INFLUENCE OF NATURAL FIBER POWDERS WITH CARBOXY METHYL CELLULOSE ON MECHANICAL AND PHYSICAL PROPERTIES OF LAMINATED PLATE

S.Vengatesh [1], D.R.Rajkumar[2]

[1] *PG Scholar, Mechanical Engineering,C.A.R.E Group of Institutions, Trichy - 09.India.*
[2] *Assistant Professor,Department of Mechanical Engineering,C.A.R.E Group of Institutions,Trichy – 09,India*

---***---

Abstract – *The project work deals with mechanical and physical behavior of composites plate made of coconut shell powder, palm kernel powders and carboxy methyle cellulose. The composite plate is fabricated using hand layup method at different proportions of coconut shell powder, palm kernel powder and carboxy methyl cellulose. As per ASTM Standards, tensile strength, hardness, total dissolved solid test, biodegradable test, water soluble test are conducted and the properties are compared with available literatures.*

Key Words: Acetic Acid, Coconut Shell Powder , Carboxy methyl cellulose using Hand layup method

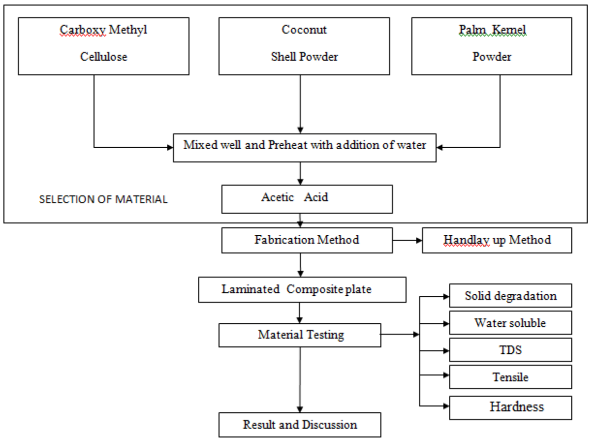
1.INTRODUCTION

Materials required for this composite are coconut shell power and Palm kernel powder and CMC. chemical composition of coconut shell powder consists of Lignin (29.4%), Pentosans (27.7%), Cellulose (26.6%), Moisture (8%), Solvent Extractives (4.2%), Uronic Anhydides (3.5%) and Ash (0.6%). The cleaned coconut shell were dried in open air, pulverizing machine is used to make coconut shell into powder.The idea of composite materials is not a new or recent one. Nature is full of examples wherein the idea of composite materials is used. The coconut palm leaf, for example, is nothing but a cantilever using the concept of fiber reinforcement. Wood is a fibrous composite: cellulose fibers in a lignin matrix. The cellulose fibers have high tensile strength but are very flexible (i.e. low stiffness), while the lignin matrix joins the fibers and furnishes the stiffness. Bone is yet another example of a natural composite that supports the weight of various members of the body. It consists of short and soft collagen fibers embedded in a mineral matrix called apatite. In addition to these naturally occurring composites, there are many other engineering materials that are composites in a very general way and that have been in use for very long time. The carbon black in rubber, Portland cement or asphalt mixed with sand, and glass fibers in resin are common examples. Thus, we see that the idea of composite materials is not that recent. Nevertheless, one can safely mark the origin of the distinct discipline of the composite materials as the beginning of the 1960s. It would not be too much off the mark to say that a concerted research and development effort in composite materials began in 1965. Since the early 1960s, there has been an increasing demand for materials that are stiffer and stronger yet lighter in fields as diverse as aerospace, energy and civil constructions. The demands made on materials for better overall performance are so great and diverse that no one material can satisfy them. This naturally led to a resurgence of the ancient concept of combining different materials in an integral-composite material to satisfy the user requirement. Such composite material systems result in a performance unattainable by the individual constituents, and they offer the great advantage of a flexible design; that is, one can, in principle, tailor-make the material as per specifications of an optimum design.

The tensile strength of natural fibers is substantially lower than that of glass fibers though the modulus is of the same order of magnitude. However, when the specific modulus of natural fibers (modulus per unit specific gravity) is considered, the natural fibers show values that are comparable to or even better than glass fibers. Material cost savings, due to the use of natural fibers and high fiber filling levels, coupled with the advantage of being non-abrasive to the mixing and molding equipment make natural fibers an exciting prospect. These benefits mean natural fibers could be used in many applications, including building, automotive, household appliances, and other applications. This chapter outlines some of the recent reports published in literature on composites with special emphasis on mechanical properties of Natural Fiber Reinforced Polymer Matrix Composites. As a result of the increasing demand for environmentally friendly materials and the desire to reduce the cost of traditional fibers (i.e., carbon, glass and aramid) reinforced petroleum-based composites, new bio-based composites have been developed. Researchers have begun to focus attention on natural fiber composites (i.e., bio composites), which are composed of natural or synthetic resins, reinforced with natural fibers. Natural fibers exhibit many advantageous properties, they are a low-density material yielding relatively lightweight composites with high specific properties. These fibers also offer significant cost advantages and ease of processing along with being a highly renewable resource, in turn reducing the dependency on foreign and domestic petroleum oil. Recent advances in the use of natural fibers (e.g., flax, cellulose, jute, hemp, straw, switch grass, kenaf, Saw dust, coir and bamboo) in composites have been reviewed by several authors

