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TRIBOLOGICAL BEHAVIOUR OF RICE HUSK AND EGG SHELL HYBRID PARTICULATED COIR-POLYESTER COMPOSITES

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ABSTRACT: *The surface roughness of rice husk and egg shell impregnated coir fiber reinforced polyester composite were evaluated. The short untreated coir fibers with different proportions of fiber length, fiber content and filler content were used as reinforcement in polymer based matrix. The fabricated composites with the different levels of fiber parameters were tested as per ASTM standards. The effects of egg shell and rice husk of coir polyester composites and prophecy of surface roughness properties were investigated.*
Key words: *Natural fiber composite, coir/polyester, Eggshell, Rice husk*

I. INTRODUCTION

A composite is combination of two materials in which one of the materials, called the reinforcing phase, is in the form of fibers, sheets, or particles, and is embedded in the other materials called the matrix phase. . The reinforcing material and the matrix material can be metal, ceramic, or polymer. Composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members.

A particle has roughly equal dimensions in all directions, though it doesn't have to be spherical. Gravel, micro balloons, and resin powder are examples of particulate reinforcements. Reinforcements become fibers when one dimension becomes long compared to others. Discontinuous reinforcements (chopped fibers, milled fibers, or whiskers) vary in length from a few millimeters to a few centimeters. Most fibers are only a few microns in diameter, so it doesn't take much length to make the transition from particle to fiber.

Hull.D et al[1]Composites are materials that comprise strong load carrying material (known as reinforcement) imbedded in weaker material (known as matrix). Reinforcement provides Strength and rigidity, helping to support structural load. The matrix or binder (organic or inorganic) maintains the position and orientation of the reinforcement. Significantly, constituents of the composites retain their individual, physical and chemical properties, yet together they produce a combination of qualities which individual constituents would be incapable of producing alone.

Mcmullen.P et al [2].The history of natural fiber reinforced polymer composites can be traced back to the advent of synthetic polymers in the early part of twentieth century. Before this even. examples of the use of natural fibers with natural or semi synthetic polymers exist. For instance ,in 1850s,Shellac was being compounded with wood floor in USA with the invention of Bakelite phenolic moulding resin in 1909,it was not long before natural fiber like wood floor was added to from the earliest form of synthetic composites. Bledzki,A.K. et al[3] The use of natural fiber for the reinforcement of the composites has received increasing attention both by the academic sector and the impithry. Natural fibers have many significant advantages over synthetic fibers.

Rabinowicz.E et al [4**]** investigated mechanical properties and physical properties of natural fibers vary considerably depending on the chemical and structural composition, fiber type and growth conditions. Mechanical properties of plant fibers are much lower when compared to those of the most widely used competing reinforcing glass fibers. However, because of their low density, the specific properties (property-to-density ratio), strength, and stiffness of plant fibers are comparable to the values of glass fibers. S.N. Monteiro et al [5] ,investigated that composites prepared with two molding pressures and with amounts of coir fiber up to 80 wt% were fabricated. Up to 50 wt% of fiber, rigid composites were obtained. For amounts of fiber higher than this figure, the composites performed like more flexible agglomerates. The results obtained for flexural strength allowed comparison of the technical performance of the composites with other conventional materials.

II. MATERIALS AND FABRICATION METHODS

2.1 Rice husk

Rice husk (RH) is one of the major agricultural residues produced as a by-product during rice processing. Usually it has been a problem for rice farmers due to its resistance to decomposition in the ground, difficult digestion and low nutritional value for animals. According to the lignin and hemicelluloses contents of rice husk are lower than wood whereas the cellulose content is similar. For this reason (RH) can be processed at higher temperatures than wood. Therefore, the use of rice husk in the manufacture of polymer composites is attracting much attention.

