International Journal of Mechanical Engineering

STUDY OF MECHANICAL PROPERTIES OF COCONUT SHELL POWDER

M. Sugumar
Assistant Professor, Department of Mechanical Engineering, Nandha Engineering College, Erode–52, Tamil Nadu, India.

S. Magibalan*
Assistant Professor, Department of Mechanical Engineering, Nandha Engineering College, Erode–52, Tamil Nadu, India.
magibalan42@gmail.com

V. Chandramohan
Assistant Professor, Department of Mechanical Engineering, Nandha Engineering College, Erode–52, Tamil Nadu, India.

Gladys Kalpana K
Assistant Professor, Nandha College of Pharmacy, Erode – 52, Tamil Nadu, India.

ABSTRACT

The non-food element of a coconut is the shell, which is one of the tough agricultural wastes Coconut shell holds a lot of promise due to its high strength and modulus. When compared to other materials, coconut shell powder has excellent qualities, low cost, renewable, high specific strength to weight ratio, low density, low abrasion on machine, and environmental friendliness are some of the benefits. Plastics take a long time to disintegrate, polluting the environment. To make composite material, three various percentages of coconut shell powder and epoxy resins are combined and the results are examined for each of the three composite materials. The input needed to solve this problem is to reduce the use of plastics by substituting them with natural materials. Coconut shell is becoming more widely available around the world, yet most shells are discarded or burned as waste. Efforts to identify a use for this substance have mostly resulted in low yields.

Keywords: The availability of coconut shell, the binder material, the moulding process, and the reduction of plastic usage are all factors to consider.

1. INTRODUCTION

Composites have recently met the optimal requirement criterion for materials used by various designers. In recent years, there have been significant advancements in the design and manufacture of light weight, high strength materials as a result of the increased use of polymer composite materials. Several researchers have focused their efforts on defining a wide range of combinations of biodegradable matrix/natural filler in order to promote new classes of biodegradable composites with improved mechanical properties and low-cost products. Among the many natural fibers studied in this area, several fillers play a key role. With the increased usage of wood-based raw materials, for example, the development of wood flour composites has received a lot of attention. Substitutions were unavoidably required [1-4].

Natural Fillers (NF) reinforced materials have a number of environmental benefits, including reduced reliance on non-renewable materials, reduced pollution, and reduced greenhouse gas emissions. Flax, jute, hemp, and other natural lignocellulose fillers are an eco-friendlier alternative to traditional reinforcing fibres (glass, carbon) [5-10].

The coconut shell powder is a reinforced material which does not have any poisonous content like plastic. Making of composites using these reinforced materials with addition of additives can be replace the plastics. The main goal is to raise awareness about environmental protection by avoiding chemical composites. Reduce the dependence on product made of plastic [11-13].

Balaji A. Karthikeyan B., Sundar raji C. Baggase has investigated the use of coconut shell particles as a reinforcing material. In a grinding machine, shell particles ranging in size from 200 to 800 microns are created. Because of their increased strength and modulus qualities, coconut shell fillers are viable candidates for the development of novel composites [1].

John D. Venables studied natural fibres are hair-like threads obtained directly from studied plants, animals, and mineral sources. Natural fibres, like synthetic fibres, are made up of polymers (in this case, biologically produced compounds like cellulose and protein), but they emerge from the textile manufacturing process relatively undamaged. Some man-made fibres are also made from naturally occurring polymers. [2].

Madakson P.B., Yawas D.S. And Apasi in this experiment, Epoxy resin, hardener, coconut shell powder, and crushed nut shell powder were used.. To make it easier to remove the specimen from the mould, a layer of wax was applied to it. Ground nut shell particles and resin were measured and placed in a plastic container, where they were thoroughly mixed to achieve a uniform mixture. [3].

Prakash Tudu studied the Unsaturated polyester resin,grade “KPR 6600”, the catalyst used, MEKP- methyl ethyl ketene peroxide and cobalt accelerator were supplied by KEMROCK industries and export limited, Halol. To remove air bubbles from the mixture, a vacuum was used for 5 minutes. [4].

Salmah H., Koay SC., and Hakimah O. has studied the use of epoxy resin, hardener, and coconut shell powder. Runchi Organic Limited in Kanpur, Uttar Pradesh, India, supplies epoxy resin moditite EL301, a medium viscosity thermosetting epoxy resin. As a matrix material, it has excellent adhesion to various materials, high resistance to chemical and atmospheric attack, high dimensional stability, excellent mechanical properties, nontoxicity, and negligible shrinkage. [5].

