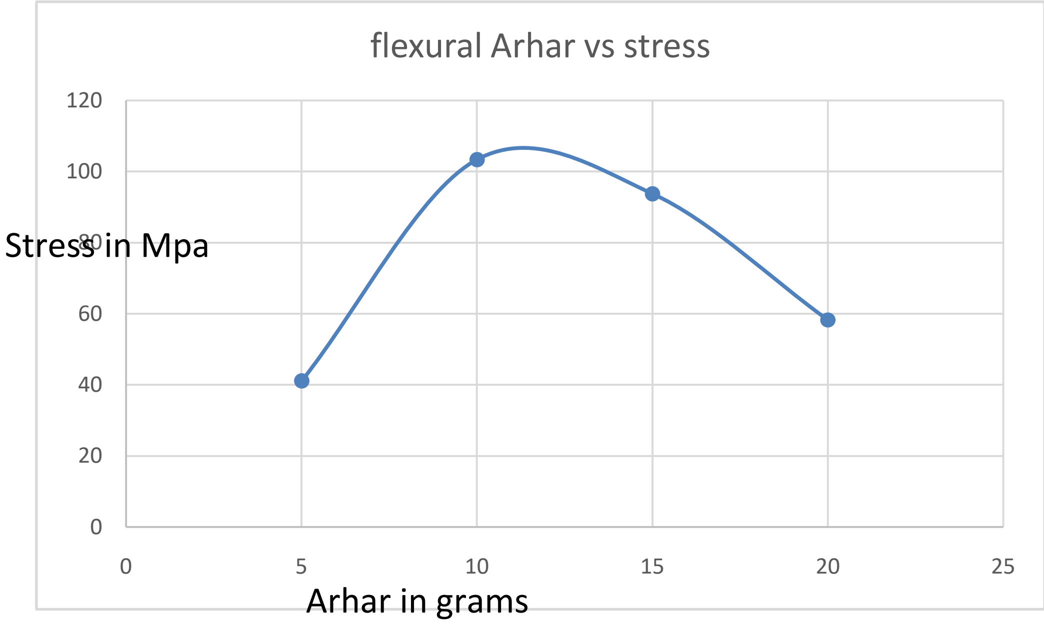
From all the above shown graphs, it is clearly observed that Specimen 3 can sustain highest tensile load than others. But the tensile strain is highest for the specimen 4 than the remaining others.

3.2 FLEXURAL TEST RESULTS:

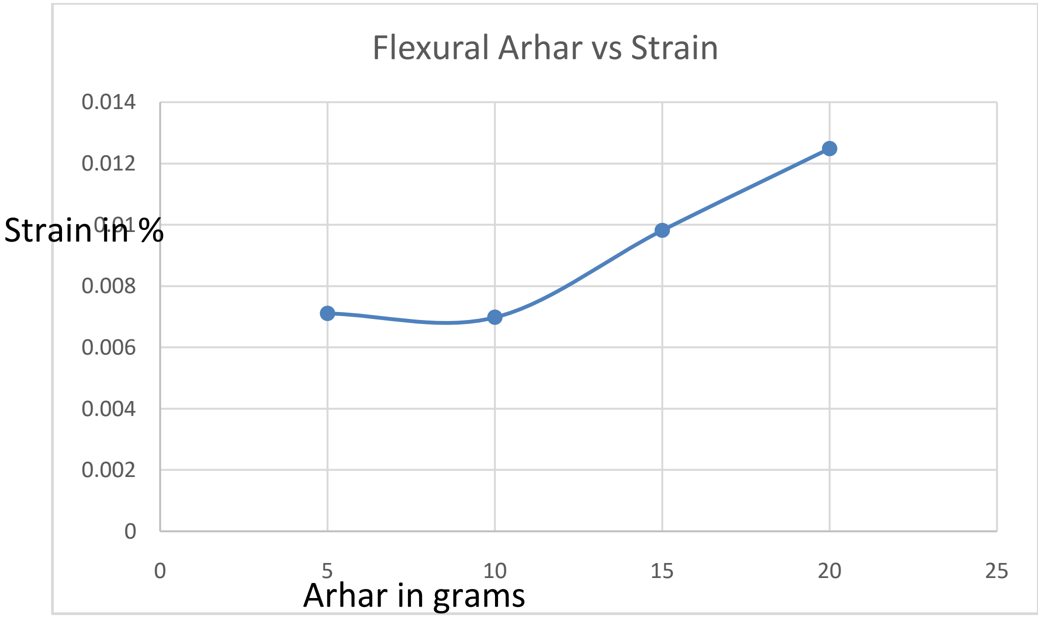
In the present work, the testing of all the specimens was conducted in Universal Testing Machine. The result of UTM, Maximum Load at where the specimen breaks was noted and the corresponding stresses, strain and young's modulus are calculated & listed in the below table.

