DEVELOPMENT OF COMPOSITE MATERIAL MADE OF PALF AND OATS WITH POLYESTER RESIN

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Abstract - *The development of particulate composite based on pineapple leaf fiber and oats powder is to be carried out. Pineapple leaf and oats powder is taken as reinforcement in polyester resin matrix. The particulates are to be added in different composition. Their mechanical properties is to be tested by addition of pineapple leaf and oats powder. The mechanical properties can be checked by standard methods. By the reference of journals it has been noted that the properties are increasing by particulate addition. Properties of the composite by combination of the two particulate reinforcements are to be tested. Hence the development of composites material with good mechanical properties and light weight which is relevant to the auto and building industries can been achieved*

1. INTRODUCTION

Composite materials are made up of two or more constituent materials that work together to deliver the desired qualities. Two or more constituent materials make up a composite material, which can have more desirable qualities than separate materials. There are two stages to do it. Matrix phase: In a composite, the matrix phase is a continuous phase. Polymer, metal, or ceramic are all possibilities. Among these, polymer is the best in terms of mechanical and thermal qualities, as well as cost. The reinforcing phase is the composite's dispersion phase. Natural fibre, particle, and other reinforcing materials are available.

When compared to individual materials, composite materials have superior mechanical qualities. A composite material produces a new material with outstanding mechanical and thermal qualities that a single material cannot match. Natural fibre reinforced polymer composites are becoming increasingly popular for low-cost constructions and building applications. In many areas where natural fibres are abundant, scientists and engineers use appropriate technology to economically employ such fibres in the development of high-quality fibre reinforced polymer resin composites for construction and other applications.The fibres should be totally segregated from one other and surrounded by polymer matrix in a suitable distribution. As a result, there is a demand for the development of fibre reinforced polymer composites as a substitute for rare wood and synthetic fibres. Natural fibres have a low density, which means they are more efficient and emit less pollution than other materials. Composites are made up of a polyester resin matrix and natural fibres as reinforcement medium in this project. The research is centred on the creation of a composite consisting of palf (pineapple leaf fibre), oat powder, and polyester resin. Palf has good mechanical qualities and is environmentally sustainable, which has piqued researchers' interest in using it as a potential reinforcement in structural and non-structural applications.

2. METHODOLOGY

1. Selection of matrix phase and reinforcing phase.
2. Fabrication of the mould.
3. Cleaning and Production of the material to the required form.
4. Preparation of the specimen with required quantity
5. Conducting the tests with the specimens.

2.1 PREPARATION OF SPECIMEN

To prepare the specimen with the given percentage distributions,

1. 10 % Palf + 90% Polyester resin
2. 20% Palf + 80% Polyester resin
3. 30% palf + 70% Polyester resin
4. 7.5% palf + 2.5% Oats + 90% Polyester resin
5. 12.5% palf + 2.5% Oats + 85% Polyester resin
6. 17.5% palf + 2.5% Oats +80% Polyester resin

For the preparation of specimen, the following steps to be followed;

- In the measuring vessel take appropriate amount (depending on the weight of PALF/ OATS to be added) of polyester resin and mix well with the cobalt.
- After mixing well, add the weight percentage of oats to the mixed resin.
- Mix it well until it gets uniformly distributed.
- Then add 2-5 ml of accelerator to the mixture and stir it well.
- Then poured the half amount of mixture to mold.
- Place the PALF along the poured mixture.
- Finally pour remaining mixture and allow them to cure.
- After curing we can remove the material from the mould.
- It took about 24 to 48 hours for the POP to set and the polyester resin takes 12 hours to cure properly.

The specimens are prepared according to the specimen standards. ASTM standard**s** for given specimens

- Tensile test: ASTM D 638
- Flexural test: ASTM D 790.

Size of the given specimens

- Tensile test: 165x13x3mm
- Flexural test: 125x12x3mm

3. TEST CONDUCTED

3.1TENSILE TEST

Tensile testing is a fundamental materials science and engineering test in which a sample is subjected to a controlled tension until failure. Properties that are directly measured via a tensile test are ultimate tensile strength, breaking strength, maximum elongation and reduction in area. The tensile test specimen is prepared according to the ASTM D638standard. According to the ASTM D638 standard the dimensions of specimen used are 165x19x13. The thickness were reduced using filing,

Fig 1 – Tensile test specimen

3.1FLEXURAL TEST

The three-point bending flexural test provides values for the modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress–strain response of the material. This test is performed on a universal testing machine the sample is placed on two supporting pins a set distance apart. The flexural test specimen is prepared according to the ASTM D790. According to the standard the dimension of the specimen is 125x12x3.

