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Study of Mechanical properties of Rice Husk and PP based composites using Injection Moulding Process

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Abstract: *Today the aim of the manufacturing companies is to reduce all types of wastes which are; man, money, material and mechanical their properties through the system simplification, organizational potential by using modern techniques. To remain the market leader many types of refinements are used to make the product cheaper and system efficient. Now day, various automotive and cycle industry starts to use the plastic components instead of different costly and heavy metals. So in the chaotic scenario the natural fiber composites are widely used for this addible purpose.*

Keywords: *Mica, Polypropylene, Rice Husk, Silica*

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I. Introduction

1.1 INTRODUCTION TO COMPOSITES

It is a truism that technological development depends on advances in the field of materials. One does not have to be an expert to realize the most advanced turbine or air-craft design is of no use if adequate materials to bear the service loads and conditions are not available. Whatever the field may be, the final limitation on advancement depends on materials. Composite materials in this regard represent nothing but a giant step in the ever constant endeavour of optimization in materials [9].

1.2 COMPOSITES

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composite industries [2]. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in designing, material processing, tooling, quality assurance, manufacturing, and even programmed management for composites to become competitive with metals. The composites industry has begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years. Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibers of glass, carbon and aramid, the penetration of these advanced materials has witnessed a steady expansion in uses and volume.

1.3 CHARACTERISTICS OF COMPOSITES

Composites consist of one or more discontinuous phases embedded in a continuous phase. The discontinuous phase is usually harder and stronger than the continuous phase and is called the 'reinforcement' or 'reinforcing material', whereas the continuous phase is termed as the ' matrix'. Properties of composites are strongly dependent on the properties of their constituent materials, their distribution and the interaction among them [7]. The composite properties maybe the volume fraction sum of the properties of the constituents or the constituent's may interact in a synergistic way resulting in improved or better properties. Apart from the nature of the constituent materials, the geometry of the reinforcement (shape, size and size distribution) influences the properties of the composite to a great extent. The concentration distribution and orientation of the reinforcement also affect the properties [5]. The shape of the discontinuous phase (which may by spherical, cylindrical, or rectangular cross-sanctioned prisms or platelets), the size and size distribution (which controls the texture of the material) and volume fraction determine the interfacial area, which plays an important role in determining the extent of the interaction between the reinforcement and the matrix.

II. Literature Review

Several researchers have performed the analysis of polymer based composites. Some of the salient contributions made by various researchers are discussed below; Balashov et al. (1957) investigated the relation between the extensibility and the fine structure of sisal fibers. The spiral arrangement of the cellulose micro fibrils in the secondary walls of the fibers undergoes regular change from the base to the tip of the leaf. When fiber bundles are stretched the cellulose spirals steepen in a way analogous to the steepening of a spiral spring. This change in the spiral orientation of the cellulose micro fibrils is of reversible character.

Coutts and Campbell (1979) studied the effects of surface treatment of wood fibers incorporated into cement by measuring the fracture energy and flexural strength of the derived composite materials and investigated the mechanical performance of a wood fiber reinforced cement composite can be altered by the use of coupling agents.

Kapur (1985) described a tube-in-basket (TiB) burner to burns rice husk in a controlled manner to produce amorphous silica powder of high surface area and analyzed phase composition of silica in the ash and its surface area depend critically on the temperature of combustion of the rice husk.

Maldas et al. (1988) investigated the mechanical properties of sawdust wood (soft wood and hard wood) fiber polystyrene composites. Sawdust wood residue as a filler for thermoplastics has been tested using two different mesh sizes (20 and 60), as well as by varying the weight percentage of fibers from 10% to 40% and reported that the improvement in mechanical properties depends on the fiber loading, on the particle size of the fiber, on the concentration and chemical structure of the coupling agents.

2.1 INJECTION MOULDING

Injection moulding is a manufacturing process for producing parts by injecting material into a mould. Injection molding can be performed with a host of materials mainly including metals, (for which the process is called die-casting), glasses, elastomers, confections, and most commonly thermoplastic and thermosetting polymers. Material for the part is fed into a heated barrel, mixed, and forced into a mould cavity, where it cools and hardens to the configuration of the cavity. After a product is designed, usually by an industrial designer or an engineer, moulds are made by a mould-maker (or toolmaker) from metal, usually either steel or aluminium, and precision-machined to form the features of the desired part. Injection moulding is widely used for manufacturing a variety of parts, from the smallest components to entire body panels of cars. Advances in 3D printing technology, using photopolymers which do not melt during the injection moulding of some lower temperature thermoplastics, can be used for some simple injection moulds.