Table 5: variations in Flexural Test results

Specimen	Max. Flexural Load (KN)	Flexural Stress (Mpa)	Flexural Modulus (Mpa)	Flexural strain at break (mm/mm)
Specimen 1	0.07	41.09	5988.34	0.007
Specimen 2	0.19	103.41	16277.65	0.007
Specimen 3	0.17	93.77	10670.41	0.01
Specimen 4	0.10	58.24	6043.29	0.012



Graph 3. Variation of Maximum Flexural stress for different specimens at Maximum flexural Load



Graph 4. Variation of Flexural strain for different specimens at maximum Flexural Load

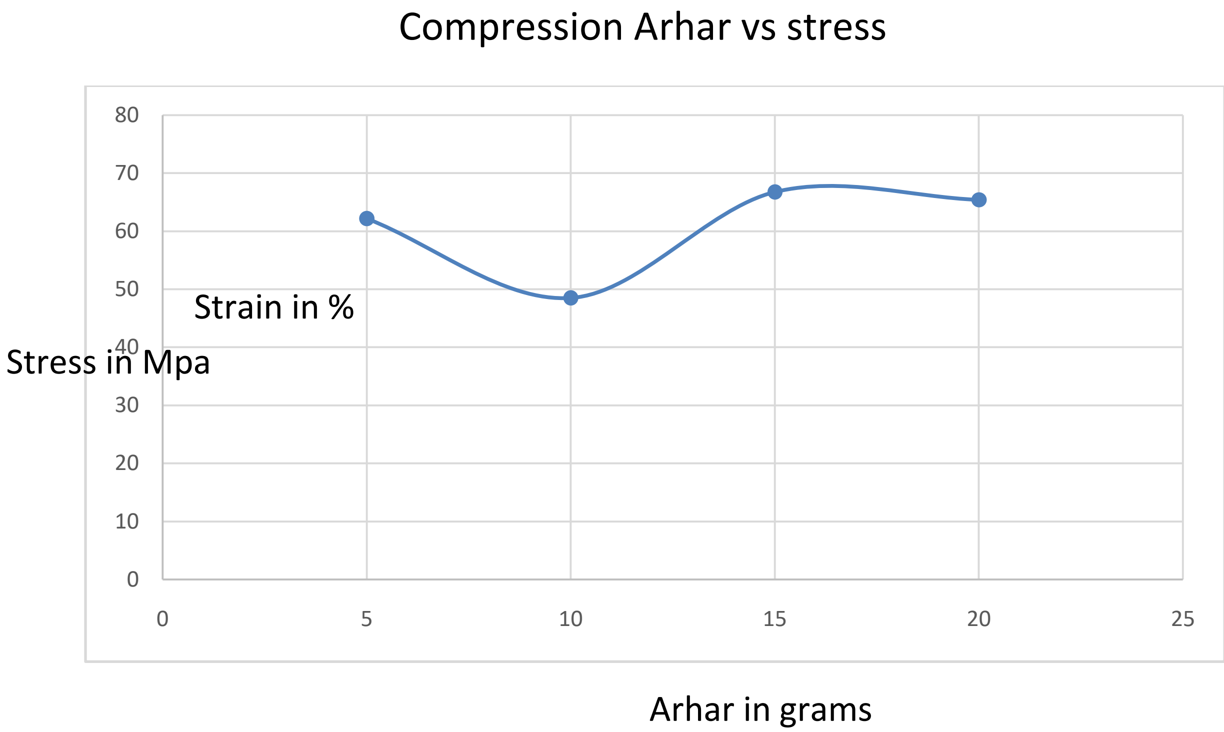
From all the above shown graphs, it is clearly observed that Specimen 2 can sustain highest flexural load than others. But the flexural strain is highest for the specimen 4 than the remaining others.