Fig:1 Photographic Image of Particulated Material Rice Husk

2.2. Egg shell

The most common fillers for polyester and vinylester resins is calcium carbonate,which is used to reduce costs as well as mould shrinkage`

Fig:2 Photographic Image of Particulated Material Egg shell

2.3 Matrix Material

From the list of terephthalic, isophthalic and orthophthalic unsaturated polyester resin types, the orthophthalic type is selected because of its availability, low weight and good compatibility with fibers. The resin system consists of unsaturated Orthophthalic polyester (Specific gravity@27°C: 1.136, Viscosity: 470 Cps and Mass per unit area: 449.96 g/sq.m) . Polyester resins are unsaturated resins formed by the reaction of dibasic organic acids and polyhydric alcohols. Polyester resin, tends to have yellowish tint, and is suitable for most backyard projects. It is often used in the making of surfboards and for marine applications. MEKP is composed of Methyl Ethyl Ketone Peroxide, a catalyst. When MEKP is mixed with the resin, the resulting chemical reaction causes heat to build up and cure or harden the resin .The use of excessive catalyst can, therefore, cause charring or even ignition during the curing process. Excessive catalyst may also cause the product to the fracture or form a rubbery material.

2.4 Materials of Composites

The specimen used in this study was made of coir fiber reinforced composite material. The composite was made up of general polyester resin and coir fibers. Accelerator was cobalt octoate and catalyst was Methyl Ethyl Ketone Peroxide as shown in Table-1.

Table-1 Materials of fabrication composites

Material	Type
Matrix	Polyester Resin
Catalyst	Methyl Ethyl Ketone Peroxide(MEKP)
Accelerator	Cobalt Octoate
Filler	Rice husk, Eggshell
Reinforcement	Coir fiber

2.5 Fabrication of Composites:

The natural coir fiber was selected as reinforcement material in this investigation. The matrix material of unsaturated polyester resin and the filler material of Rice husk and Egg shell was used .The compression moulding process technique was used for fabricating filler impregnated Coir polyester composites. Poly Vinyl Acetate (PVA) release agent was applied to the surface before the fabrication. The coir fibers were pre-impregnated with the matrix material consisting of unsaturated polyester resin, of Rice husk and Egg shell filler, Cobalt Octoate accelerator and MEKP catalyst in the ratio of 1:0.015:0.015.The impregnated layers were placed in the resin matrix (300 mm × 300 mm) and pressed heavily before removal. After 1h, the composites were removed from the mould and cured at room temperature (28^0c) for 24 hr.

Table-2 Composition of composites

Sl.No.	Fiber length(mm)	Rice husk (wt %)	Boiled egg shell (wt %)
1	10	5	5
2	10	10	10
3	10	15	15
4	30	5	5
5	30	10	10
6	30	15	15
7	50	5	5
8	50	10	10
9	50	15	15

Fig: 3 Photographic Image of Fabricated Composite Sheets

III. EXPERIMENTAL RESULTS

3.1. Tribology Testing Of Specimen

Surface roughness plays an important role in many areas and is a factor of great importance in the evaluation of surface accuracy. The variation of surface roughness with respect to the work piece fiber orientation indicated that the surface roughness fluctuated for different fiber orientation. Photographic image of surface roughness tester (Mitutoyo SJ-310) has been in Figure 4.

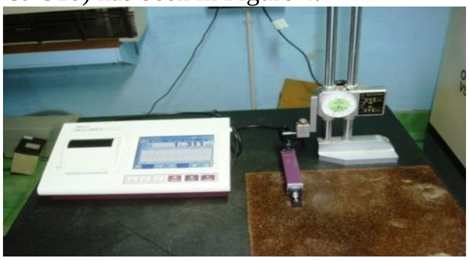


Fig :4 Photographic image of surface roughness tester(Mitutoyo SJ-310)

The variation of surface roughness with respect to the work piece particulate orientation indicated that the surface roughness fluctuated for orientation. The surface roughness increased more rapidly after 100 µm particulate orientations. At larger particulates, compressive strain is generated within the work material during the compression moulding process, this resulted in larger surface roughness value. For evaluating condition cut off value of 0.8mm, cut off length 2.5 µm, While the more average surface roughness Ra is 2.26 µm when incorpating of rice husk of 10.0 % of wt and 10.0 % wt of boiled egg shell respectively. The maximum surface roughness Ra is 5.13 µm due improper adhesion between particulate and polyester matrix, generally polymer resin are amorphous structure in nature, because of this polyester surface will better, when incorpating with reinforcement particulate, surface of particle will improved due inability of resin.