Fig 2- Flexural test specimen

3.3 WATER ABSORPTION TEST

Water absorption is used to determine the amount of water absorbed under specified conditions. Factors affecting water absorption include: type of material, additives used, temperature and length of exposure. For the water absorption test, the specimens are dried and measure the weight of the specimens. The material is then immersed in water at room conditions, 72 hours. The Specimens are removed and weighed**.**

Fig 3- Water absorption test

4. RESULTS AND DISCUSSIONS

4.1 TENSILE TEST

The table shown below is the result of specimens obtained in the test. The values obtained are in the respective order specimen (1) 10 % Palf + 90% Polyester resin, specimen (2) 20% of Palf + 80% of Polyester resin, specimen(3) 30% Palf + 70% Polyester resin, specimen(4) 7.5% Palf +2.5% oats + 90% Polyester resin, specimen(5) 12.5% Palf + 2.5% oats + 85% Polyester resin, specimen(6) 17.5% Palf + 2.5% oats + 80% Polyester resin.

Table -1: Tensile test

SL NO:	Ultimate Load (N)	Change in length (mm)	Tensile strength (Mpa)	Tensile strain
1	608.4	1.1	15.6	0.0068
2	671.89	1.34	17.226	0.0083
3	680.61	0.73	17.451	0.00456
4	656.76	1.3	16.84	0.00812
5	743.1	0.7	17.18	0.0071
6	791.13	0.77	17.39	0.0075

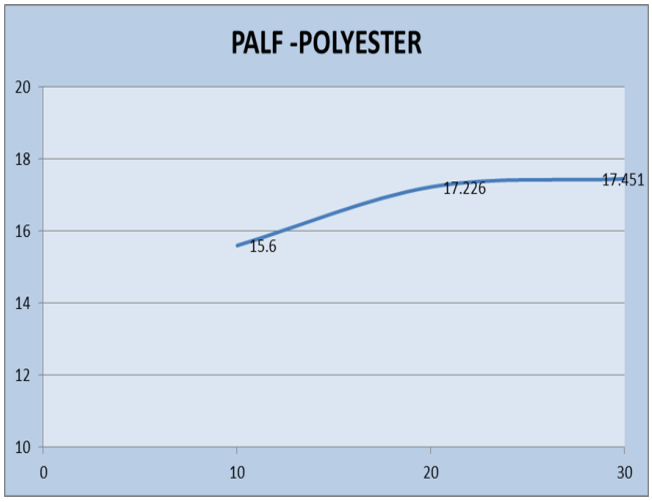

Fig 4- Graph of specimens (1),(2) and (3) containing % of palf –polyester resin v/s tensile strength

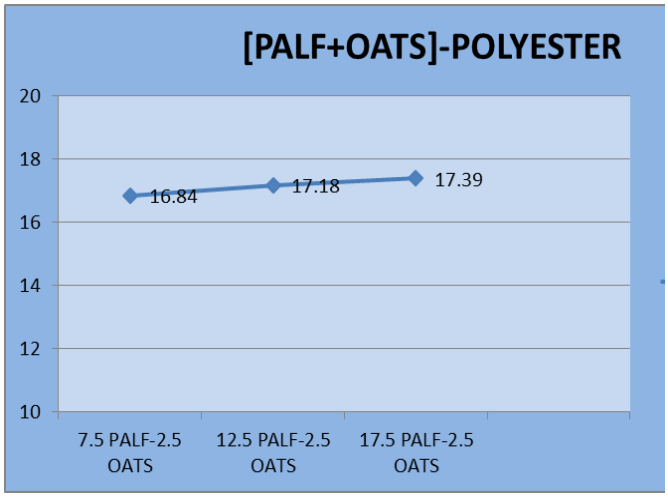

Fig 5- Graph of specimens containing % of Palf – oats with resin v/s tensile stress

From table, it is clear that the composite of palf and polyester resin shows a tensile strength of 15.6 Mpa to 17.45 Mpa from 10% of natural fiber composition to 30%.In which the ranging from 20% to 30% showed a good tensile strength. The composite of palf and oats with resin shows gradual increase in tensile strength from 16.84 Mpa to 17.39 Mpa which ascends from 10% to 20% addition.

