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Development of Natural Fiber Reinforced Recycled Polyethylene Composite

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Abstract : *Natural fibers are replacing man-made fiber in fiber-reinforced composites which have increased and opened up further industrial possibilities. Composites made from natural fiber like hemp, sisal, rice husk, bagasse, wood flour, jute, coconut etc. are economical, light weight, biodegradable, non-toxic as well as they does not leave residue or toxic byproducts on combustion. Hemp fibers are having resistance to water absorbing and have balanced ph. fiber Moreover, addition of compatiliser is necessary as they give desired mechanical and thermal properties to the composites. High density polyethylene (HDPE) was compounded with chemically treated Hemp fiber. Composite is checked for flexural and tensile properties. Both mechanical properties have approximate similar values to the virgin HDPE. With proper care in mixing and processing more progress can be made. Results show that we can use composite of hemp fiber in place of pure high density polyethylene in different places reducing the pollution to large extent.*
Keywords: *Composite materials, Hemp reinforced composites, Natural reinforced composites.*

I. INTRODUCTION

Over the last years natural composite materials have been the dominant emerging materials over plastics, fibres and ceramics. The volume and number of applications of natural composite materials have grown steadily, penetrating and conquering new markets relentlessly. [1,2,3] The composites should not be regarded simple as a combination of two materials." The interest in natural fibre-reinforced polymer composite materials is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable, and biodegradable. Their availability, renewability, low density, and price as well as satisfactory mechanical properties make them an attractive ecological usage for the manufacturing of composites.

Natural Fiber Reinforced Composite

Demand for sustainable materials and increased environmental concerns have paved a way for intense research in the field of natural fiber reinforced composites. Natural fibers are favored over synthetic fibers as reinforcement due to positive environmental benefits such as raw material utilization at source and easy disposable of the biodegradable fiber. Also natural fibers have been used during recent years as an alternative solution to the ever depleting petroleum sources. However, 100% replacement of natural fiber-based production with petroleum-based material cannot be an economical solution. [4,5] Finally, combining of petroleum and bio-based resources lead to the development of a cost-effective product with diverse applications. Besides Environmental benefits, natural fibers also provide advantages such as low cost, easy availability, low density, improved toughness and reasonable specific strength. Natural fibers such as hemp, flax, jute, and kenaf are frequently used as reinforcement due to their good mechanical properties. [6,7,8] Some other advantages of using natural reinforcements in composite materials includes biodegradability and renewability, lower specific weight and higher specific strength and stiffness compare with glass fibers (GFs), friendly processing and reduced wearing on tools, better working conditions without skin irritation, good thermal and acoustic insulating properties.

II. METHODOLOGY

Composites were prepared using treated hemp fiber and polyethylene matrix (fresh and recycled) on Injection Moulding Machine (Make: J.B. Industries Pvt. LTD, Model BH 100). [9,10] The weights of hemp fiber and HDPE layers were controlled to maintain composites with 7.5%, 15%, and 22.5% hemp fiber volume fraction. Table1 gives the details of material used for manufacturing of Specimen.

Table 1: Detail of material used for Specimen preparation

Hemp Fiber %age	**Density**	**Tensile PEwt (gm)**	**Fiber wt (gm)**	**Fiberwt. of 12sample**	**Wt. of PE for 12 sample**	**Wt. of fiber/100 gm of Sample**	**Flexural wt. (gm)**	**Fiber Wt (gm)**	**Fiber wt. For 12 sample**	**Wt. of PE for 12 sample**	**Wt. of fiber/100 gm of Sample**
7.5	0.9782	8.74555	0.6559	7.871	97.075	7.5	5.0477	0.3785	4.5429	56.0302	7.5
15	1.0165	9.08751	1.3631	16.357	92.692	15	5.2451	0.7867	9.4412	53.5004	15
22.5	1.0547	9.42946	2.1216	25.459	87.694	22.5	5.4425	1.2245	14.694	50.6153	22.5
			Total wt. (gm)	**49.688**	**277.46**				**28.679**	**160.146**	

[Density of Hemp 1.45 gm/cc, Density of HDPE 0.94gm/cc]

III. Evaluation Of Mechanical Properties

Energy There are different parameters for analyzing chaotic functions. The analysis of chaotic functions in terms of Average, Standard Deviation and Entropy has been done in this paper. [11,12,13] The brief introduction to these parameters has been presented here.

