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Study of Mechanical Properties of Composite Material Based on Polypropylene and Rice Husk Filler : A Review

Syed Shane Raza[1], S.Mazhar Abbas Rizvi[2] Abhishek Dwivedi[3]

Research Scholar[1,2] Assistant Professor,[3]
[1,2,3]Department of Mechanical Engineering, Integral University, Lucknow, Uttar Pradesh, India

ABSTRACT

Composite materials have come to the fore a few decades ago because of their superior specific mechanical properties, as a result of the increasing demand of both consumers and industries for highly performing materials and structures. However, the combination of the fibers with the aggregating material or matrix highly increases the complexity of the design process and usually leads to challenges in the composite engineering and, correspondingly, to more conservative solutions for a given application. Although the success of these materials is obvious, recently, a general consensus all around the world was reached regarding the negative influence of the human being on global warming and the environment. The best way in which the environment could be conserved is by using renewable and nontoxic natural materials, and all efforts should be undertaken to make them competitive. Actually, the environmental consciousness all around the world has led to the research and development of the next generation of materials, products, and processes. Now basically in this report the hybridisation of rice Husk and pp based composite material making process represent, in this review paper we are trying to explain the what is composite material and the fabrication process of natural fiber composite with testing .we are took result from many type references which is given in references point and we attempting to find the optimum mechanical properties of natural fiber [1].

Keywords : Composites, Polymers, Natural Fibres Rice, Fabrication Methods, Mechanical Testing, Chemical Testing

I. INTRODUCTION

Why the focus on the natural fiber composite?

Composite materials have come to the fore a few decades ago because of their superior specific mechanical properties as a result of the increasing demand of both consumers and industries for highly performing materials and structures. However, the combination of the fibers with the aggregating material or matrix highly increases the complexity of the design process and usually leads to challenges in the composite engineering and, correspondingly, to more conservative solutions for a given application. Although the success of these materials is obvious, recently, a general consensus all around the world was reached regarding the negative influence of human beings on global warming and the environment. The best way in which the environment could be conserved is through the use of renewable and nontoxic natural materials, and all efforts should be undertaken to make them competitive. Actually, environmental awareness all around the world has led to the research and development of cheap and biodegradable materials that are concurrently available from nature. This triggered interest in more sustainable materials that could be processed with lower energy consumption, such as natural fiber composites. Recycling of natural fiber composites and natural fiber reinforcement of waste materials are other steps used for saving resources and the environment. Although the use of these materials dates back to civilization itself, it is clear that renewed incentives for their use are emerging. Thus, scientists and engineers have become more interested in the study of natural fibers and their composites. The replacement of conventional materials and artificial composites with natural fiber composites can thus become a reality, contributing towards the creation of a sustainable economy. On the other hand, concerns on the availability of petrochemicals in the future can also trigger the use of natural fiber composites. On account of large research efforts in fiber extraction and chemical treatments, fiber–matrix adhesion, or processing conditions, natural fiber composites are currently a viable replacement for glass composites in many applications in terms of both mechanical strength and a lower price. Actually, by treating the fibers with coupling agents, engineering the fiber orientation of the natural fiber components, devising extraction techniques to increase the fiber length, and combining with the best possible matrix, very interesting characteristics have been found. These achievements and the superior environmental performance are important drivers for the growing use of natural fiber composites in the near future. Despite all these advantages, some features still prevent a more widespread use of these materials, such as the strength prediction during structural loading and uncertainties about long-term performance. However, it is expected that a lot of useful information previously gathered for artificial composites can be applied to these materials. This book is comprised of 12 independently written chapters covering the most relevant topics related to introductory knowledge on natural fiber composites, material properties, treatment and processing, modelling, design, and applications.

What is a composite Material?