Salleh Z, Islam M.M., and Ku H The coconut shell was dried in the open air before being ground into powder with a crushing machine and sieved in accordance with BS 1377:1990 requirements. The results of the chemical analysis of coconut shell powder are shown in one table. The chemical composition of the coconut shell was determined using the absorption spectrometer (AAS)-peckinhelma 2006 model. [6] The particle size used was 100 micrometres..

Ticoalu A., Aravinthan T., &Cardona F investigate the coconut shell powder used as filler obtained from slip India Exporters Erode. It is reported tocontained lignin, pentosans, cellulose, moisture, ash, solvent extractives and uronic anhydrides. The formulation of CSP/NR composites is given in table. The mixing was done on an ASTM-D 15-627- laboratory two-roll mixing mill that is compliant. The nip gap, mill roll speed ratio, mixing time, and order of constituent addition were all kept for the sample for all of the composites. [7].

Kumar et al. [8] evaluate the mechanical properties of polyester typha fibre in a combination of wood powder and coconut shell ash were investigated..

Maheswaran et al. [9] characterized the natural fiber reinforced polymer composite. This piece was made using both chemically untreated coconut and palm fibre with epoxy resin and chemically treated coconut and palm fibre with epoxy resin..

Kumar et al. [10] investigated on mechanical properties of CET (Coconut Shell, Egg shell powder, Teak wood flour) composite materials.

Srivastava and Maurya [11] characterized epoxy-based composite developed from biowaste material. Hand layup technique was used to create composites using 10, 20, and 30% coconut shell powder epoxy composites.

The effect of mixing time on the mechanical properties of an epoxy-fly ash composite was investigated by Pattanaik et al. [12].

Venkatesh [13] investigate the hand layup method was used to create and test coconut shell powder reinforced epoxy composites with varying percentages of weight fractions of coconut shell for different grain sizes. Plastic pollution is defined as the accumulation of plastic objects in the environment that harms wildlife and humans. Humans produce a large amount of plastic because it is inexpensive and long-lasting. Furthermore, the chemical structure of most plastics makes them resistant to many natural breakdown processes, making them slow to disintegrate. These two factors have combined to make plastic pollution a major environmental issue.

2. MATERIALS AND METHOD

2.1 Preparation of Shell Powder

Equipment for crushing and pulverizing that is designed and produced to provide optimal efficiency to our clients. These crushing and pulverizing machines are used to reduce the size of various types of coconut shells and turmeric. For thermo set moulding powder, a mesh size of 80-100 mesh is appropriate, whereas synthetic resin glues require a mesh size of 230-240 mesh.

2.2 Mixing of Binders and Filler Material

Primarily pulverized or crushed a coconut shell powder get mixed in Maida (additive) with the gluten to attain composite materials' properties. The composite material such as (coconut shell powder and maida flour) (coconut shell powder and maida flour).

3. METHOD OF PRODUCTION

3.1 Compression Moulding Machine

The warmed composite material is first deposited in an open chamber in compression moulding. The mould is sealed with a top force or plug member, and pressure is applied to force the composite material into contact with all mould areas.

Fig.1 Compression Moulding Machine

3.2 Specification of compression molding machine

Table 1 Specification of compression molding machine

Minimum Order Quantity	1 Unit
Height	400 mm
Make	SSE
Control Feasting	3 to 6 units/hour
Material	Coconut shell powder
Manufacture Volume	2200 to 2500 Plates/8 hours
Capacity (pieces per min)	1 plate/min
Plate Size Range (inch)	4-12
Sizes	9.5 x 4.5 x 2.5
Width	800 mm
Length	3000 mm

3.3 Testing samples

Figure 2 shows that Sample A consist of 20% coconut shell powder added with 60% of binder as Maida.

Fig. 2 sample (A) 20% CSP filled composite

Figure 3 shows that Sample A consists of 30% coconut shell powder added with 60% of binder as Maida.

Fig. 3 sample (B) 30% of CSP filled composite

Figure 4 shows that Sample A consists of 40% coconut shell powder added with 60% of binder as Maida.

