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Some Experimental Study of Hen Quills Composite Material

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Abstract

Market demands environmental friendly fibrous materials which enables composite materials to be manufactured. Composites have already proven their worth as weight saving materials; the current challenge is to make them cost effective. Natural fiber composites can easily be recycled than glass fiber or carbon fiber composites. The natural fibers are currently extracted from plants like sisal, jute, and palm etc. wood-thermoplastic composites products are growing rapidly. Major markets are decking materials, pallets, automobiles and building materials. Animals can also provide a source of fibers. The animal products like hair, bird's feathers, quills etc can be used as fiber materials. Natural Fiber composites can easily be recycled than glass fiber or carbon fiber composites. It is anticipated that by incorporating quill particulates into polypropylene/epoxy resin matrix, the composite materials can be produced which can give good mechanical with low weight. Also the quill being the waste product of the poultry industry, the final cost of the composite product will be too low compared to other biological composite material. Mean while the problem of poultry solid waste handling can be solved. To aid the development of successful applications for poultry feather fiber in composite making; this work has been taken up. The objective is to develop processing and testing of hen quill as a reinforced material for composite making and investigation of its tensile strength also comparison with different orientation.

Keywords: Natural Fibers, Hen Quills, Composite Material.

Introduction

Natural fibers are environmentally friendly, fully biodegradable, abundantly available, renewable and cheap also has less density. Natural fibers pose no health hazards and finally, provide a solution to environmental pollution can be achieved through proper selection of fiber type, fiber orientation and fiber reinforcement form. [1]. currently, the abundant quantity of poultry feathers produced annually by the poultry industry as a waste which can be effectively used as a reinforcing material. Finding new uses for waste materials. A wide variety of properties Around 24 billion chickens are killed per year across the world, which are discarded around 8.5 billion tons of feathers, in which India's contribution alone is 400 million tones. India was ranked the fifth largest poultry producer in the world [2-4]. Chicken feathers are approximately half feather fiber and half quill (by weight). The feather fiber and quill are both made from hydrophobic keratin, a protein that has strength similar to nylon and a diameter smaller than wood fibre [5].The fiber is more durable and has a higher aspect ratio than the quill. Feathers can't be taken from the chicken and made directly into new materials [5-8]. The stiff central core of the quill must be stripped of from the barbs. This soft barb material can be used as reinforcing material. Although the whole feather is made of keratin, the crystal structure of the protein in the brittle central quill is different from that in the soft but durable barbs; only the barbs have the desirable properties [8-12]. Feather barbs are too short to allow them to spin into thread and woven into cloth, but they can be mixed with man-made materials to prepare slab or mat of randomly oriented type. The length of the barbs is depending on the region location along the rachis. The barbs located at the base of the rachis are so long than those at the tip [13]. A physical and mechanical property of the chicken feather depends upon the percentage of keratin protein present, which generally varies with ecological condition of the bird [14].

Experimental Approach

Sample collection

Chicken feathers were obtained from poultry farm in the Kolhapur, Maharashtra, India.

Cleaning of hen quill

Hen quill directly collected from a chicken processing plant or slaughterer are always dirty and contain various foreign materials, such as skin, blood, feces and flesh. Initially feathers were washed many times with hot water with detergent and dried as shown in figure 1. After drying quills were separated by stripping from barbs, since they differ physically. Initially barbs were mechanically treated to convert them into wool form and used suitable straining device to separate out coarser elements. Then the fibers are cleaned in running water and dried. It is shown in figure 2.

Figure 1: Raw Hen Quills after Cleaning

A solution was prepared in a glass beaker by adding 6% NaOH to distilled water. Mechanically treated and dried fibres were soaked in a solution for three hours and then washed in running water. These were dried for 10 hours in natural light. These barb fibres were used for estimating physical properties like density, aspect ratio and strength.

Figure 2: Soaking and Drying Of Hen Quills

By using sharp tools like blades and seizers barbs were separated from the quill fibers and collected separately. Due to the problem to get the composite material in various or complex shapes it require crush the quill fiber by using plastic crushing machines used in plastic industries or by using domestic mixer, and mix it with barbs to get mixture suitable to make mat's.

Hen quills diameter

For each chicken feather 10 samples were randomly chosen for measurement and the mean was calculated. The diameter of the feather fractions were measured at three different points along each fraction using an microscope. The average diameter of each fraction was calculated and was considered as the fibre diameter. [1].

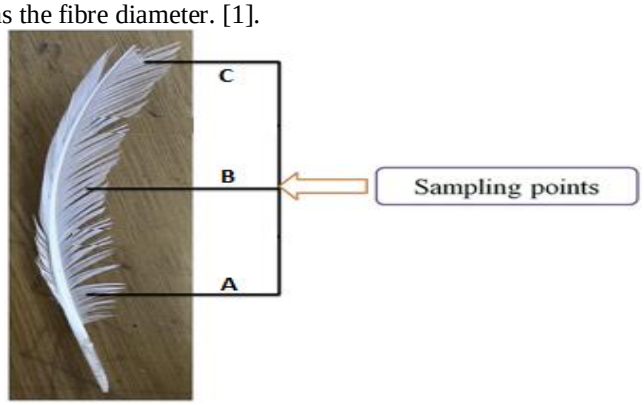

Figure 3: Single Hen quill

Table 1: The Dimension and Measuring Of the Randomly Selected Quills

Samp-les	Measuremen-t at different points	Diameter in mm	Mean diameter	Leng-th in cm
1	A	2.66	1.74	15.4
	B	1.83		
	C	0.73		
2	A	2.17	1.31	14
	B	1.16		
	C	0.59		
3	A	1.66	1.31	11.4
	B	1.68		
	C	0.59		
4	A	2.56	1.65	14
	B	1.67		
	C	0.72		
5	A	2.66	1.66	12.9
	B	1.65		
	C	0.66		
6	A	2.07	1.4	13.5
	B	1.5		
	C	0.63		
7	A	2.4	1.51	12.5
	B	1.63		
	C	0.5		
8	A	2.42	1.53	14
	B	1.53		
	C	0.64		
9	A	2.44	1.46	15
	B	1.47		
	C	0.46		
10	A	2.44	1.41	14.1
	B	1.33		
	C	0.46		