Subsequent to processing of specimen, the samples were tested to evaluate the mechanical properties like Tensile and flexural strength of hemp fiber reinforced polyethylene composite (HFRPC). The Average of five reading were taken as the Tensile and Flexural strength of specimen having different ratio of fiber and matrix as indicated in Table 1. The result obtained by tensile and flexural testing are summarized in Table 2

Table 2: Observation of tested samples

Tests	**S1**	**S2**	**S3**	**S4**	**S5**
	100% fresh PE	**50% fresh + 50% recycled PE**	**7.5% hemp + 92.5% (fresh + recycled) PE**	**15% hemp + 85% (fresh + recycled) PE**	**22.5% hemp +77.5% (fresh+ recycled) PE**
Tensile strength (MPa)	21.26	16.39	20.95	19.97	19.60
Flexural strength (MPa)	12.27	19.45	16.69	17.62	18.98

Tensile Strength

Tensile properties of hemp fiber (NaOH treated) hemp-HDPE composite, with different fiber loading, were estimated according to ASTM D 638 standard. Figure 3 & 4 shows the comparison of tensile strength of various specimens-S3, S4, S5 having 7.5%, 15%, 22.5% fiber contents respectively, with **S1** having 100% fresh HDPE and S2having equal proportion of fresh and virgin HDPE