Fig. 4 sample (C) 40% of CSP filled composite

4. Results and discussion

4.1 CSP composite testing results utilizing UTM

Table 2 testing result of CSP composite

SI. No	Properties	20% CSP filled Composite (A)	30% CSP filled Composite (B)	40% CSP filled Composite (C)
1.	Tensile strength (Mpa)	19.23	17.05	14.64
2.	Flexural strength (Mpa)	83.38	86.45	73.92
3.	Impact strength (KJ/m^2)	0.20	0.23	0.25

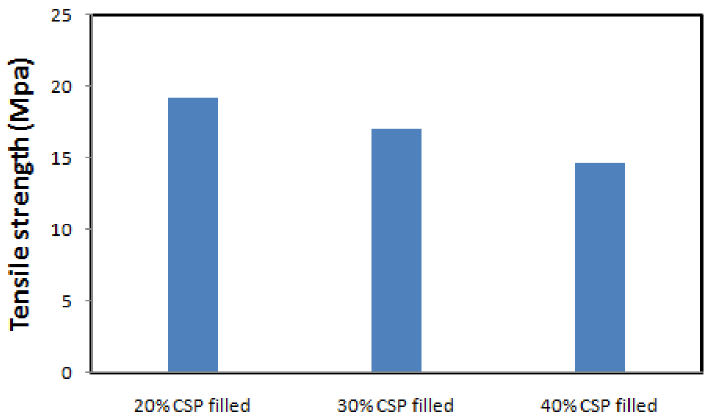

Fig. 5 Tensile Strength of CSP filled composite

The tensile strength of CSP filled composites is one of the most essential elements, and Fig. 5 depicts the differences in tensile strength of composites as a function of filler weight percentage. Flexural asset of the 20 percent CSP Filler composite is higher than the rest of the composite. In Fig. 5, the tensile asset of composites with 30 percent and 40 percent filler content declines linearly while the tensile asset of composites with 20 percent filler content increases. When compared to other composites, the tensile break load of 20% CSP Filler composite is comparable to that of other composites [14-15].

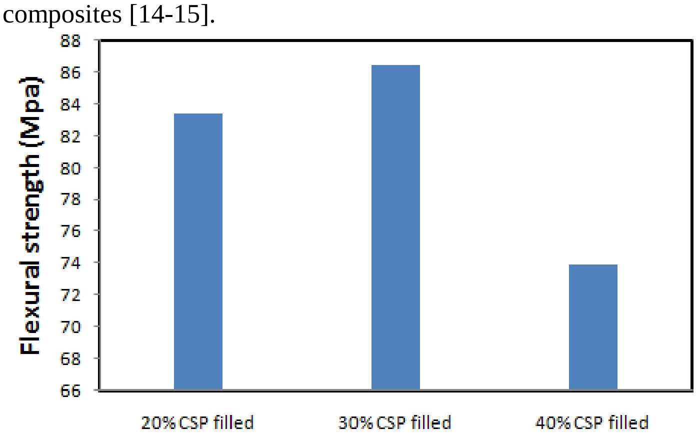

Fig. 6 Flexural Strength of CSP filled composite

Flexural strength is a key aspect in CSP filled composites, and Fig. 6 portrays the changes in composite flexural asset as a function of filler content in weight percent. The flexural strength of the 30 percent CSP Filler composite is higher than the rest of the composite. Figure 6 depicts the flexural strength of composites containing 20 percent and 40 percent filler content declines linearly, but increases in composites with 30 percent filler content. When compared to other composites, the flexural break load of 30% CSP Filler composite is comparable to that of other composites.

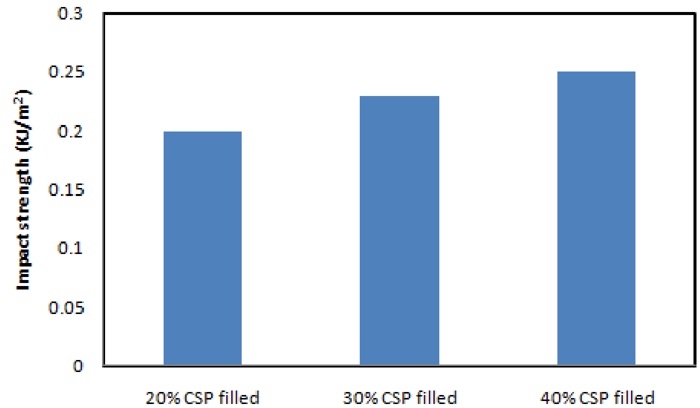

Fig. 7 Impact Strength of CSP filled composite

The impact strength of CSP filled composites is one of the most essential elements, and Fig. 7 depicts the differences in impact strength of composites as a function of the weight percent of filler content. The impact strength of the 40 percent CSP Filler composite is stronger than the rest of the composite. Figure 7 shows that the impact asset of composites with 20% and 30% filler content rises linearly, but the impact strength of composites with 40% filler content increases exponentially.. When compared to other composites, the impact break load of a 40 percent CSP Filler composite is comparable.

