To Analyse the Mechanical Properties of Split Wheat Straw with Fresh/ Recycled High Density Polyethylene Based Polymer Composites

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Abstract: **In recent years, many researches may be done work to make superior quality composite material with different types of natural fiber and other synthetic fibers. All countries have challenges like pollution, global warming, limited energy resources, easy recycles and other etc. Various processing methods and conditions; compression moulding process, injection moulding and extrusion methods are used in composite productions. Characterization challenges associated with agro waste plastic composites productions were also examined. Then finding the research review can be used as a data base into the agro waste plastic composites to development in this sector (Abba et al. 2013). The wheat straw/ polyester composites were made as per the hand layup procedure. Four weight fractions of wheat straw 2%, 4%, 6% and 8% chosen. The specimens are then tested in three point bend configuration in accordance with ASTMD 790-07 at a span of depth ratio of 16.When voids exist, flexural modulus decreases with the addition of straw fiber then finding better processing techniques to reduce voids are needed**

Keywords: **Composite, wheat straw fiber, High density polyethylene, Chemical treatment.**

I. INTRODUCTION

All countries have challenges like pollution, global warming, limited energy resources, easy recycles and other etc. so adapt the modern thought, manufactures and engineers must design and make product that are less harmful to the environment, cost control and meet our needs. Naturally fiber produce superior quality fiber reinforced polymer composites. Natural fibers are renewable resources means easily repelled naturally and can be used again and again so they are the future of our world. Natural fiber contains sisal, bamboo, jute and other plant fibers which come from different natural resources. The fiber properties, content orientation, and arrangement determine the strength of composite. Fiber performs in structural parts typically consist of many layers of fabrics, each in the form of stitched fabrics containing stands of hundreds and thousands of individual layers. The layer have strong properties in one direction (parallel to fibers), these different orientation produce a finished product which is strong in the required directions only. Composite material has wide practical use in our daily life products. They are widely used in Transportation, building and construction, industry, electric devices, furniture and other etc.

Natural fiber wheat straw is used in this time. India is a agricultural country and leading top to producing wheat. The total area under the crop is 29.8 million hectare in the country. The production of wheat in the country 2011-2012 is 94.88 million. India climate and soil is according to the requirement of wheat crop. Wheat straw is a relatively inexpensive agricultural by-product since wheat is planted primarily for food. The cell wall in wheat straw is a natural composite composed of cellulose amorphous matrix of hemicelluloses and lignin. High tensile and flexural properties of the fiber are due to cellulose content **(Digabel et al. 2006).**

1.2 What is Composite?

Composite is combination of two materials in which one of the materials is called the reinforcing phase, is in the form of fibers, sheets, or particles, and is embedded in the other materials called the matrix phase. Reinforcement provides strength and rigidity. Matrix is a binder and holds the fibers in desired position. The matrix also protects the fibers from abrasion and environmental attack. The matrix has high specific (weight-adjusted) properties. Composite composed of two dissimilar constituents. In composites, materials are combined to get better use and minimizing the effect of their deficiencies.

Jartiz explained composites are multifunctional materials system that provides characteristics not obtainable from any discrete material. They are cohesive structures made by physically combining two or more compatible materials, different in composition and characteristics and sometimes in the form"

1.3 Constituents of composites

1. Matrices

2. Reinforcing fibers

These play a major role in making composite material. So these are explained as follows:-

1.3.1 Matrices: - The matrix is a binder and made from metal, polymer and ceramic. It is a continuous phase. The matrix isolates the fibers from one another in order to prevent abrasion and formation of new surface flaws and acts as a

bridge to hold the fibers in place. A good matrix should possess ability to deform easily under applied load, transfer the load onto the fibers and evenly distributive stress concentration. For the lake of simplicity however composites can be grouped into categories based on the nature of matrix each type possesses methods of fabrication. It also varies according to physical and chemical properties of matrices. The classification of matrices given as:-

(a) Polymer matrix composites:- The most common advanced composites are polymer matrix composites. These composites consists of a polymer thermoplastic or thermosetting reinforced by fiber (natural fiber Or boron) these materials can be fashioned into a variety of shapes and size. They provide great strength and stiffness along with resistance to corrosion. The reason for these being most common is their cost, high strength and simple manufacturing principle.

(b) Metal matrix composites:- Metal matrix composites as the name applies, have a metal matrix. Examples of matrices in such composites include aluminum, magnesium, and titanium. The typical fiber includes carbon and silicon carbide .metals are mainly reinforced to suit the needs of design.

II. LITERATURE REVIEW

Abba et al. (2013) articles reviews the literature reports base on agro waste plastic composites using different fibers as fillers and reinforcement. Compression moulding process, injection moulding process and extrusion methods are used in composites productions. Then the findings of the research review can be use as a data base for further inquiry into the agro waste plastic composites to development of this sector.

Begum et al. (2013) analyzed the improvement in mechanical properties of natural fiber reinforced polymer composites. The volume fraction needed in case of natural fiber reinforced polymer composite for getting the equal mechanical strength should be much higher than that of the glass fiber. It is clear that natural fiber reinforced polymer composites can be considered as the better alternative to other composites. Automotive, transportation and packaging industries have been using these composites and produced favorable outputs .The NFPRC are biodegradable, lighter in weight and can be produced with lower emission as compared to SFRPCs. The tensile strength of the fibers is more than polymers.