Sample preparation

Specimen is made with additive such as hardener and resin as a binding material. Specimen shape flat with width 75mm and thickness is 15mm. The feathers were dried and conditioned at a relative of humidity 65 ± 2% and a temperature of 20 ± 20C. The barbs were separated from the rachis manually by cutting with scissors. [8]. the cutting of fibres was performed near the rachis so as not to lose length and the natural properties due to the format of the fibre along the extension [15].

Hand lay-up is the oldest and simplest method used for producing reinforced plastic laminates. Capital investment for hand lay-up process is relatively low. There is virtually no limit to the size of the part that can be made. The Hen quills reinforcement which is normally in the form of a woven cloth or chopped strand mat or crushed material is laid first. The plastic resin mixed with hardener is then applied by using brush. Rollers are used to thoroughly wet the resin matrix material to enable good compaction and to remove entrapped air. To increase the thickness of the composite material being produced; more layers of the fiber and resin are added.

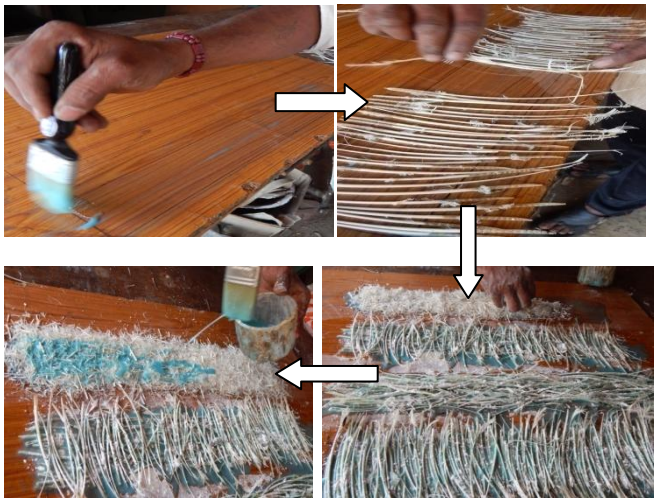

Figure 4: Process of Sample Preparation

Measurement of resign and hardener in some proportion. The proportion is for 100ml of resign, the hardener is 50ml. The proportion is same for all sample. When resign and hardener is mixed in bowl, steer for 2 to 3 minutes. After 2 to 3 minutes the mixture is ready for next step.

Sample orientation

The hen quills is put in different orientation such that,

A] Random orientation.
B] Matrix orientation
C] 90 degree orientation
D] 0 degree orientation (straight)

Figure 5: orientation of Samples

Calculation for chicken feather

The average diameter = 1.656 mm
Length = 154 mm
The maximum load carried:-35 N
Extension at maximum load: - 0.375 mm
Tensile stress = 16.2501N/mm^2
Young's modulus = 43.3337 N/mm^2

The curing time of this mixture is two hours. After pouring the resign and hardener into the mould, the mould is stay in stable condition. When the mixture is solidified it is removed from mould. This fiber is cut into different dimensions the fiber is ready for testing

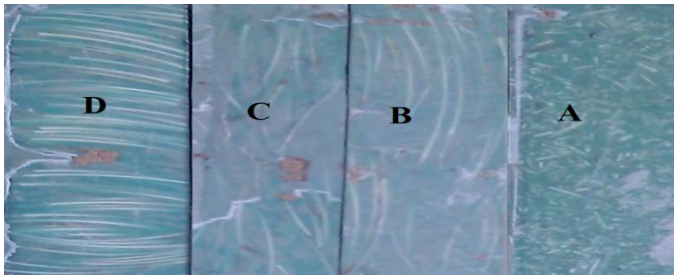

Figure 6: Ready Samples for Testing

Figure 7: UTM (Universal Testing Machine)

Result Table:

Table 2: Shows Effect Of Parameters With Different Orientation

	Samples orientation				Unit
	Random	**Matrix**	**90^0**	**0^0**	
Load at yield	20.17	16.34	19.4	18.81	KN
Elongation yield	4.650	0.140	1.290	2.250	mm
Yield stress	17.929	14.524	17.244	16.72	N/mm2
Load at peak	22.240	20.430	24.330	21.500	KN
Elongation at peak	6.580	2.760	3.020	4.840	mm
Tensile strength	19.769	18.160	**21.627**	19.111	N/mm2
Load at break	15.240	17.180	15.370	15.610	KN
Elongation at break	6.680	3.05	3.110	4.890	mm

Conclusion

Form above result we conclude that 90 degree orientation has more tensile strength 21.627 N/mm2 compare with other orientation. All quill samples behaves like an elastic material, and also it was observed that, material having good stiffness since, it has represented very less elongation This fiber material is used in home appliances components. This composite material having better mechanical properties compare to composite material made by hair, wood and plastic.

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