4.2 FLEXUURAL TEST

The table shown below is the result of specimens obtained in the test.The values obtained are in the respective order specimen(1) 10 % Palf + 90% Polyester resin, specimen(2) 20% of Palf + 80% of Polyester resin, specimen(3) 30% Palf + 70% Polyester resin, specimen(4) 7.5% Palf +2.5% oats + 90% Polyester resin, specimen(5) 12.5% Palf + 2.5% oats + 85% Polyester resin, specimen(6) 17.5% Palf + 2.5% oats + 80% Polyester resin.

SL NO	Ultimate load (N)	Deflection (mm)	Flexural strength (Mpa)	Flexural strain
1	91.3	3.41	38.04	0.01705
2	104.3	3.21	43.45	0.01605
3	108.5	3.83	45.28	0.01915
4	87.6	3.3	36.5	0.0165
5	90.2	3.42	37.58	0.0171
6	92.7	2.96	38.62	0.0148

Table -2: Flexural test

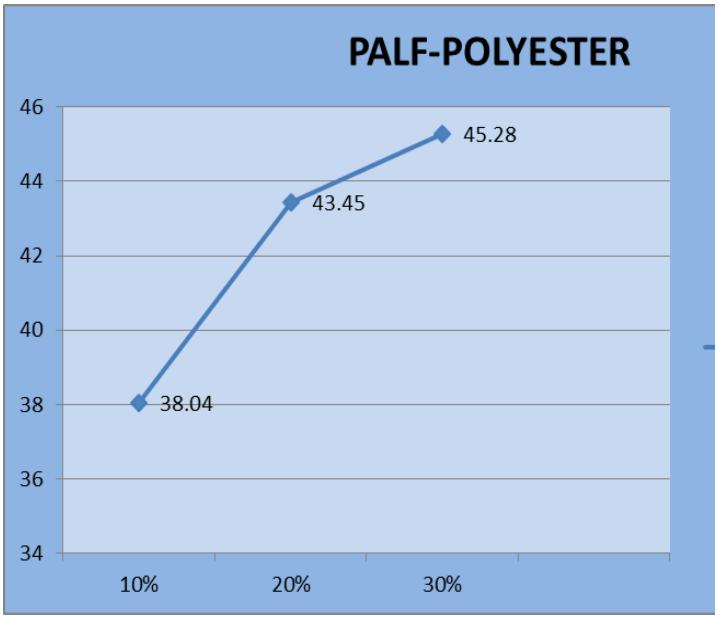

Fig 6-Graph of specimens (1), (2) and (3) containing % of palf –polyester resin v/s flexural strength

From the table, the composite of palf and polyester shows a flexural strength of 38.04 Mpa to 45.28 Mpa from 10% of palf composition to 30%. And palf + oats composite has flexural strength ranging from 36.5 Mpa 38.62 Mpa. From 10% to 30% natural fiber composition which was slightly less compared to palf and polyester resin.

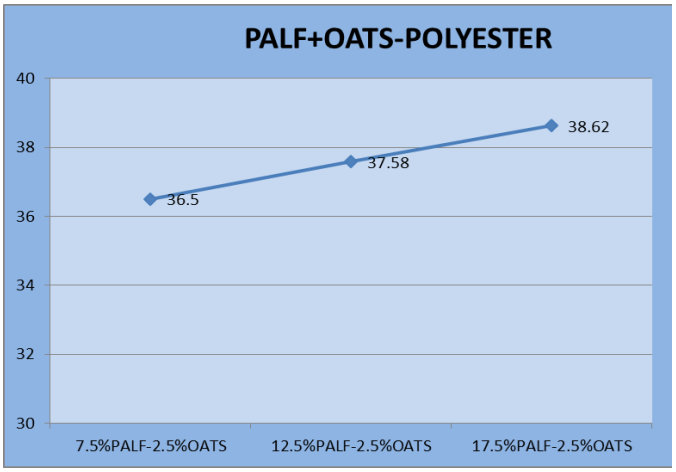

Fig 7- Graph of specimens containing % of Palf – oats with resin v/s flexural strength

4.3 WATER ABSORPTION TEST

The table shown below is the result of specimens obtained in the test.The values obtained are in the respective order specimen(1) 10 % Palf + 90% Polyester resin, specimen(2) 20% of Palf + 80% of Polyester resin, specimen(3) 30% Palf + 70% Polyester resin, specimen(4) 7.5% Palf +2.5% oats + 90% Polyester resin, specimen(5) 12.5% Palf + 2.5% oats + 85% Polyester resin, specimen(6) 17.5% Palf + 2.5% oats + 80% Polyester resin.