3.3 COMPRESSIVE TEST RESULTS:

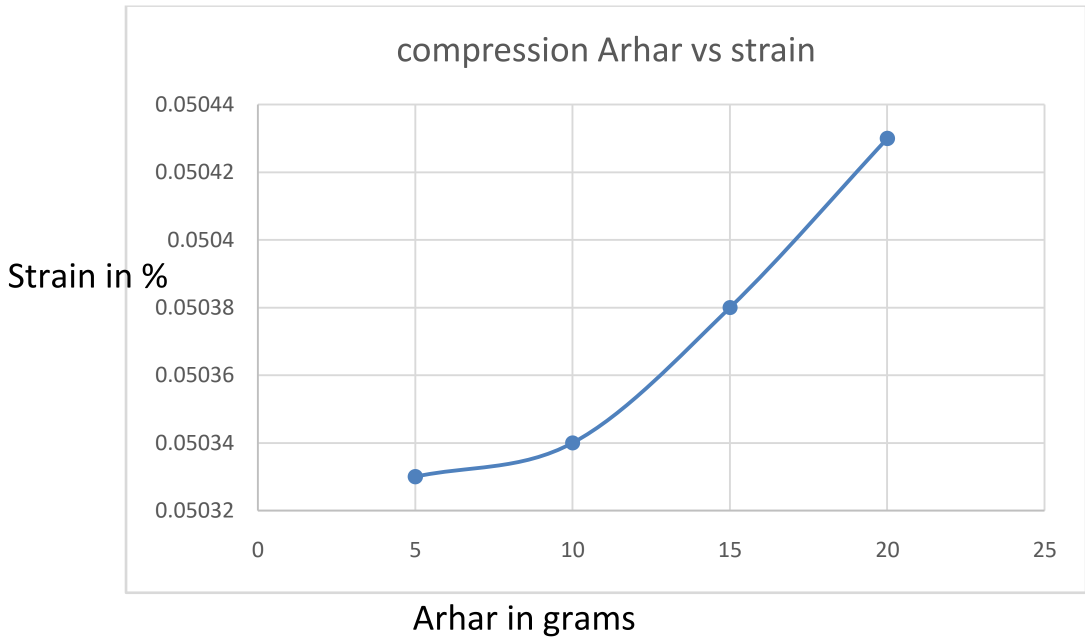
In the present work, the testing of all the specimens was conducted in Universal Testing Machine. The result of UTM, Maximum Load at where the specimen breakswas noted and the corresponding stresses, strain and young's modulus are calculated & listed in the below table.

Table 6. variation in Compressive Test Results

Specimens	**Max. Compressive Load (KN)**	**Compressive Stress (Mpa)**	**Compressive Modulus(Mpa)**	**Compression strain at break (mm/mm)**
Specimen 1	6.22	62.19	2200.91	0.05032
Specimen 2	4.85	48.51	3128.3982	0.05034
Specimen 3	6.68	66.77	5046.1294	0.05038
Specimen 4	6.54	65.41	3094.0792	0.05043



Graph:Variations of Compressive Stress for different specimens at Maximum Compressive Load



Graph 6: Variations of Compressive Modulus for different specimens at Compression Load

From all the above shown graphs, it is clearly observed that Specimen 3 can sustain highest compression load than others. But the compression strain is highest for the specimen 4 than the remaining others.