III. Methodology

The experimentation and techniques used are described in this chapter. Methods and specification of the equipment and other instruments used for present study are also discussed. The Equipment/Instruments utilized to carry out the experiments are shown by indicating their specific use in the project along with their specifications and particulars in details. A detailed report is also provided on the raw materials used for fabrication of the PMC test specimens and the characterization of the raw material used for fabrication. The chapter also houses a description of the detailed step-wise methods adopted for fabrication of the test specimens and the Mechanical testing was carried out.

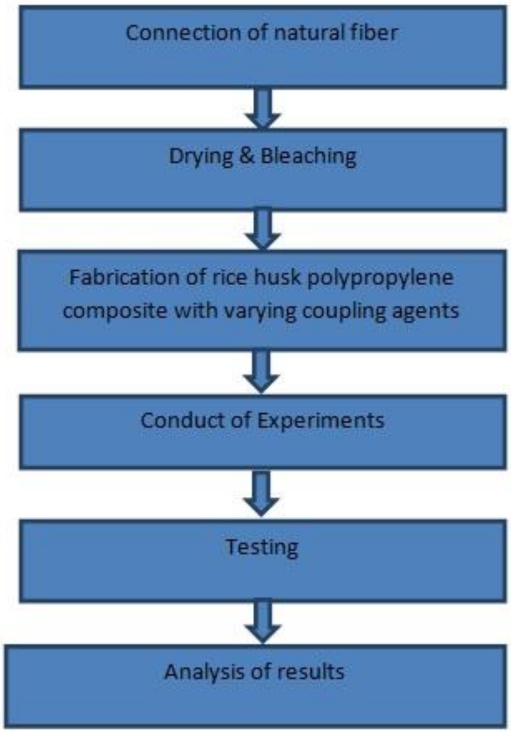
IV. Fabrication And Sampling

4.1 Fabrication and Sampling

Then to make the desired material, the dry fine rice husk powder was mixed to polypropylene plastics (PP) by varying the percentage of the rice husk powder with polypropylene plastics by which nine compositions were formed with use of three different additives or coupling agents. Compositions of rice husk and polypropylene plastics are in following:

- 70% of PP & 30 % of rice husk powder
- 75% of PP & 25% of rice husk powder
- 80% of PP & 20% of rice husk powder

To make above written compositions three additives are used which talc powder, mica powder and calcium carbonate (CaCo3) are having part of 2% in above compositions which were used as coupling agents.

