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ISSN 2348-0424
USA CODEN: JETRB4

Journal of Engineering And Technology Research, 2014, 2 (5):1-7

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CHARACTERIZATION OF NOVEL COCONUT SHELL POWDER REINFORCED - EPOXY COMPOSITE

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ABSTRACT

The interest and capabilities of polymer patterning have originated from the abundance of functionalities of polymers and a wide range of applications of the patterns [1]. An empirical approach for micro scale fabrication and characterization of three dimensional novel coconut shell powder (CSP) reinforced polymer matrix composite (Epoxy-resin) have been reported. The novel coconut shell powder is a specific mixing ratio of different coconut shell particle size. The result shows the potential of 20% to 30% novel coconut shell powder reinforced composite as an alternative material for the interiors of an aircraft, spacecraft, ships, motor car and automobile.

Keywords: Polymer-matrix composites, Mechanical properties, Mechanical testing, Casting.

INTRODUCTION

Ever increasing energy demands and environmental concerns, together with the diminishing fossils fuels reserves, have prompted increasing amount of work toward developing novel materials worldwide. These natural filler filled polymers composites are renewable, cheap, completely or partially recyclable or biodegradable; due to these beneficial characteristics researchers show their interest in this field [2-4].

Coconut shells are available in abundance in tropical countries (India, China, Sri Lanka, Malaysia etc.) as a waste product after consumption of coconut water and meal. Such abundance may fulfill the demand of filler based composites while reducing waste. Procurements and processing of CSP is cost effective than other artificial fillers[5-6].

The present paper reports to develop a novel coconut shell powder in different particle size for reinforcing in different volume and evaluate its tensile strength and flexural strength along with engineering application of resulting composites.

MATERIALS AND METHODS

Materials used in this experimental work are Epoxy resin, Hardener and Coconut shell powder. Epoxy resin Moditite EL 301 is a thermosetting epoxy resin of medium viscosity supplied by Ruchi Organics Limited, Kanpur, Uttar Pradesh, India having outstanding properties as the matrix material like excellent adhesion to different materials, high resistance to chemical and atmospheric attack, high dimensional stability, excellent mechanical properties, nontoxic nature and negligible shrinkage. Hardener MH-933 is used to harden matrix material. The chemical composition of coconut shell powder consists of Lignin (29.4%), Pentosans (27.7%), Cellulose (26.6%), Moisture (8%), Solvent Extractives (4.2%), Uronic Anhydrides(3.5%) and Ash (0.6%).The cleaned coconut shells were dried in open air and grinded into powder using a pulverizing machine. The collected powder was sieved from different mesh sizes. For discriminating the particle size about 1000 g of CSP was put over the sieve shaker and shaken it for 20 min in shaker. The sieves were arranged in the following order - crushed powder, 600 micron sieve (ASTM no. 8), 425 micron sieve (ASTM no. 7), 300 micron sieve (ASTM no. 6), 212 micron sieve (ASTM no. 5) and then dust collector. The mixing ratio of different coconut particle size was chosen as illustrated in table-1 for developing novel coconut shell powder (CSP) [7].

Table 1: Composition ratio of Novel CSP

S.No.	Particle Size	Percentage
1	850 > size > 600	40%
2	600 > size > 425	20%
3	425 > size > 300	20%
4	300 > size > 212	10%
5	Dust	10%

TESTING OF MECHANICAL PROPERTIES OF COMPOSITE

The study of mechanical properties such as tensile strength and flexural strength of novel coconut shell powder reinforced composite have been conducted as per ASTM standards [7].

RESULTS AND DISCUSSION

The experimental curves for tensile strength from INSTRON 1195 testing machine of 20% CSP Filled, 30% CSP Filled and 40% CSP Filled composites are shown in Fig-1, Fig-2 and Fig-3 respectively.