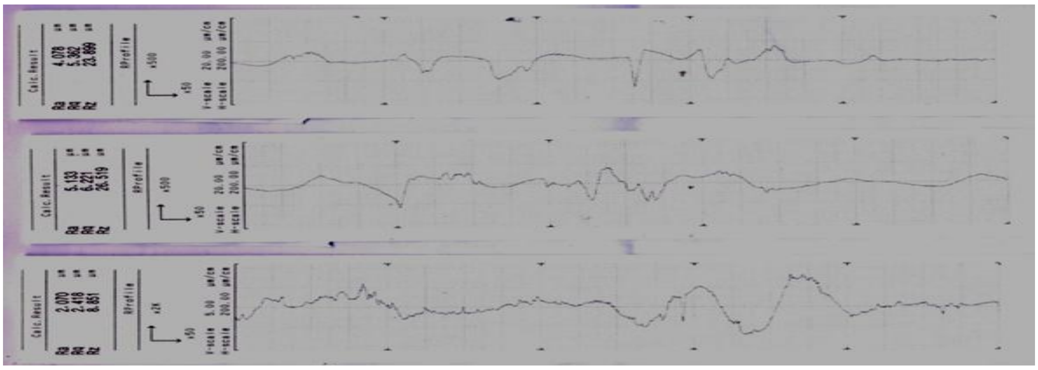


Fig. 5 Samples S1, S2 & S3

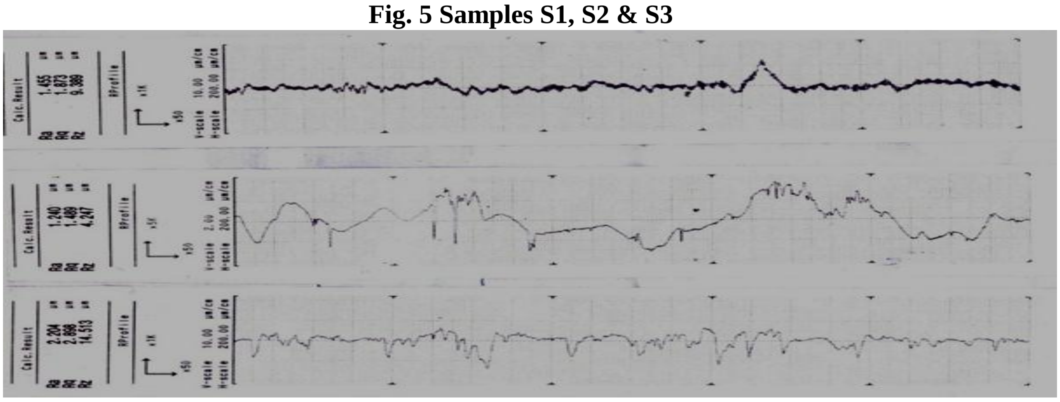


Fig. 6 Samples S4, S5 & S6

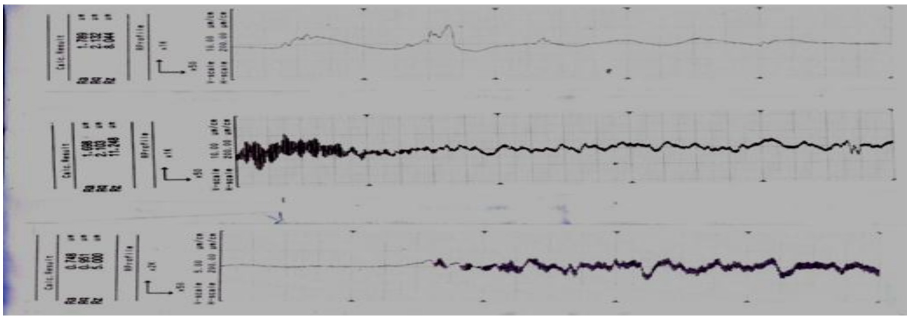
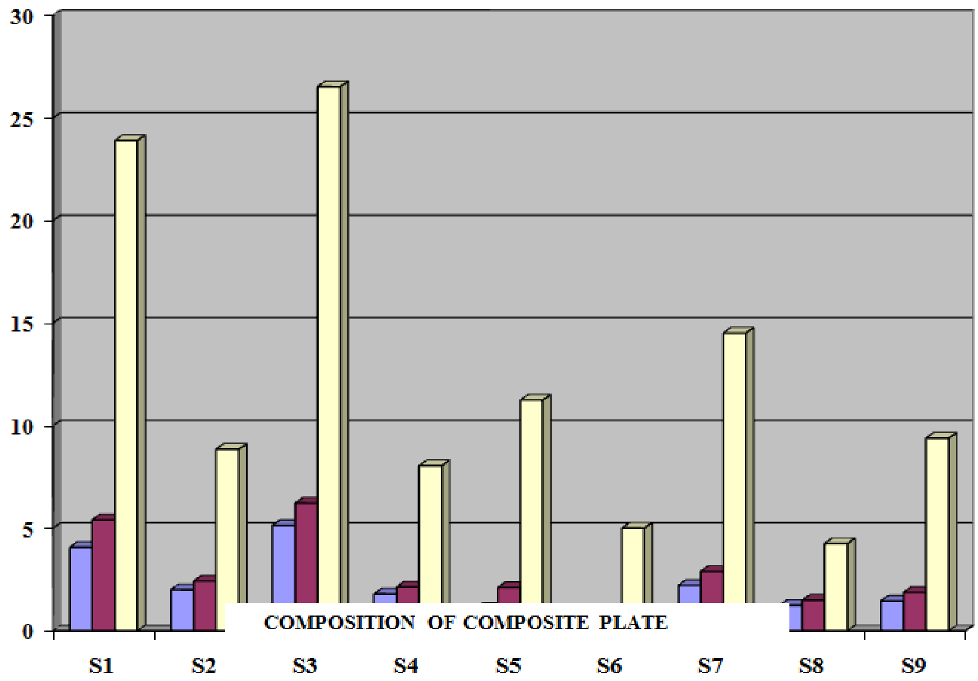


Fig. 7 Samples S7, S8 & S9

Table-3 Statistical analysis of surface roughness of particulates composites

Sample identification	Surface Roughness Ra (µm)	Mean Square Of Roughness Rq (µm)	Maximum Height Rz (µm)
S1	4.07	5.40	23.90
S2	2.00	2.42	8.85
S3	5.13	6.22	26.52
S4	1.789	2.132	8.044
S5	1.098	2.103	11.248
S6	0.74	0.95	5.00
S7	2.204	2.898	14.513
S8	1.24	1.49	4.25
S9	1.45	1.87	9.39

omparison Between Various Composition Plates And $R_{A,}$ R_B & R_Z



COMPOSITION OF COMPOSITE PLATE

IV. CONCLUSION

The surface behaviors of boiled egg shell and rice husk particulates were studied in this investigation. The particulate composites were fabricated as per the different combinations of the fabrication parameters. The maximum surface roughness value (R_a) is obtained in coir length of 10mm,10% wt of fiber content and15% wt of hybrid particles(rice husk and boiled egg shell each). The least surface roughness value (R_a) is obtained in coir length of 30mm,10 % wt of fiber content and15% wt of hybrid particles.

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