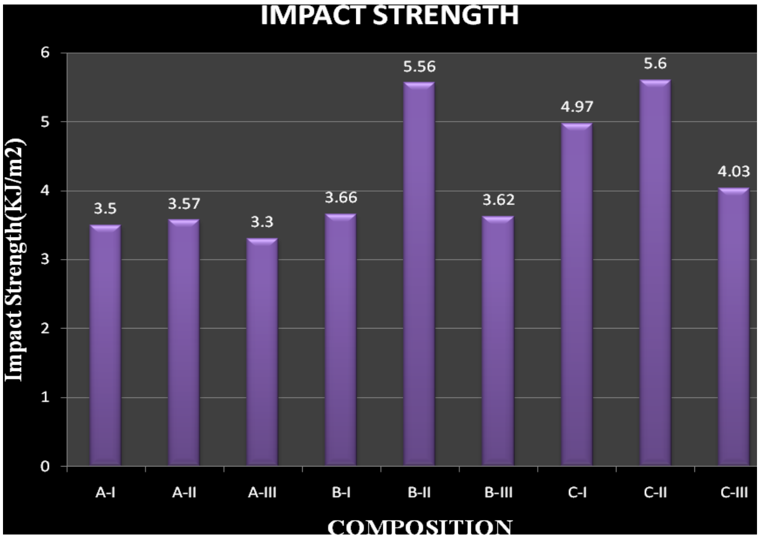


Flow Chart Diagram of Methods for research

V. Fabrication And Sampling

5.1 Charpy Impact Test

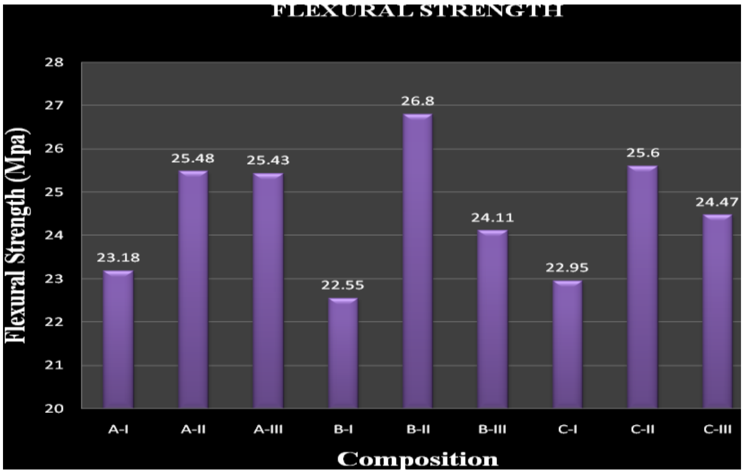
The Charpy impact test was performed on the Impact testing machine provided by the institute. This result is shown in the figure below, in the form of bar chart with all process parameters.



The sample A-I, A-II, A-III, B-I, B-II, B-III, C-I, C-II and C-III with the composition of 70% of PP & 30 of rice husk powder, 75% of PP & 25% of rice husk powder and80% of PP & 20% of rice husk powder respectively which were clamped one by one on the impact testing machine for the Izod testing. After clamping the components A-I, A-II, A-III, B-I, B-II, B-III, C-I, C-II and C-III one by one load was gradually applied on them. Then they were ruptured on 3.5, 3.574, 3.309, 3.66, 5.56, 3.626, 4.977, 5.607 and 4.034 MPa respectively on the Izod impact testing machine.

5.2 Flexural Strength

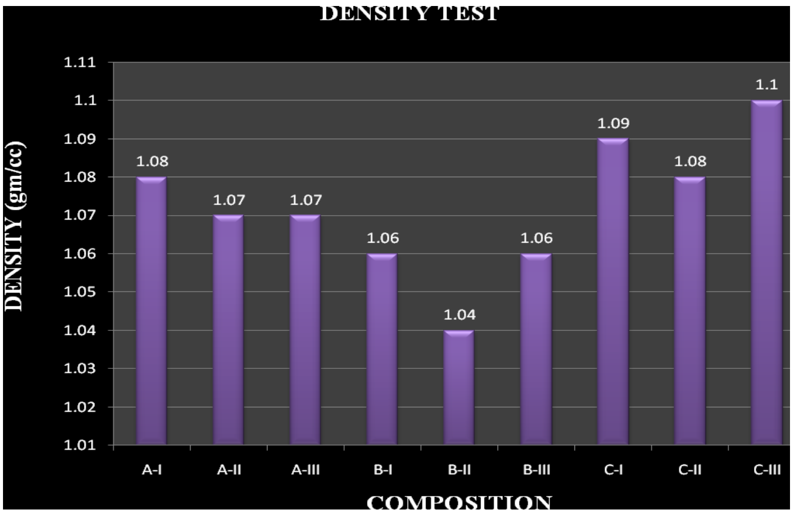
After the flexural test various results are displayed in the graph as follows. The graph shows the variation of composites samples with respect to load up-to its rupture. The force applied in MPa to attempt the test is shown in the vertical lane and the composition of nine samples of rice husk with different additives is shown by the horizontal lane. Using bar chart result is shown in figure below with all process parameters.



From above figure the sample A-I, A-II, A-III, B-I, B-II, B-III, C-I, C-II and C-III with the composition of 70% of PP & 30 of rice husk powder, 75% of PP & 25% of rice husk powder and80% of PP & 20% of rice husk powder respectively which were clamped one by one on the universal testing machine for the flexural testing. After clamping the components A-I, A-II, A-III, B-I, B-II, B-III, C-I, C-II and C-III one by one load was gradually applied on them. Then they were ruptured on 28.18, 25.48, 25.43, 22.55, 26.8, 24.11, 22.95, 25.6 and 24.47 MPa respectively on the universal testing machine. From them A-I results resists at 28.18MPa which was best.

5.3 Density Test

The density or specific gravity is an important property of solid materials. The density of a sample may change due to change in crystallinity, loss of plasticizers, absorption of solvent, etc. Also the different portions of a sample may differ in density because of the difference in crystallinity, porosity and composition (types of resin, plasticizer, filler, etc.). Therefore, it is very much important to know the exact value of density as it is very much useful to identify the material. Using bar chart result is shown in figure below with all process parameters.