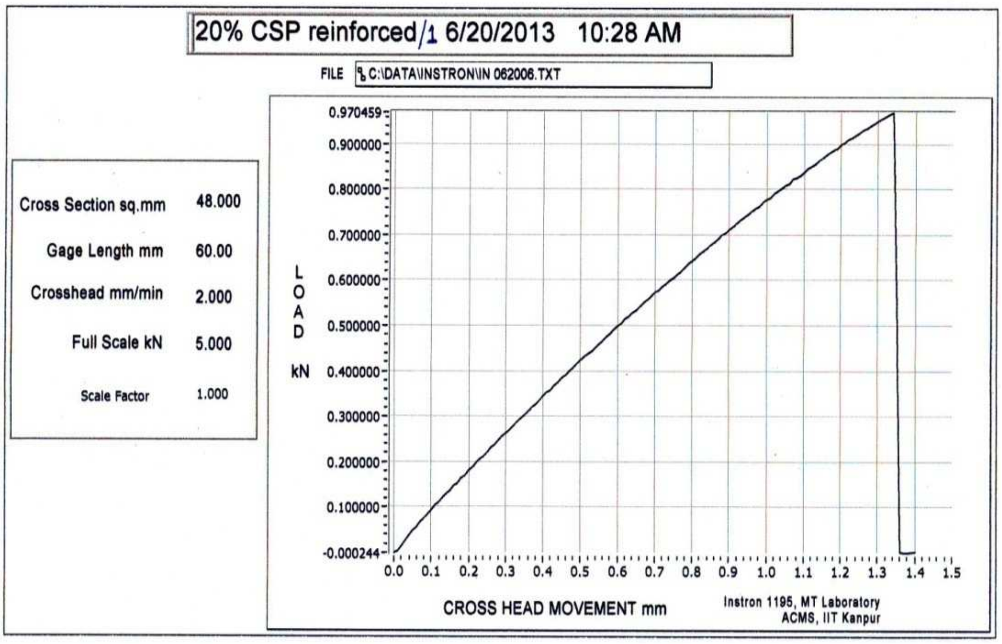

Figure 1: Load versus elongation curve of 20% CSP reinforced composite for tensile strength.

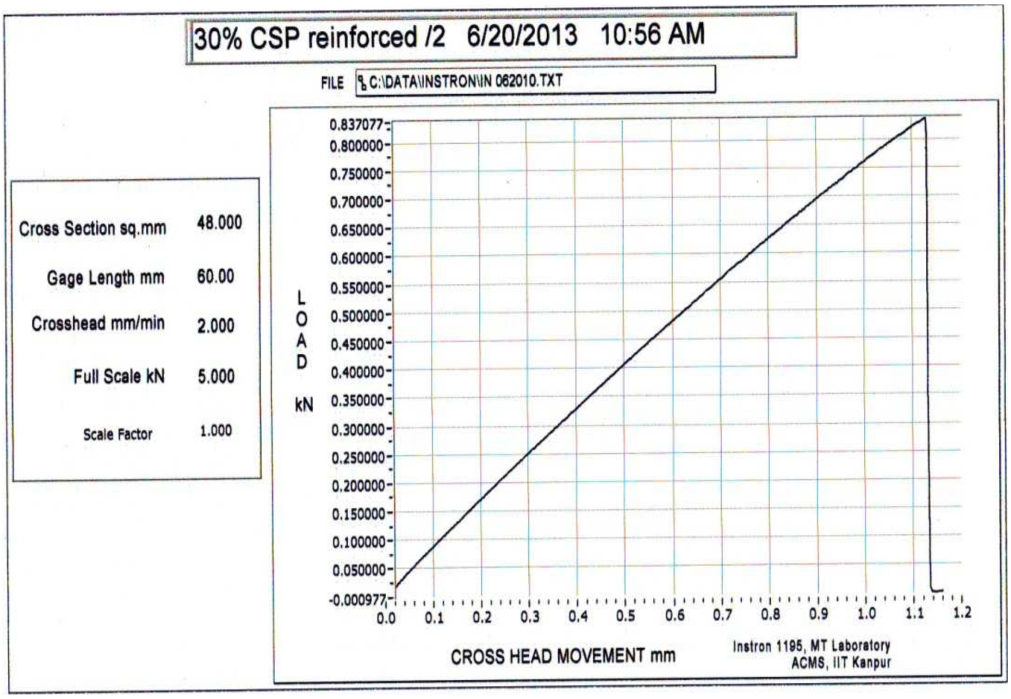

Figure 2: Load versus elongation curve of 30% CSP reinforced composite for tensile strength.