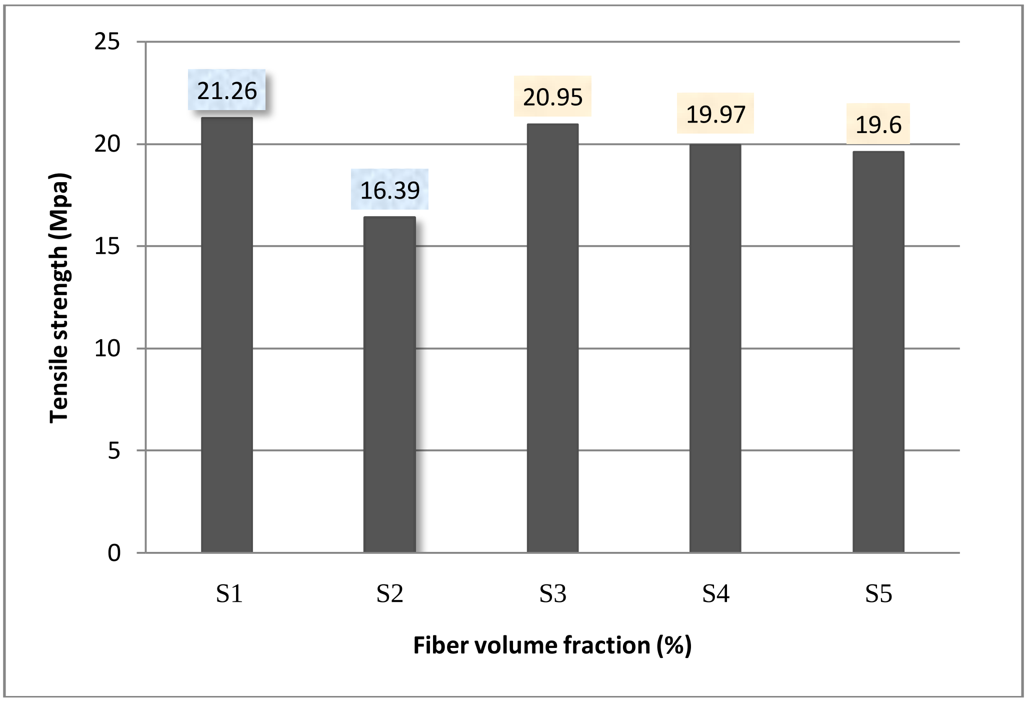

Figure 3

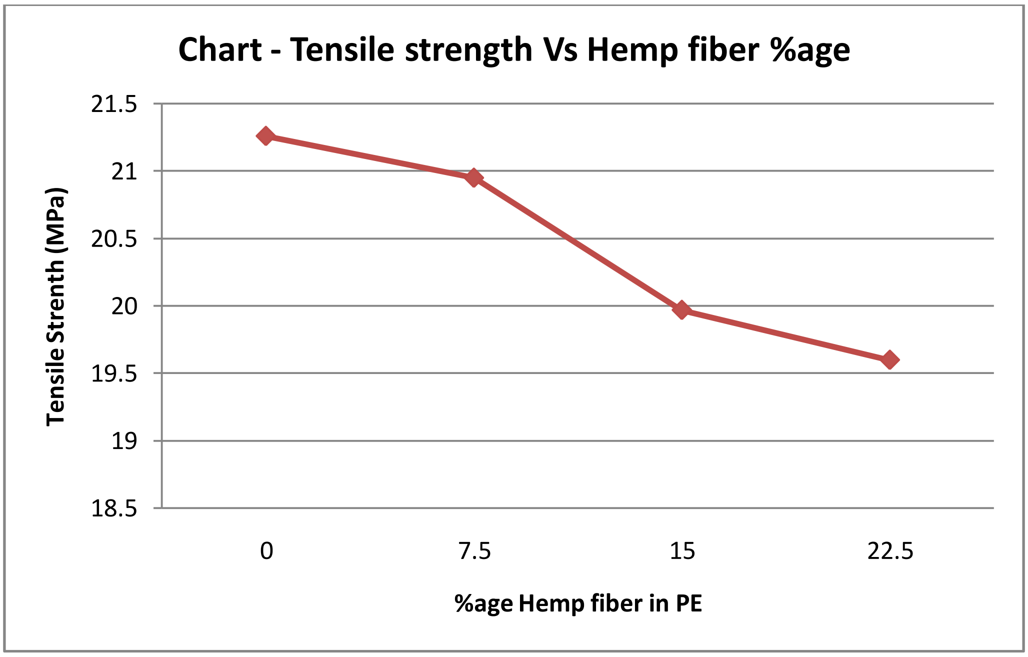

Figure 4

Flexural Strength

Flexural strength of discontinuously and randomly oriented hemp-HDPE composites with different fiber loading and HDPE samples was obtained in accordance with ASTM D 790 standard. Figure 5 shows the flexural strength of various samples.