Two or more chemically distinct materials combined to have improved properties of Natural/synthetic. Wood is a natural composite of cellulose fiber and lignin, Cellulose provides strength and the lignin is the "glue" that bonds and stabilizes the fiber. Bamboo is a wood with hollow cylindrical shape which results in a very light yet stiff structure. Composite fishing poles and golf club shafts etc.The ancient Egyptians manufactured composites! Adobe brick sare a good example which was a combination of mud and straw.
Classification of composite material is three type with is given below [2]:

1. Metal Matrix Composites (MMCs)
   a) Mixtures of ceramics and metals, such as cemented carbides and other cermets
   b) Aluminum or magnesium reinforced by strong, high stiffness fibers
2. Ceramic Matrix Composites (CMCs)
   a) Least common composite matrix
   b) Aluminum oxide and silicon carbide are materials that can be imbedded with fibers for improved properties, especially in high temperature applications
3. Polymer Matrix Composites (PMCs)
   a) Thermosetting resins are the most widely used polymers in PMCs.

II. METHODS AND MATERIAL

Polypropylene (maleated-(PPm), 5% maleinization, (KA 805)), a product of Montell, was used as a matrix, while the waste rice husk used.Rice Husk/Polypropylene (RS/PPm) composites of different rice husk contents (20/80 and 30/70% wt) were prepared by a two-step procedure: extrusion (100 rpm, 165 °C) and compression molding (T = 170 °C, P = 50–150 bar). Before the extrusion, the rice husk was vacuum-dried for 24 h to adjust a moisture content of 1–2%.[3]

A. Method of Fabrication

Method of sample

Rice husk was previously ground and screened. The particle sizes of RHF used were from 16 to 150 mesh. The filler was oven dried at 80 ºC, for 24 hours, at 30mm Hg, to adjust its moisture contents and then it was stored over a desiccant. The RHF was used without any subsequent treatment.

A laboratory-size conical co-rotatory twin-screw extruder Haake, Model Rheomex CTW 100p, was employed for compounding RHF and PP. The screw speed was 40 rpm and the temperature range varied from 170 to 190 ºC. 4 levels of filler loading (10, 20, 30 and 40 wt. (%)) were used. After pelletizing the composites were compression moulded. The hot press procedure involved preheating at 190 ºC for 10 minutes followed by compressing at 2.5 KPa for 4 minutes at the same temperature. After this the set was allowed to cool down to room temperature and the samples were manually removed from the moulds.[5]

B. Material Properties

The main objective of this project is to determine the material properties (Flexural modulus, flexural rigidity, Hardness number, % gain of water, wear resistance, Bonding structure) of natural fiber reinforced composite material by conducting the following respective tests.[4],[5]

1. Flexural test
2. Hardness Test
3. Water absorption Test
4. Wear Test
5. SEM analysis

C. Flexural Test

Flexure tests are generally used to determine the flexural modulus or flexural strength of a material. A flexure test is more affordable than a tensile test and test results are slightly different. The material is laid horizontally over two points of contact (lower support span) and then a force is applied to the top of the material through either one or two points of contact (upper loading span) until the sample fails. The maximum recorded force is the flexural strength of that particular sample.

D. Formula Used

E = $FL^3/48YI$ N/MM^2 E – Modulus of elasticity E I – Flexural Rigidity y- Deflection in mm F- load in N

I=$BH^3/12$, [4]

E. Hardness Test

The hardness test of a material is generally performed to know its resistance against indentation and abrasion. Through there are many test to determine the hardness of materials which is following are Brinell hardness test, Rockwell hardness etc. The increment of penetration depth for each point of hardness on the Rockwell scale is 0.00008 inch. For example, if a piece of steel measures Rockwell C 58 (extremely hard) at same point and C 55 at another, the depth of penetration would have been 0.00024 inch deeper at the softer spot.

F. Water Absorption Test

Water absorption is used to determine the amount of water absorbed under specified conditions. Factors affecting water absorption include: type of plastic, additives used, temperature and length of exposure. The data sheds light on the performance of materials in humid.