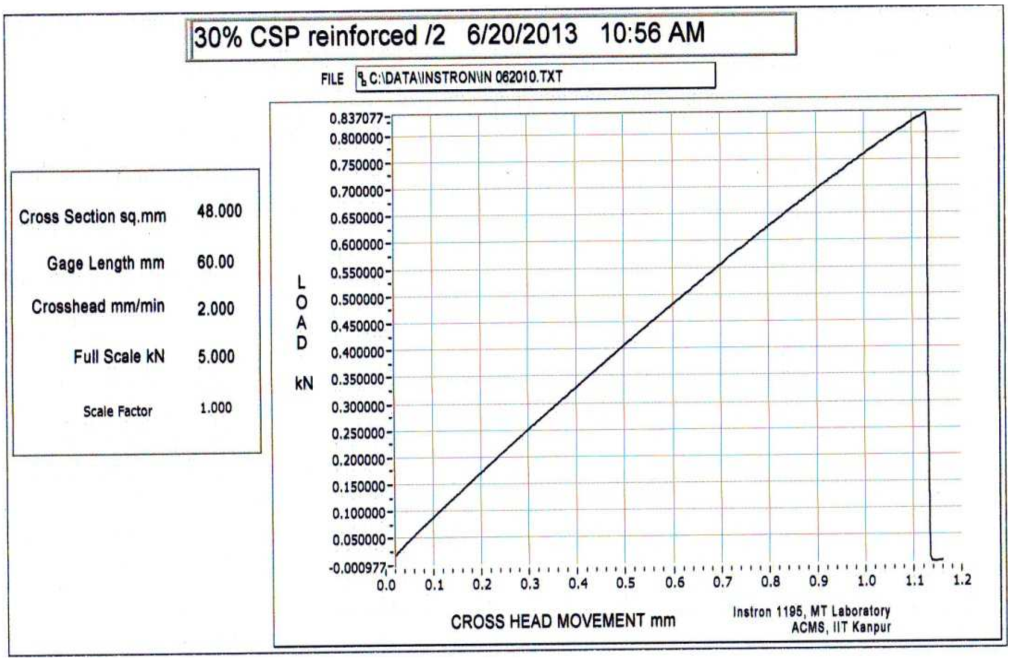

Figure 3: Load versus elongation curve of 40% CSP reinforced composite for tensile strength.

Table 2: Tensile Strength of Composite Sample.

S.No.	Composite Sample	Tensile Strength (MPa)
1	20% CSP Filled	21.55
2	30% CSP Filled	19.21
3	40% CSP Filled	16.45

The tensile strength results in table-2 for composite samples which are prepared with CSP filler in different volume fraction. The load versus elongation curve illustrates that, the maximum tensile strength is obtained for the composite prepared with 20% CSP volume fraction. The coconut shell powder reinforced polymer composite with the highest fraction of filler 40% has the lowest tensile strength 16.45 Mpa. This may be due to imperfect interfacial bonding between coconut shell powder particles and epoxy-resin to transfer the tensile stress.

The experimental curves for flexural strength from INSTRON 1195 testing machine of 20% CSP filled, 30% CSP filled and 40% CSP filled composites are shown in Fig-4, Fig-5 and Fig-6 respectively.