2. METHODOLOGY

Chart -1: Methodology



2.2 FABRICATION METHOD

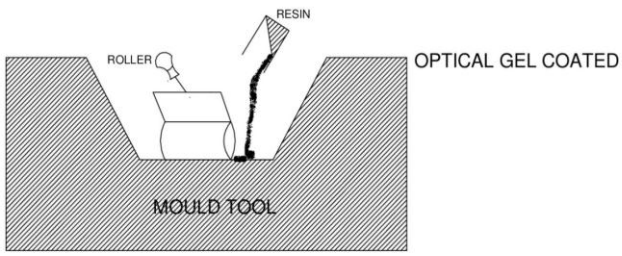
In this project work the composite plate is fabricated by using the following materials.

Fig -1: Selection of Material

2.2 FABRICATION METHOD

The most basic fabrication method for thermoset composites is hand layup, which typically consists of laying dry fabric layers, or "plies," or by hand onto a tool to form a laminate stack. Initially mix the powders at the different ratio. after preheat treatment bonds and vacuum are created. So the acetic acid is used to remove the bonds and fabricate plate using mould tool.

Fig -2: Hand-layup method



2.3. COMPOSITE PREPARATION

The various samples of different proportions are prepared. They are tabulated below

Table -1: Mixing ratio for CMC,CS,PK

Mixing ratio of CMC,CS,PK			
PLATE NAME	CS POWDER %	PK POWDER %	CMC POWDER %
A	30	0	70
B	40	0	60
C	50	0	50
D	0	0	100
E	30	15	55
F	10	10	50
G	50	5	45

Fig -3: Sample pieces

3. TESTING OF SAMPLES

3.1 SOIL TEST

The American Society for Testing of Materials (ASTM) and the International Standards Organization (ISO) define degradable plastics as those which undergo a significant change in chemical structure under specific environmental conditions. These changes result in a loss of physical and mechanical properties, as measured by standard methods. Biodegradable plastics undergo degradation from the action of naturally occurring microorganisms such as bacteria, fungi, and algae. Plastics may also be designed as photodegradable, oxidative degradable, hydrolytically degradable, or those which may be composted. Between October 1990 and June 1992, confusion as to the true definition of "biodegradable" led to lawsuits regarding misleading and deceitful environmental advertising (Narayan et al. 1999). Thus, it became evident to the ASTM and ISO that common test methods and protocols for degradable plastics were needed. There are three primary classes of polymer materials which material scientists are currently focusing on. These polymer materials are usually referred to in the general class of plastics by consumers and industry. Their design is often that of a composite, where a polymer matrix (plastic material) forms a dominant phase around a filler material (Canadian Patent #2350112-2002). The filler is present in order to increase mechanical properties, and decrease material costs. Conventional plastics are resistant to biodegradation, as the surfaces in contact with the soil in which they are disposed are characteristically smooth (Aminabhavi et al. 1990).

Microorganisms within the soil are unable to consume a portion of the plastic, which would, in turn, cause a more rapid breakdown of the supporting matrix. This group of materials usually has an impenetrable petroleum based matrix, which is reinforced with carbon or glass fibers.

The second class of polymer materials under consideration is partially degradable. They are designed with the goal of more rapid degradation than that of conventional synthetic plastics. Production of this class of materials typically includes surrounding naturally produced fibers with a conventional (petroleum based) matrix. When disposed of, microorganisms are able to consume the natural macromolecules within the plastic matrix. This leaves a weakened material, with rough, open edges. Further degradation may then occur. The final class of polymer materials is currently attracting a great deal of attention from researchers and industry. These plastics are designed to be completely biodegradable. In this graph is clearly shows that the composite plate or sample Plate A easily decomposed. It is indicated that the less amount of cmc level is easily decomposed in soil.

