OPENING MINDS:
RESEARCH FOR SUSTAINABLE
DEVELOPMENT

Producing Claddings and Partition Boards Using Induru Fibre

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1 INTRODUCTION

The increase in environmental consciousness and community interest, the new environmental regulations and unsustainable consumption of petroleum, has resulted in the need to use environmentally friendly material. Natural fibres are considered one of the most environmentally friendly materials which have good properties compared to synthetic fibres. Recently, there has been a rapid growth in research and innovation in natural fibre composites for so many products in various industries. On the other hand, natural fibres are renewable, replaceable and have a low environmental impact. These fibres can be produced at a lower cost than synthetic fibres and show low hazard levels in manufacturing. This study focused on the retting methods of fibres, properties of the fibres, bleaching and dyeing of the fibres and the method of developing composite and its properties. The composite was developed using Induru Fibre *(Hanguana malayana)* with unsaturated polyester resin and the fibres were randomly orientated in composites.

2 METHODOLOGY

2.1 Extraction of Fibres

Different fibre retting methods were analysed to identify the most relevant retting method. Chemical retting with NaOH was identified as the most significant method.

2.2 Testing of Fibre Properties

Tensile strength was tested by using Pressley fibre strength tester under ASTM D1445. The moisture content (MC) and moisture regain (MR) of the fibre were tested according to the standards ASTM D2495-07 and ASTM D1776-15 respectively.

2.3 Development of Composites

The composite was developed by using unsaturated Polyester resin, catalyst and mature vein fibres of Induru plant. Based on the weight of fibres 50%, 55%, 60%, 65%, 70% and 75% were used in this experiment while keeping the length of fibres constant. The fibres were arranged in a random orientation.

2.4 Preparation of the Specimen of Composites

Initially a wooden mould was lubricated and then filled with the mixture of fibre and resin. Then the composite was compressed to remove excess resin. The prepared composite was kept for 24 hours for curing under room temperature and then the composite was de- moulded.

2.5 Testing of Composite Properties

The tensile strength of the composite was tested according to the ASTM D638-03 standard. Six specimens were tested for different fibre loading (Table 2) and the average strength was calculated. The impact strength of the composite was tested according to the standard ASTM D256.

There were five samples tested at room temperature and the other sample was frozen with water below 0^0C. Five samples were tested and the average impact strength was calculated. The water absorption of the composite was tested under the ASTM D570-98 standard and the calculations were done according to the standard.

The workability factor of the composite was tested to prove the ability to work with composite.

3 RESULTS AND DISCUSSION

3.1 Results of Fibre Properties

During the study the fibre properties such as tensile strength, moisture content and moisture absorption properties were tested.

3.1.1 Tensile Strength of Induru Fibres

Table 1 shows the test results of tensile strength of the Induru fibres. The Pressley Index (PI) of Induru fibres was calculated using

PI= Bundle strength in lbs/Bundle weight in mg--- (1)

Then, the tensile strength was calculated based on the following method.

Estimated tensile strength (g/tex) = 5.36 x PI = 5.36 x 5.71 = 30.61 g/tex

Table 1: Tensile strength of Induru fibres

Sample No.	Bundle strength in Lbs	Bundle weight in g	Bundle strength in Lbs/Bundle weight in g	Bundle strength in Lbs/Bundle weight in mg
1	15.2	0.0029	15.2/0.0029	5.24
2	10.6	0.0021	10.6/0.0021	5.05
3	7.9	0.0017	7.9/0.0017	7.65
4	8.9	0.0017	8.9/0.0017	4.88
5	9.7	0.0017	9.7/0.0017	5.71
			Average PI	5.71

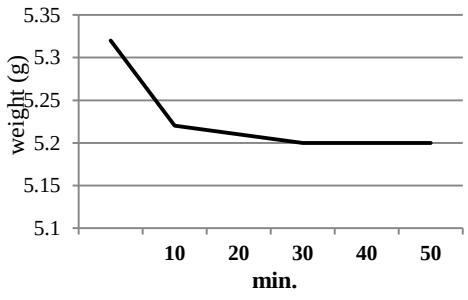

Figure 1: Variation of weight of the fibre sample over the time (minutes)