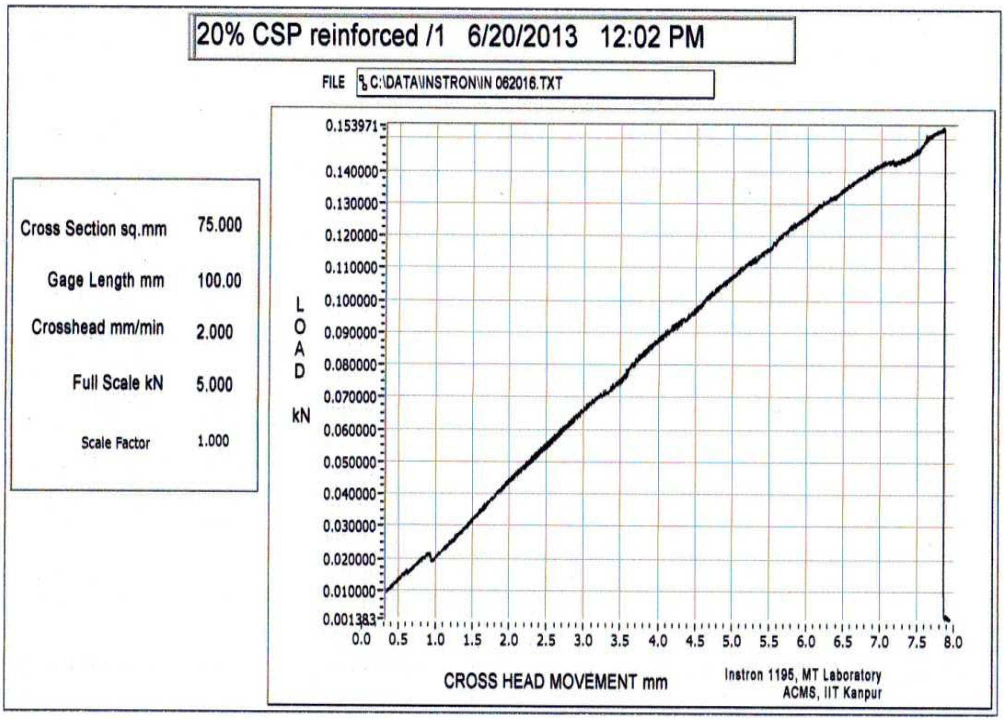

Figure 4: Load versus deflection curve of 20% CSP reinforced composite for flexural strength.

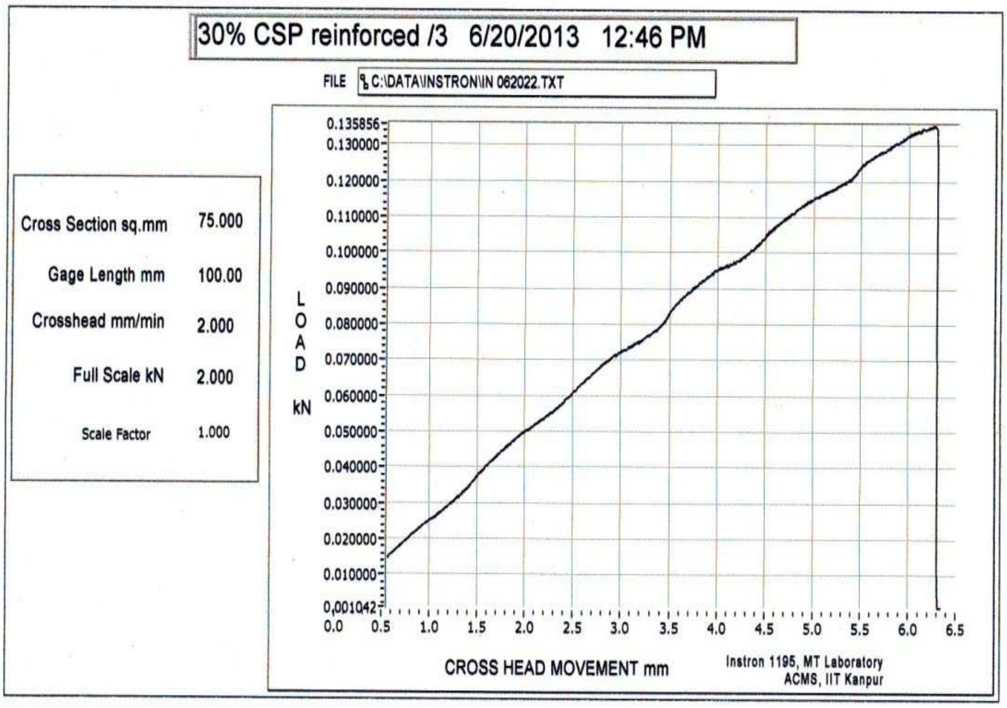

Figure 5: Load versus deflection curve of 30% CSP reinforced composite for flexural strength.