Dong et al. (2011) investigated the flexural properties of wheat straw reinforced polyester composites. The wheat straw/polyester composites were made as per hand layup technique. These specimens were then tested in the three point bend configuration in accordance with ASTM D790-07 at a span to depth ratio of 16.Four weight fractions of wheat straw 2%, 4%, 6%, 8% were chosen. The pre induced voids were studied and it plays important role in flexural properties. When voids exist, flexural modulus was calculated using a micromechanical model. Results show that flexural modulus decreases with the addition of wheat straw. This is due to poor interfacial adhesion and existence of voids**.**

III. PROBLEM FORMULATION

All countries have challenges like pollution, global warming, limited energy resources, easy recycles and other etc. Various processing methods and conditions; compression moulding process, injection moulding and extrusion methods are used in composite productions. Characterization challenges associated with agro waste plastic composites productions were also examined. Then finding the research review can be used as a data base into the agro waste plastic composites to development in this sector **(Abba et al. 2013).**

The wheat straw/ polyester composites were made as per the hand layup procedure. Four weight fractions of wheat straw 2%, 4%, 6% and 8% chosen. The specimens are then tested in three point bend configuration in accordance with ASTMD 790-07 at a span of depth ratio of16.

Objectives

1. To get better reinforcement, Chemical treatment of straw fibers and to reduce interfacial adhesion and existence of voids
2. Agro waste materials to utilize for plastic composites
3. Different surface, porosity other surface properties checked by SEM testing.
4. To analysis tensile and flexural properties of composite materials.

Calculations of samples: - Five samples of each tensile specimen and each flexural specimen. Ten polymer composite samples were made with the help of injection moulding machine. Formula's have been used for calculations for different proportions of split wheat straw fiber and HDPE are given as below-

Density of wheat straw fiber = 2.12g/cm³

Density of HDPE = 0.94g/cm³

Density of composite

$$= \frac{(\text{prop of fiber} \times \text{split wheat straw density}) + (100 - \text{prop.of fiber}) \times (\text{density of HDPE})}{100}$$

Specimen	Wheat straw fiber Density (gm/cc)	Density	Tensile wt (gm)	Fiber wt (gm)	PE wt (gm)	Flexural wt. (gm)	Fiber Wt (gm)	PE wt (gm)
11	**2.12**	1.070	9.564	1.052	8.512	5.520	0.607	4.913
13	**2.12**	1.093	9.775	1.271	8.504	5.642	0.733	4.908
15	**2.12**	1.117	9.986	1.498	8.488	5.764	0.865	4.899
17	**2.12**	1.141	10.197	1.733	8.463	5.885	1.001	4.885
19	**2.12**	1.164	10.408	1.978	8.430	6.007	1.141	4.866

Table: 4.1 Calculations of samples

Tensile weight of composite

=Vol. of composite for tensile ×density of composite

Fiber weight of 1 sample (tensile)
IV.
= Tensile weight × prop. of 100
100

Flexural weight of composite

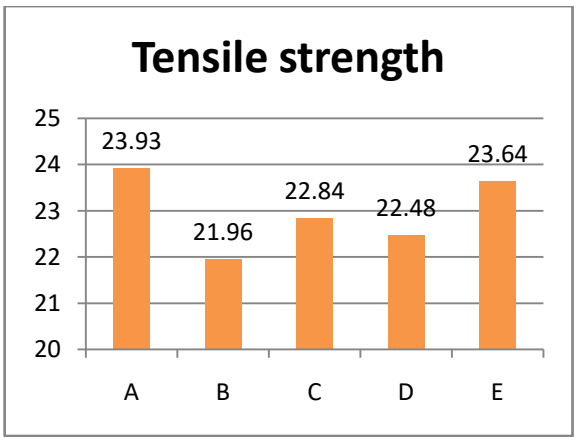
=Vol. of composite for flexural × density of composite

Fiber weight for 1 sample (Flexural)

= Flexural weight × prop. of fiber
100

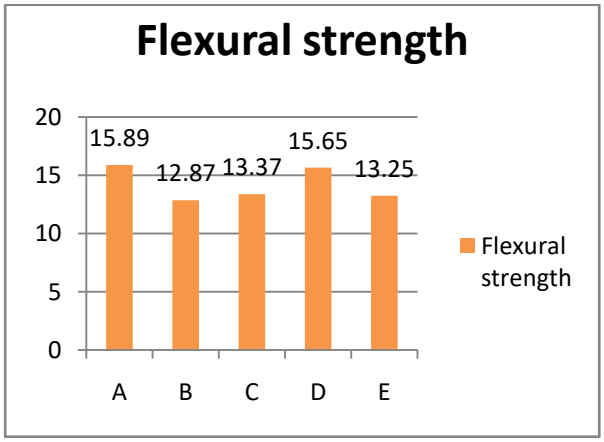
IV. RESULTS

Specimen	A	B	C	D	E
Fiber to HDPE% (Fresh & recycle)	11%	13%	15%	17%	19%
Tensile Strength (MPA)	23.93	21.96	22.84	22.48	23.64



The value of tensile strength of specimens A and B i.e. (Fresh and recycled) HDPE specimens. The specimen A has greater value as compared to other specimen. Specimen C 15% split wheat straw has increase in tensile strength as compared to 13%. The specimen D is therefore small decrease as compared to specimen C. The specimen E has greater tensile strength value as compared to D specimen. The specimen A has highest value of 11% of than the others specimens.

Specimen	A	B	C	D	E
Fiber to HDPE %	11	13	15	17	19
Flexural strength (MPa)	15.89	12.87	13.37	15.65	13.25



The value of flexural strength specimen A has higher strength. The specimen C has higher flexural strength as compared to specimen B. There may be increase in flexural strength. The specimen D has higher strength as compared to specimen C. There may also increase in flexural strength. but the specimen E has lower value of flexural as compared to specimen D.

V. CONCLUSION

It has been noticed that the mechanical properties of composites such as tensile strength, flexural strength of the composites are greatly influenced by the split wheat straw

fiber. The tensile and flexural strength of 11% was higher than the other specimen due to improper mixing of fiber and matrix.

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