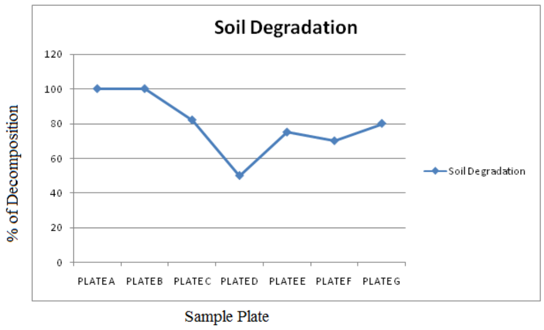
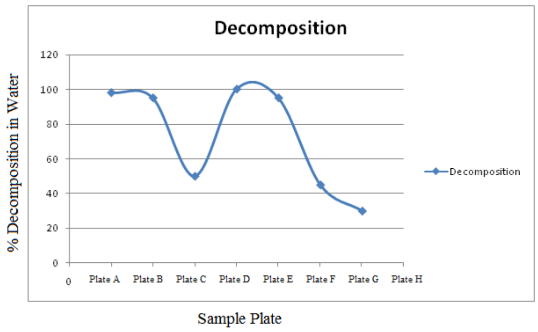


Chart -2: Soil Degradation test

3.2 WATER SOLUBLE TEST:

Water soluble polymers cover a wide range of highly varied families of products of natural or synthetic origin, and have numerous uses. Among these families, synthetic polymers, and more particularly coagulants and flocculants, are used mainly for facilitating the separation of materials in suspension in aqueous media. They also help to dewater sludge from various separation processes. The separation of solids in a liquid medium takes place rapidly when the density of the particles is markedly different from that of the liquid medium. Either the particles settle out or they float on top of the liquid. Difficulties occur when the particle size allows it to remain in suspension in the liquid medium. In this case, the use of coagulants and flocculants allows separation to be carried out. Plate A and C is easily decomposed in water.

Chart -3: Water Soluble test



3.3 TENSILE TEST :

Tensile strength of a material is the ability of the material to withstand tensile forces applied either sides of the specimen. The test is used to determine the tensile strength and young's modulus of the material. For this test Universal Testing Machine (UTM) is used. Using this machine with suitable jigs, almost all mechanical tests are performed by this machine to determine the material properties. According to ASTM standards, the composite specimen was prepared for tensile testing to determine the material properties. Each test specimen of 100 mm gauge length, 15 mm wide and thickness 6mm were prepared as shown in chart 4. For this test UTM of capacity 100kN was used. All the required dimensions of the specimen are entered into the computer along with the maximum load and displacements are assumed and entered. After the failure of the specimen, the computer shows the Load Displacement curve. From these obtained curves Stress, Strain and Young's modulus were evaluated

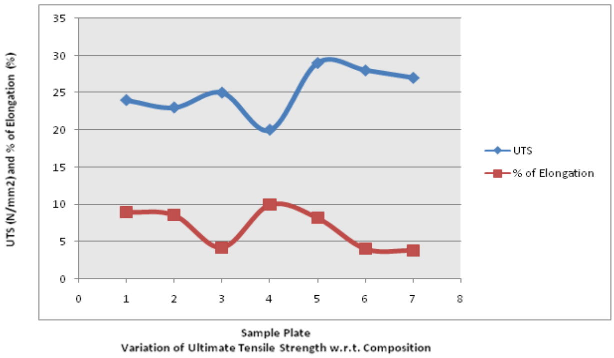


Chart -4: Tensile test

3.4 HARDNESS TEST

A standard specimen is placed on the surface of the Rockwell Hardness tester. A minor load is applied and the gauge is set to zero. The major load is applied by tripping a lever. After 15 seconds the major load is removed. The specimen is allowed to recover for 15 seconds and then the hardness is read off the dial with the minor load still applied. The standard specimen for ASTM D785 has dimensions of 20mm by 20mm. chart 5. shows the variation of Rockwell hardness number for different composition of composite material. From the above result it can be concluded that by the addition of required amount of palm kernel powder the surface hardness can be increased. Hence by experimenting with addition of suitable percentage of palm kernel powder we can obtain a better result.

