

Hybrid Reinforced Composite Material from Garbage to Biomaterials

S.Dineshkumar, S.Mohamed Haris, R. Mujeebur Rahaman, K.Balamurali

Abstract: A hybrid reinforced composite material which fundamentally contains horticulture squander materials like banana stem outer layer (*Musa sepientum*) modified to powder form, egg shell modified to fine powder, the said powders (powder have a size in a range of 10 to 50 microns) being mixed in a matrix of bio epoxy resin using a catalyst to effect complete mixing of the said powdered fibers to yield the said hybrid reinforced composite, the said hybrid composite capable of being molded to any geometrical object, the said composite having a low water retention property with retention being in a range of 14-23% with a soaking time of 120 hrs. Before and after chemical treatment in both with and without moisture, the youngs modulus varies from 12321.5241 N/mm² to 25779.2532 N/mm², the flexural values varies from 17.4 N/mm² to 25.5 N/mm², impact strength varies from 12.6 J to 20.9 J, % of elongation varies from 5.6% to 10.1%. The composite has negligible change in tensile properties up to a load of 270 Kg also flexural properties and impact strength of the composite were not be affected by under moisture conditions.

Key words: Hybrid composites; Mechanical properties; *Musa sepientum*; Egg shells.

I. INTRODUCTION

Composite materials have been in use for many a variety of applications and have been developed in a variety of configurations [1]. Such materials show some extraordinary properties in terms of mechanical strength, thermal properties etc [2]. The environmental aspects of these materials still pose a challenge in the form of disposability of the finished product if it breaks or gets damaged [3]. Some attempts have been made in recent years to incorporate natural products from plants in the form of fibers. However, composites purely from all ingredients being natural source from plants or bio waste is still not a reality [4-5].

Reference may be made to a US patent publication US2004/0234803 to Catherine Joyce [27]. The innovator reveals a multi fiber composite comprising of a combinant structure of cellulosic wood or polymeric strands blended with non-stringy materials [28-31]. The divulgence

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identifies with financial and natural efficiencies to wood, non-woods paper making and other polymeric tasks. The disclosed invention also provides application to various categories of products like automotive, construction, food and non-food items [32]. And personal care items. However, the said disclosure is not clearly stating use of any other natural fiber other than wood. This still is not a beneficial use as wood means deforestation and hence threat to environment. The fiber of the invention may also nit have bio degradability property [6]. In yet another patent publication US 2009/0118396, to Stephan .J Faehner and Michael . J Pisczor, the invention relates to enhancement of cellulosic properties to wood by adding natural fibers. The common strands utilized incorporate horse feed, bagasse, bamboo, coconut husks, cornstalks, cotton, cotton gin squander, flax, hemp, kenaf, oat frames, nut bodies, rice structures, sisal, switch grasses, wheat stalks or different kinds of cellulosic materials. The measure of characteristic strands utilized in the alteration of wood powder is in a scope of 5-95%. The exposure is restricted to adjustment of wood just by including normal filaments recorded [7]. Banana fiber and silica powder fortified composite material dependent on the epoxy gum. Banana strands are all around scattered in the gum framework and expansion of fiber expands the modulus of versatility and diminishes a definitive rigidity of the epoxy [34-36]. Furthermore, further expansion of silica additionally expands the modulus of versatility lessens a definitive elasticity. Expansion of banana very decreases yield quality and expansion of silica gives preferable outcomes over banana fortified composites yet at the same time having yield quality exceedingly diminished. Banana strengthened improve the effect quality of epoxy materials. Expansion of filaments builds the limit of water ingestion. Expansion of banana fiber lessens bowing quality and expansion of silica with banana has not given preferred twisting quality over banana fiber fortified composites. Various blends of silica particles, banana fiber epoxy pitch were set up by mechanical mixing at 3000 rpm [8]. The pretreatment of the egg-shell to make it in fine powder. After the treatment, it is added to the polymer in various weight part (5, 10, 15, 20, 25) wt. % utilizing blender 600 instrument joined to Haake Rehochard meter with blending time 15 min; blending temperature 1750C; blending speed 32 RPM.

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The ductile modulus fluctuated between 450 to 340 for egg shell weight proportion between 5 to 25%. The expansion of egg shell powder causes an increment in the flexibility which prompts lessen the quality of the material; increment of the extension break with the expanding filler stacking shows the capacity of the filler to help the pressure move from polymer filler to framework. The expansion of the egg shell expanded the firmness of the HDPE steadily with expanding filler content. Hardness diminishes with expanding filler content. The expansion of egg shell filler has brought about some improvement in the mechanical properties of HDPE. The rigidity, modulus of versatility and hardness prolongation at break of (HDPE/egg shell powder) composite were marginally diminished with the consolidation of the filler. Extension at break and the effect quality increment continuously with expanding filler content [9]. The arrangement of egg shell powder and the planning of the LDPE based composites from it. The egg shells were washed, dried and ground to a powder utilizing the blender. A sifter was utilized to acquire a normal molecule size of 63 μm . The egg shell powder with a normal molecule size of 63 m was treated with an answer of 10% NaOH [10]. .

II. EXPERIMENTAL

A. Materials

Agricultural /biological wastes used in this invention: The composite which fundamentally contains horticulture squander materials like banana stem outer layer (*Musa sepientum*) & Egg shell and resin used in this research are plant-based materials were significantly better for the environment [11-12]. Geo-geographical location from Tamilnadu, India, Agricultural by-products / biological wastes used in this invention [13-14]

B. Chemical Treatment of said natural fibres

Strands were treated by 1% NaOH + 99% of refined water is included and an answer is made and in this way drying of the filaments in typical concealing for 3 to 4 hours, the strands were taken and absorbed the above said arranged arrangement and with various time interims splashing was completed [15-16]. .