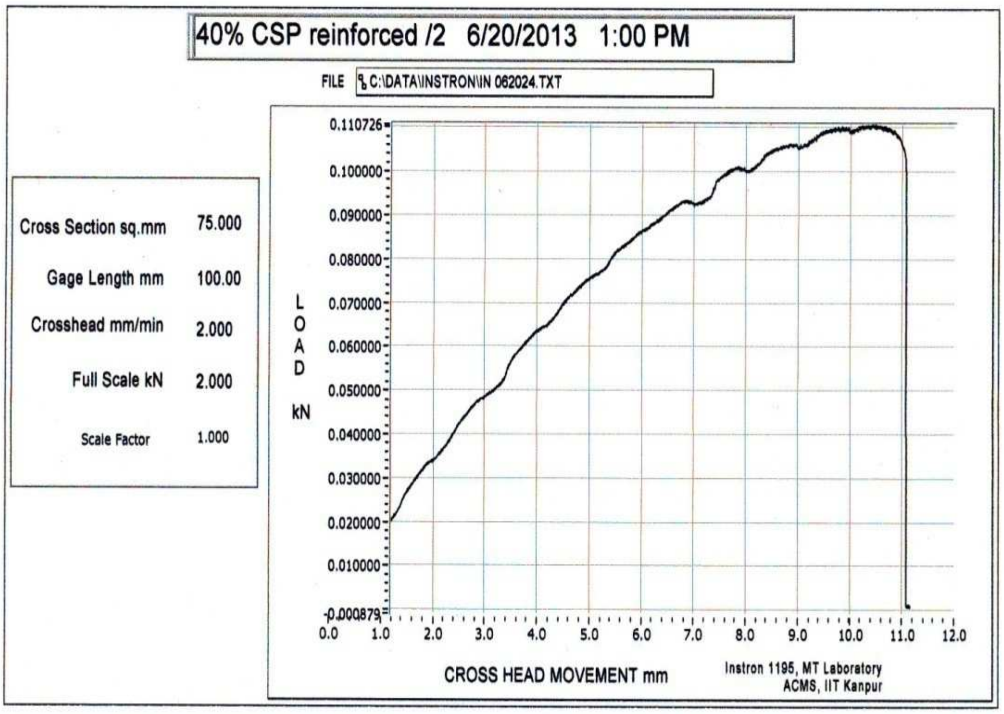

Figure 6: Load versus deflection curve of 40% CSP reinforced composite for flexural strength.

Table 3: Flexural Strength of Composite Sample.

S.No.	Composite Sample	Flexural Strength (MPa)
1	20% CSP Filled	91.25
2	30% CSP Filled	94.55
3	40% CSP Filled	78.95

The flexural strength results in table-3 for composite samples which are prepared with CSP filler in different volume fraction. The load versus deflection curve illustrates that, the maximum flexural strength is obtained for the composite 30% CSP filled volume fraction. Moreover, Composite samples had small or large defects owing to inhomogeneous dispersion of novel coconut powder which caused to concentrate the stresses locally, effectively causing a localized weakness. Therefore it is common for flexural strengths to be higher than tensile strengths for the same composite sample.

CONCLUSION

The experimental characterization of novel coconut shell powder reinforced composite leads to the following conclusions;

- The maximum tensile strength is obtained for the composite prepared with 20% CSP volume fraction.
- The maximum flexural strength is obtained for the composite prepared with 30% CSP filled composite whereas the minimum flexural strength is obtained for the composite prepared with 40% CSP filled composite.
- The composite prepared with 20% to 30% novel coconut shell powder reinforced can be used as an alternative material for the interiors of an aircraft, spacecraft, ships, motor car and automobile.

ACKNOWLEDGEMENTS

We are gratefully acknowledged to Advanced Center of Material Science (ACMS) Laboratory, Indian Institute of Technology, Kanpur, INDIA for providing Tensile and Flexural strength testing facility.

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