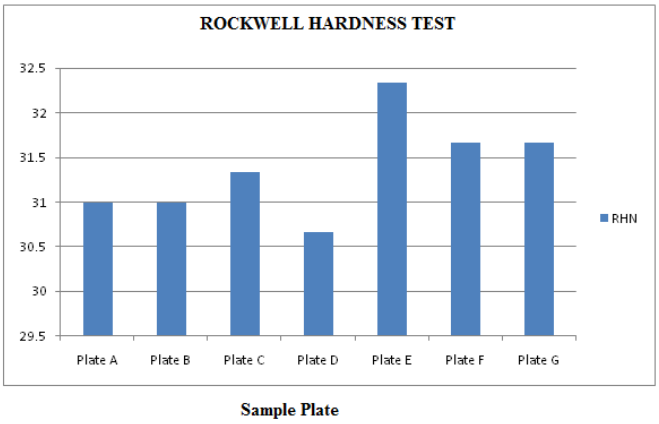


Chart -5: Rockwell hardness test

4. CONCLUSIONS

The prepared samples of different proportionate are buried in the soil and water. biodegradability of each samples are analyzed after the one week .Various tests have taken for our material such as ,soil test, water soluble test, tensile, hardness test. It is concluded that the composite materials are made of coconut shell powder ,palm kernel powder and carboxy methyl cellulose using handlay up method. By comparing the decomposition, tensile , hardness for our composite plate we obtain the following result.In tensile test, the composition coconut shell powder 30% , palm kernel powder 15% and Carboxy methyl cellulose has 55% more load carrying capability compared to other plates. Hence plate E Has better tensile properties. similarly hardness test composite plate E has better hardness value. In the decomposition test are taken both soil and water. We obtain the following result. plate A is easily decompose both soil and water degradation.

REFERENCES

[1] Somashekhar T M , Premkumar Naik, Vighneshanayak, Mallikappa, Rahul S 'Study of Mechanical Properties of Coconut Shell Powder And Tamarind Shell Powder Reinforced With Epoxy Composites', iconmmee (2018),pp.376.

[2] Budrun Neher, Md. Mahbubur Rahman Bhuiyan 'Study of Mechanical and Physical Properties of Palm Fibre Reinforced Acrylonitrile Butadiene Styrene Composite', Scientific Research Materials Sciences and Applications, Vol.5(2014),pp.39-45.

[3] Dr. Shajan Kuriakose , Dr. Deviprasad Varma , Vaisakh V.G,' Mechanical Behaviour of Coir reinforced Polyster Composites–An Experimental Investigation, International Journal of Emerging Technology and Advanced Engineering Certified Journal, Vol.2, Issue no 12, (2012),pp.1

[4] Mulinari; Baptista; Souza; Voorwald, 'Mechanical

Properties of Coconut Fibres Reinforced Polyester Composites', science direct Procedia Engineering Vol.10 (2011), pp. 2074–2079, 1877-7058 ; Doi:10.1016/j.proeng.2011.04.343

[5] Girisha K G, Anil K C, Akash,' Mechanical Properties Of Jute And Hemp Reinforced Epoxy/Polyester Hybrid Composites Impact: International Journal of Research in Engineering & Technology; Vol. 2 ,(2014),Issue no. 4 .pp. 2347-4599,

[6] V. Muthukumar, R. Venkatasamy, A. Sureshbabu, D. Arunkumar , 'A Study on Mechanical Properties of Natural Fibre Reinforced Laminates of Epoxy (Ly 556) Polymer Matrix Composites', International Journal of Production Technology and Management Research • Vol.2, (2011),Issue 2,pp.1.

[7] N.Maheswaran, M.Hemanth Kumar 'characterization of natural fibre reinforced polymer composite', ISSN: 2277-9655 international journal of engineering sciences & research technology. Vol.4(1): (2015).

[8] PNE Naveen 'experimental analysis of coir-fibre reinforced polymer composite materials', Int. J. Mech. Eng. & Rob.Res.Vol.2, (2013),pp.1.

[9] P. N. E. Naveen, R. V. Prasad 'Evaluation Of Mechanical Properties Of Coconut Coir/Bamboo Fibre Reinforced Polymer Matrix Composites', International Journal of Metallurgical & Materials Science and Engineering (IJMMSE).Vol. 3(2013),Issue no. 4, pp.15-22. Doi:10.4028/www.scientific.net/jnanor.24

[10] Pradeep, P, Edwin Raja Dhas, J 'characterization of chemical and physical properties of palm fibres', Advances in Materials Science and Engineering: An International Journal (MSEJ), Vol .2,(2015), pp. 4. : Doi : 10.5121/msej.2015.2401

[11] Daniella R. Mulinari, Araujo J. F. Marina, Gabriella S. Lopes 'Mechanical Properties of the Palm Fibres Reinforced HDPE Composites', International Journal of Chemical, Molecular, Nuclear, Materials and Metallurgical Engineering Vol:9, No:7, 2015.

[12] Saira Taj , Munawar Ali Munawar ' Review natural fibre-reinforced composites', publications on ResearchGate: Retrieved on: (2016);Doi:10.1177/0731684417745368

[12] V. Muthukumar, R. Venkatasamy, A. Sureshbabu, D. Arunkumar , 'A Study on Mechanical Properties of Natural Fibre Reinforced Laminates of Epoxy (Ly 556) Polymer Matrix Composites', International Journal of Production Technology and Management Research. Vol 2,(2011) Issue 2