In above figure the sample A-I, A-II, A-III, B-I, B-II, B-III, C-I, C-II and C-III with the composition of 70% of PP & 30% of rice husk powder, 75% of PP & 25% of rice husk powder and80% of PP & 20% of rice husk powder respectively which were test one by one with density testing machine. After testing the components A-I, A-II, A-III, B-I, B-II, B-III, C-I, C-II and C-III the value was 1.08,1.07,1.07,1.06,1.04, 1.06,1.09,1.08 and 1.1MPa respectively on the density testing machine. From the above composition A-I, B-I, C-III were giving the excellent results as comparative with others.

VI. Conclusion & Remarks

In our research work experimental investigation has been done. In the present study Polymer matrix composite with rice husk as filler material and polypropylene plastic are used as basic material. With varying of volume of rice husk with different additives nine samples were prepared after it there samples were gone through different test which are impact test, flexural test and density test.

Modification in mechanical properties such as flexural strength, impact strength and density of rice husk polypropylene composites was attempted here which had not been studied earlier. Property of rice husk polypropylene composite can be improved with variation of compositions. The group of sampling which was having ratio of composition of 70% and 30% with which having a additive of talc powder gives excellent result . It is analyzed that mechanical properties which were tested had average results. In flexural test the composition of 70% and 30% with additive of talc powder had good result comparative other compositions. So the composition of code A-1 is suitable in plastic and rubber industry where the as much percentage of flexibility required. In Izod impact test result show the all composition was averagely good. But composition of code of B-II and C-II are the best in all of them. Certain products where having good impacts strength which can be used in making composite panels and plastic automobiles components. In the density code C-III has excellent results. According to analysis of results the composition of C-III (80% PP + 20% RH + $Caco_3$) is recommended for where the density of 1.1 gm/cc is required. For the low cost product manufacture of plastic product can be done with help of using composite by the same mechanical properties.

References

[1]. Ashori A. (2008), "Wood- plastic composites as premising green composites for automotive industries" *Bioresource technology*, Vol. 99, No. 11, pp. 4661-4667.

[2]. Alves, C., Ferra, P. M. C., Silva, A. J., Reis, L. J., Freitas, M., Rodrigues, L. B., and Alves, D. E. (2010), "Ecodesign of automotive components making use of natural jute fiber composites", *Journal of Cleaner Production*, Vol. 18, No. 4, pp. 313–327.

[3]. Akil, H. M., Omar, M. F., Mazuki, A. A. M., Safiee, S., Ishak, Z. A. M. and Abu Bakar A. (2011), "Kenaf fiber reinforced composites: A review", *Materials and Design*, Vol. 32, No.8, pp. 4107–4121.

[4]. Balashov, V., Preston, R. D., Ripley, G. W., and Spark, L. C. (1957), "Structure and Mechanical Properties of Vegetable Fibres. I. The Influence of Strain on the Orientation of Cellulose Microfibrils in Sisal Leaf Fibre", *Proceeding of Royal Society , Vol. 146, No. 925, pp. 460-468* .

[5]. Bahadur, P. and Sastry, N. V. (2005), "*Principles of polymer science*", 2nd ed., New Delhi. Bax, B. and Mussig, J. (2008), "Impact and tensile properties of PLA/Cordenka and PLA/flax composites", *Composites Science and Technology*, Vol. 68, No. 7, pp.1601–1607.

[6]. Coutts, R. S. P, Campbell, M. D. (1979), "Coupling agents in wood fiber-reinforced cement composites", *Composites*, Vol. 10, No. 4, 1979, pp. 228–232.

[7]. Crawford, R. J. (1998), "*Plastics Engineering*", Butterworth Heinemann Ltd, 3rd ed., Oxford,

[8]. MA. Fuad, M. Y. A., Ismail, Z., Ishak, Z. A. M. and Omar, A. K. M. (1995), " Application of rice husk ash as fillers in PP: Effect of titanate, zirconate and silane coupling agents", *European Polymer Journal*, Vol. 31, No.9, pp. 885-893.

[9]. Hattotuwa, G. B., Premalal, H. Ismail, A. and Baharin (2002), "Comparision of the mechanical properties of rice husk powder filled polypropylene composites with talc filled polypropylene composites", *Polymer testing*, Vol. 21, No. 1, pp. 833-839.

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