5. CONCLUSIONS

1) The global availability of coconut shell, a hard lignocelluloses Agro waste, is increasing year after year.
2) The majority of the time, coconut shells are thrown away or burned as waste.
3) The tensile break load of a composite containing 20% CSP Filler is comparable to the tensile break load of other composites.
4) The flexural break load of a composite containing 30% CSP Filler is comparable to the flexural break load of other composites.
5) The impact break load of a composite containing 40% CSP Filler is comparable to the impact break load of other composites.
6) The study of coconut shell powder in innumerable

applications may lead to the development of new avenues as well as small-scale industries to design a bearable module for the future use of coconut shell powder tackles.

7) The area CSP plate manufacturing project no just gives a practical business chance to unemployed youth addition encourages fulfillment of independence, evenhanded appropriation of natural pay and adjusted local development.

REFERENCES

[1]. Balaji A.,Karthikeyan B., Sundar raji C. Baggase Fiber-The Future Biocomposite Material. Review International Journal of Chem Tech Research. 7, 2015, 223-233

[2]. John D. Venables. Polymer matrix-composites. Materials science, 2015.

[3]. Madakson P.B., Yawas D.S. And Apasi A. Characterization of Cocunut ShellAsh for Potential Utilization in Metal Matrix Composites for Automotive Applications. 4(3), 2012, 1190- 1198.

[4]. Prakash Tudu. Processing And Characterization of Natural fiber Reinforced Polymer Composites. Department of Mechanical Engineering, National Institute of Technology Rourkela. 2009.

[5]. Salmah H., Koay SC., and Hakimah O. Surface Modulation of Coconut Shell Powder Filled Polylactic Acid Biocomposites. Journal of Thermoplastic Composite Material, 26(6), 2012, 809-819.

[6]. Salleh Z, Islam M.M., and Ku H. Tensile. Behaviors of Activated Carbon Coconut Shell Filled Epoxy Composite. 3rd Malaysian Postgraduate Conference, Sydney, New South Wales, Australia Editors: Noor M.M.Rahman, M.M., and Ismail J., 2013, 22-27

[7]. Ticoalu A., Aravinthan T., & Cardona F. A Review of Current Development in Natural fiber Composites for Structural and Infrastructure Applications. Southern Region Engineering Conference, 2010, 11-12.

[8]. Venkatesh.B, "Fabrication and testing of cocconut shell powder reinforced epoxy composites," International Journal of Advance Engineering and Research Development, vol.2, 2015, pp.89-95.

[9]. Pattanaik.A,Mohanty M.K, SathpathyM.P,Mishra .S.C, "Effect of mixing time on mechanical properties of epoxy-fly ash composite," Journal of Materials & Metallurgical Engineering,vol.2 , 2015. pp. 11-17.

[10]. Srivastava.A and Maurya.M. "Preparation and mechanical characterization of epoxy-based composite developed by bio waste material," International Journal of Research in Engineering and Technology, vol.4, 2015, pp. 397-400.

[11]. Kumar.M.L,Krishnaiah.D, Killari.N. "Investigation on mechanical properties of CET composite materials, "International Journal of Emerging Trends in Engineering Research, vol.3, 2015, pp.516-519.

[12]. Maheswaran,Hemanth M, Velmurugan.M,Vijaybabu.K, Prabhu.S, Palaniswamy.E. "Characterization of natural fiber reinforced polymer composite," International Journal of Engineering Sciences &Research Technology, vol.4, 2015, pp.362-369.

[13]. Kumar.B.S, Kumar.D.K,ShankaraBabu.CH.S, Kumar.P.V. "Effect of mechanical properties on polyester typha fibre in composition of wood powder and coconut shell ash," International Journal of Engineering Technology Science and Research, vol. 2, 2015, pp. 91-99

[14]. Karthikeyan, M., Karthikeyan, P., Muthukumar, M., Magesh Kannan, V., Thanarajan, K., Maiyalagan, T., Chae-Won Hong, Jothi, V.R., Sung-ChulYi., "Adoption of novel porous inserts in the flow channel of pem fuel cell for the mitigation of cathodic flooding", International Journal of Hydrogen Energy, Volume 45, Issue 13, Pages 7863-7872, 2020

[15]. Muthukumar M., Karthikeyan P., Vairavel M., Loganathan C., Praveenkumar S., Senthil Kumar A.P., "Numerical studies on PEM fuel cell with different landing to channel width of flow channel", Procedia Engineering, Volume 97, Pages 1534-1542, December 2014