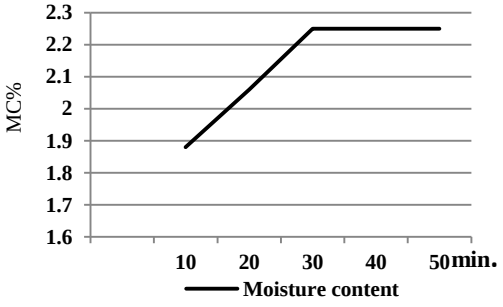

Figure 2: Moisture content of Induru fibre

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3.1.2 Moisture Absorption and Moisture Regain of Induru Fibres

Figure1 shows that the oven dry weight of the sample varies with the drying time in an oven. According to the figure, the oven dry weight comes to a constant level after 30 minutes.

Figure 2 show the moisture content (MC) of Induru fibre change with time and they reached to constant level after 30 minutes. The study shows the moisture content of Induru fibre as 2.256%.

3.2 Results of Composites

3.2.1 Tensile Strength of Composites

Table 2 shows the breaking loads which represent the tensile strength of composites. According to Table 2 the optimum breaking load can be achieved by adding 60% of fibre proportion, (40% resin + catalyst) because at this percentage the maximum load of 259 N and the maximum elongation of 10% were reported. Elongation was reduced when the fibre weight was increased more than 60% or decreased less than 60%. The breaking load of composite was directly proportional to the weight of fibre percentage of the composite.

Table 2: Breaking load of composites

Sample No	Fibre proportion (%)	Breaking load (N)	Breaking elongation %
1	50	234N	5
2	55	240N	10
3	60	259N	10
4	65	273N	7
5	70	286N	3
6	75	293N	4

3.2.2 Impact strength of composite

Impact strength of the composite was tested using the Charpy Impact strength tester. Table 3 shows the impact strengths of composites, which were tested under room temperature as well as in temperature below 0^0C to check whether the strength difference can be observed. It does not exhibit significant variation. Therefore, it can be recommended that this composite can be used even in cold weather conditions without changing the impact strength.

Table 3: Impact strength of composites

Sample No:	Impact Strength at Room Temperature in (J)
1	0.91J
2	0.80J
3	0.84J
4	1.01J
5	0.90J
Average	0.892J

3.2.3 Water absorption of composites

The percentage increase in weight during immersion was calculated as given below.

$$\text{Increase in weight \%} = \frac{\text{wet weight} - \text{conditioned weight}}{\text{conditioned weight}} \times 100$$

$$= \left(\frac{12.5671 - 12.4013}{12.4013}\right) \times 100 = 1.3369\%$$

The percentage of soluble matter lost during immersion was calculated as given below.

$$\text{Soluble matter lost \%} = \frac{\text{conditioned weight} - \text{reconditioned weight}}{\text{conditioned weight}} \times 100$$

$$= \left(\frac{12.4013 - 12.4013}{12.401}\right) \times 100 = 0\%$$

The percentage of water absorbed by composite was calculated as given below.

= [Increase in weight % + soluble matter loss %] = 1.3369%

According to the above calculations given in the standard the percentage increase in weight during immersion in water was 1.3369%, the percentage of soluble matter lost during immersion was 0% and the percentage of water absorbed by composite was 1.3369%. The relative rate of water absorption of this composite is about 1% and according to the above test results it exhibited very poor water absorption.

3.3 Workability factor of the composites

The workability factor of the composite is an important factor to consider. The composite was in better condition and work station tests proved that the composite is able to saw, grind, drill and file without presenting any cracks on the surface.

Sawing **Grinding** **Drilling** **Filling**

Figure 2. Tested workability factors of the composites

4 CONCLUSIONS

The estimated tensile strength value of the Induru fibre using Pressley Index tester was 30.61 g/tex and the moisture content of the fibre was 2.25%. The study shows that tensile strength of the composites varied according to the fibre loading and the highest breaking load observed was 293 N and the highest breaking elongation was 10%. The average impact strength of the composite was 0.892J. Water absorption percentage of the composite was 1.3369%. The composite structure was able to saw, grind, drill and file according the work station tests.

Acknowledgment

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