3.4 CHEMICAL TREATMENT TEST RESULTS:

In the present workweights of the specimens are calculated before, Chemical Treatment Process. Then the specimen is placed in NAOH solution for 24 hours in Chemical Treatment Process. After Chemical Treatment Process the change in percentage of weight of specimen are calculated.

Table 6. Change in weight and change in percentage of weight for all the specimens.

Specimen	**Weight Before Treatment (Gms)**	**Weight After Treatment (Gms)**	**Change in Percentage of weight (% change)**
Specimen 1	2.83	2.91	0.08
Specimen 2	4	4.20	0.20
Specimen 3	3.01	3.15	0.14
Specimen 4	4.07	4.70	0.63

From the Table 6. we observe that weight for each specimen is increased and increase in percentage of weight is calculated for all the specimens.

In the present workweights of the specimens are calculated before, Chemical Treatment Process. Then the specimen is placed in NAOH solution for 24 hours in Chemical Treatment Process. After Chemical Treatment Process the change in percentage of weight of specimen are calculated.

Table 7. Change in weight and change in percentage of weight for all the specimens.

Specimen	**Weight Before Treatment (Gms)**	**Weight After Treatment (Gms)**	**Change in Percentage of weight (% change)**
Specimen 1	2.88	2.89	0.01
Specimen 2	3.88	3.91	0.03
Specimen 3	2.06	2.11	0.05
Specimen 4	4.90	5.00	0.10

From the Table 7. we can observe that weight for each specimen is increased and increase in percentage of weight is calculated for all the specimens.

In the present workweights of the specimens are calculated before, Chemical Treatment Process. Then the specimen is placed in NACL solution for 24 hours in Chemical Treatment Process. After Chemical Treatment Process the change in percentage of weight of specimen are calculated.

IV. CONCLUSION

- Composite samples are fabricated with epoxy resin as hardener and Arhar as taken reinforcement. Different samples were prepared for different weights of Arhar flakes.
- Mechanical tests like tensile,flexural,compression is carried to find the mechanical properties.
- The Tensile Strength for Specimen 3 has more Tensile Strength than other specimens.
- The Flexural Strength for Specimen 2has more Flexural Strength than other specimens.
- The Compressive Strength for Specimen 3 has more Compressive strength than other specimens.

By observing all these above points, it is concluded that Specimen 3 shows better tensile and compression properties and specimen 2 gives better flexural properties than the other specimens.

V. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

VI. REFERENCES

[1] Natural fibers and their composites by Navin Chand and Mohammed Fahim, Tribology of natural fiber polymer composites, (2008) 1-58. doi:10.1533/9781845695057.1

[2] Natural fibre and polymer matrix composites and their applications in aerospace and Automobile engineering P. Balakrishnan, Mahatma Gandhi University, Kottayam, Kerala, India (Chap. 12 page 366-371]

[3] Genetic engineering of fibrous proteins: spider dragline silk and collagen, D.L. Kaplan, Advanced Drug Delivery Reviews 54 (2002) 1131–1143

[4] "Fibre-reinforced composites: Materials, Manufacturing, and Design" by Mallick P.K. published on 1988. ISBN 0-8247-7796-4

[5] 1. K. Friedrich (ed.) Advances in Composites Tribology, Composite Materials Series, Vol. 8, Elsevier, Amsterdam (1993).

[6] Recent advances and developments in matrix solid-phase dispersion, Anna Laura Capriotti PII: S0165-9936(15)00138-7

[7] Recent advances in composite materials, Proc. Special Symposium on Composites in Intelligent and Sustainable Infrastructure, 20–23 Feb., New Delhi, (2007).

[8] Prestressed natural fibre spun yarn reinforced polymer matrix composites, Composites: Part A (2015) page (3-6)

[9] Physical and Mechanical Properties of Bi-directional Jute Fiber Epoxy Composites- Department of Mechanical Engg. NIT Rourkela

[10] Fracture and impact properties of short discrete jute fibre-reinforced cementitious composites. Materials and Design 49 (2013) 35–47