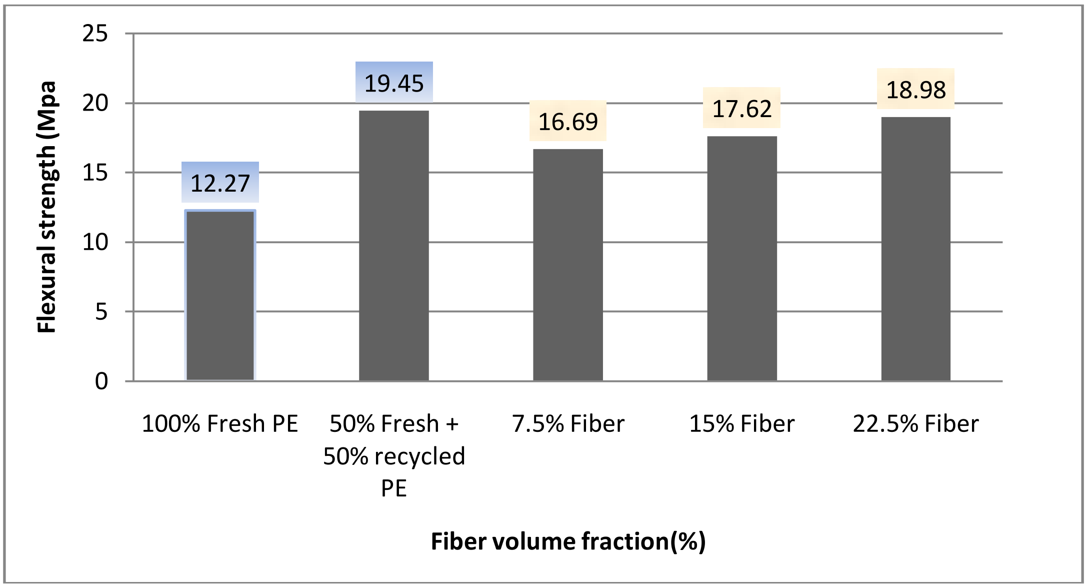

Figure 5

IV. CONCLUSION

- Hemp fiber reinforced polyethylene composite (HFRPC) could be successfully manufactured by injection molding technique and can be used in place of Pure 100% HDPE components.
- The reinforcement of hemp fibers into HDPE matrix reduces the tensile strength marginally. The tensile strength of the composite decreases by 0.31 Mpa to 1.66 Mpa with the increase in fiber content from 7.5% to 22.5% respectively when compared with specimen made of fresh HDPE. However, Margin decrease of tensile strength in Natural Fiber Composite can be overcome by controlling process parameters, mixing material with fibers properly.
- The flexural strength increases with the addition of hemp fibers into HDPE matrix having equal proportion of virgin and recycled HDPE with respect to 100% pure virgin HDPE polymer. The flexural strength of composites containing 7.5%, 15% and 22.5% hemp fiber are respectively increased by around 4.42 Mpa and 6.71 Mpa when compared with specimen made fresh HDPE.
- Fiber delamination, fiber tensile fracture and poor interfacial adhesion between hemp fiber and HDPE matrix are mainly responsible for poor tensile strength of the composite as compared to specimen having equal amount of virgin and recycled HDPE.

REFERENCES

[1] M. Faris AL-Oqla., Sapuan S.M., Natural fibre reinforced polymer composites in industrial applications: feasibility of date palm fibres for sustainable automotive industry, Journal of cleaner production, 2013.
[2] Lopez J.P., Vilaseca F., Processing and properties of biodegradable composites based on mater-bi and hemp core fibres, Resources Conservation and Recycling, 2012, pages 38-42.
[3] Kabira M.M., Wanga H., Laua K.T., Cardonaa F., Effects of chemical treatments on hemp fibre structure, Applied Surface Science, volume 276, 2013, pages 13-23.
[4] Domenico Asprone, Massimo Durante, Andrea Prota, Gaetano Manfredi, Potential of structural pozzolanic matrix–hemp fibre grid composites, Construction and Building Materials, volume 25, 2011, pages 2867-2874.
[5] Marianne Le Troedec, David Sedan, Claire Peyratout, Influence of various chemical treatments on the composition and structure of hemp fibres, Composites Part A: Applied Science and Manufacturing, volume 39, issue 3, 2008, pages514-522.
[6] F.X. Espinach, F. Julian, N. Verdaguer, Ll. Torres, M.A. Pelach, F. Vilaseca, P. Mutje, Analysis of tensile and flexural modulus in hemp strands/polypropylene composites. Composites Part B: Engineering, volume 47, 2013, pages 339-343.

[7] Ochi Shinji, Development of high strength biodegradable composites using Manila hemp fibre and starch-based biodegradable resin, Composites Part A: Applied Science and Manufacturing, volume 37, issue 11, 2006, pages 1879-1883.
[8] Sabbagh El. A., Effect of coupling agent on natural fibre in natural fibre/polypropylene composites on mechanical and thermal behavior, Composites Part B: Engineering, volume 57, 2014, pages 126-135.
[9] Kabir M.M., Wang H. and Cardona F., Effect of chemical treatment on the mechanical and thermal properties of hemp fibre reinforced thermoset sandwich composites.
[10] Kaczmar W. Jacek, Pach Joanna, Burgstaller Christoph, The chemically treated hemp fibres to reinforce polymers, Polymery, volume 56,2011,pages11-12.
[11] Le M., Rachini A., Influence of chemical treatments on adhesion properties of hemp fibres, Journal of Colloid and Interface Science, volume 356, 2011, pages 303-310.
[12] Sawpan Moyeenuddin A., Pickering Kim L., Effect of various chemical treatments on the fibre structure and tensile properties of industrial hemp fibres, Composites Part A: Applied Science and Manufacturing, volume 42, 2011, pages 888-895.
[13] Lu Na, Oza Shubhashini, A comparative study of the mechanical properties of hemp fiber with virgin and recycled high density polyethylene matrix, Composites Part B: Engineering, volume 45, 2013, pages 1651-1656.