C. Fibre ratio for mechanical testing

Specimen 1 = Fiber 5% and Resin 95% ; Specimen 2 = Fiber 10% and Resin 90% and Specimen 3 = Fiber 15% and Resin 85%

D. Characterization

Tensile test: According to ASTM D638 utilizing Universal Testing Machine, 5569 An, Instron. The speed to test was 5 mm/min [17-19].

Flexural test: According to ASTM D790 utilizing Universal Testing Machine, 5569 An, Instron. The range length was 50 mm and speed to test 2 mm/min [20-21].

Izod effect test (both indented and un-scored): According to ASTM D256 utilizing Impactor II, Ceast. The 5.5 J pendulum was utilized for the test [22-23].

Water Absorption: according to ASTM D5229 Specimen

estimate (mm) were 100 X 100 and ingestion test time of 120 hrs [24-26]

III. RESULTS AND DISCUSSION

From the Fig.1 Water absorption test results it is observed that , the said composite having a low water retention being in a range of 14-23% with a soaking time of 120 hrs.

From the Fig.2 Tensile test results it is observed that Before and after chemical treatment in both with and without moisture, the young's modulus varies from 12321.5241 N/mm² to 25779.2532 N/mm².

From the Fig.3 Flexural rigidity test results it is observed that flexural values of composites varies from 17.4 N/mm² to 25.5 N/mm².

From the Fig.4 Impact test results it is observed that impact strength of composites varies from 12.6 J to 20.9 J.

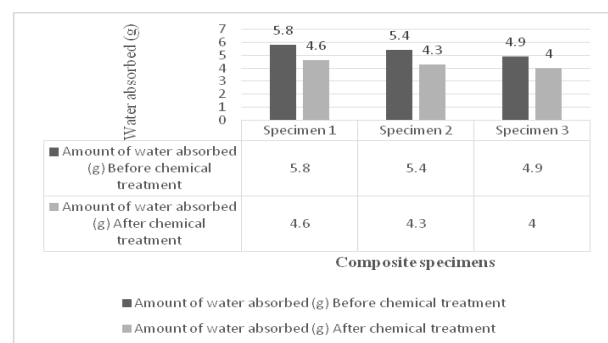


Fig.1 Water absorption test results

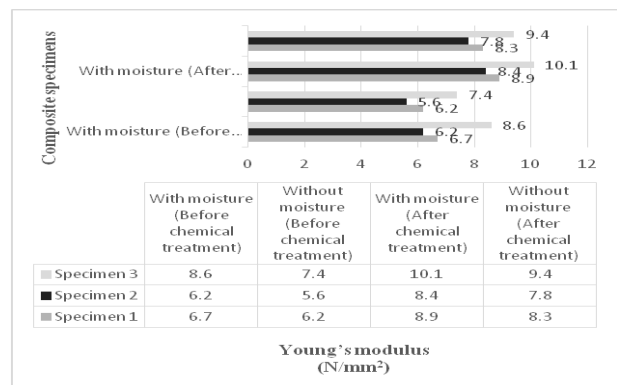


Fig.2 Tensile test results

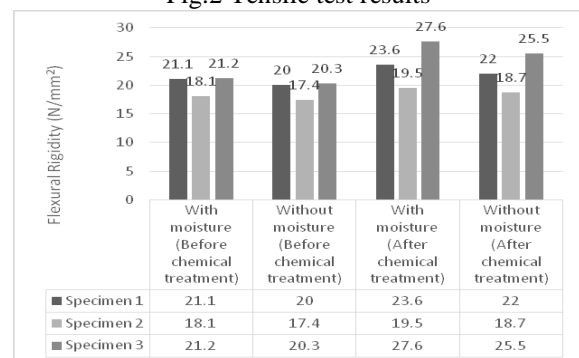


Fig.3 Flexural rigidity test results



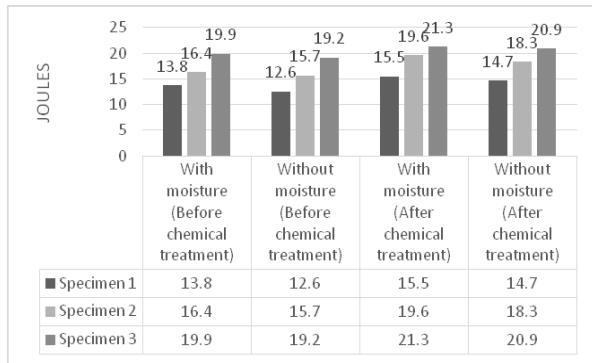


Fig.4 Impact test result

IV. CONCLUSION

From the test results (when concoction treatment) crossover of 3 distinctive example have great mechanical properties and there is no huge diverse in both with and without dampness test outcomes. The said half and half composite fit for being shaped to any geometrical article, the said composite having a low water maintenance property with maintenance being in a scope of 13.3% with a splashing time of 120hrs. The composite has irrelevant switch in ductile properties up to a heap of 270 Kg likewise flexural properties and effect quality of the composite were not be influenced by under dampness conditions. The revelation incorporates the procedure to make the composite and subsequently can be utilized for manufacture of prostheses/fake limp and bone joining substitutes (outer obsession).

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