G. Wear Test

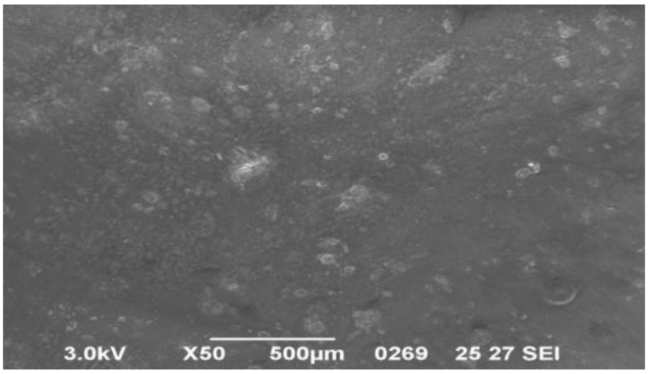
This testing method measuring the performance of materials in rubbing contact under end use type conditions. This test is specification refers to auto-lubricating. The contact can be a test material against steel or against itself.

H. Impact Test

Many machine parts are subjected to suddenly applied load called impact blows. it has been observed that a metal may be hard ,strong or of high tensile strength. But in may be unsuitable for use where it is subjected to sharp blow. The capacity of metal to with stand such blows without fracture is known as an impact resistance or impact strength. It is an indicative of the toughness of the metal .there are many type of impact testing machine available in the market .But the basic principle ,on which all of them are based, is the same .The following two type of impact testing machines are important form the subject point of view. First is charpy testing machine and other is Izod testing machine.

I. Sem Analysis

For plastics applications, a scanning electron microscope can be used to examine surface irregularities or fracture areas in a part. A SEM can also be used to measure the depth of thin coatings. Test specimens are sputter coated with gold, then placed in a vacuum chamber for viewing on the computer monitor at up to 10,000x magnification. Polaroid photos are taken for a permanent record.



(Scanning electron micrograph of Polymer Hay+ coir Composite)

III. RESULTS AND DISCUSSION

The compositions of the systems are shown in Table 1. RHF loadings varied from 10 to 40 wt. (%) while MAPP varied from 1.2 to 1.8 wt. (%) (Corresponding to 2 wt. (%) of PP content for each sample).ALL the data for the results is taking form graph of reference [5,6]

Table of Sample Testing

SAMPLE	RHF wt%	PP wt%	MAPP wt% (with and without)	TENSILE STRENGTH Mpa	ELONGATION %	Young's modulus. MPa	HARDNESS MPa
1	0.0	100	0.0	31	100	900	600
2	10	90	0.0	22	04	1000	620
3	10	88.2	1.8	25	05	1300	600
4	20	80	0.0	17	04	1000	590
5	20	78.4	1.6	21	03	1100	580
6	30	70	0.0	17	2.5	1500	560
7	30	68.6	1.4	19	02	1400	550
8	40	60	0.0	16	02	1600	540
9	40	50.8	1.2	21	02	1700	545

NOTE : RHF-RICE HUSK FIBER,PP-POLYPROPYLELE,MAPP-Maleic anhydride-grafted PP (MAPP coupling agent)

It was found that the addition of 40 wt. (%) RHF resulted in a decrease of approximately 50% in tensile strength values compared to pure PP. The maximum tensile strength determined for PP/RHF specimens prepared without the coupling agent was 22 MPa. In this table we can see that different different type of sample of RHF AND PP composite have different type of properties, which an increase and decrease with respect of material combination. Table also represents the composite properties with agent MAPP or without .with the help of coupling agent the mechanical properties of composite material has improved. So this is the review of composite martial (rice +polypropylene)[5]

IV. CONCLUSION

Rice husk was milled and dried for using as filler in PP composites. It was verified that it is feasible to use this by-product of the rice milling process as low cost filler, in view of the properties of the obtained products. The composite stiffness was seen to increase with increasing filler loading. The tensile strengths slightly decreased, however they were improved in the presence of the coupling agent MAPP. It was verified that MAPP/RHF ratio of 0.03 produced the best results. Higher ratios of the coupling agent showed poorer effect on tensile strength.

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