Table 3- water absorption test

SL NO	Dry weight(w1) kg	Wet weight(w2) kg	% of water absorbed
1	0.0124	0.0141	13.71
2	0.0126	0.0143	11.88
3	0.013	0.0147	11.56
4	0.0125	0.0138	9.42
5	0.0127	0.0140	10.02
6	0.0124	0.0137	9.86

The specimens are arranged in the table respectively as the above. The table contains the dry, wet weight of the specimens and their percentage of absorption of water. From the table, the specimen (1), (2), (3) the percentage of water absorbed gradually decreases from 13.71, 11.88, and 11.56 respectively. And the specimens (4), (5), (6) the percentage of water absorption are 9.42, 10.02, 9.86 respectively. The specimens (3) have the lowest value when comparing with the only palf and polyester resin composition. The specimen (4) has the lowest water absorbed when the specimen having palf, oats with polyester resin

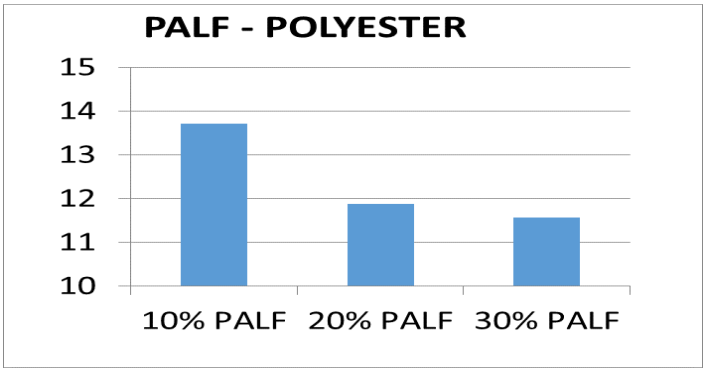

Fig 8- Graph of water absorption test

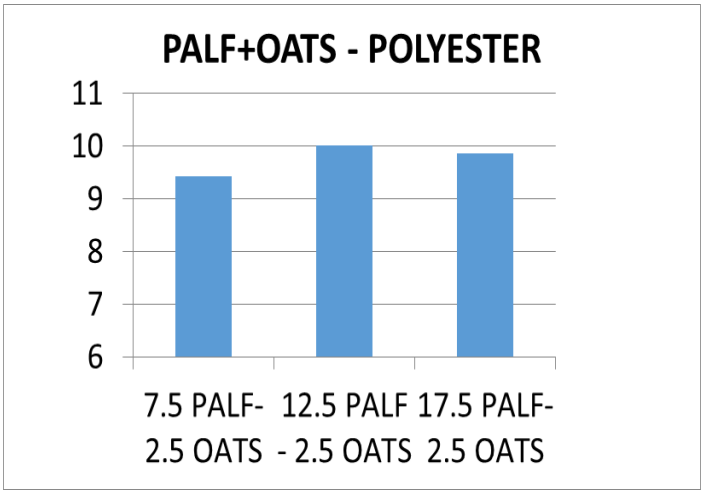

Fig 9 - Graph of water absorption test

Here, the specimen (1) with 10% of Palf and 90% of polyester resin showed more water absorptionof13.71% which decreased to11.56% from20% to 30% of palf addition. The Palf +oats and polyester resin showed lesser water absorption from 10% to20% of palf and oats addition which ranges from 9.42% to7.35%.

5. CONCLUSIONS

The specimen has been made according to the specified proportion polyester resin, oats and pineapple fiber. This newly developed composite is expected to show fairly better mechanical properties than the existing material. When we comparing the different sample of composite resin, oats powder and pine apple leaf fiber shows good values with respect to others. The tensile and flexural tests has been done on the specimen which indicates that the specimens of palf and polyester resin shown most flexural strength which ascends from 10 percent to 30 percent of fiber volume. The specimen of palf + oats shows a little more tensile strength and less water absorption compared other.

In conclusion the volume of PALF plays vital role in the properties of the specimen and while considering humid conditions for less water absorption the palf oats composite is suitable.Through analyzing various researches we found that the properties increase according to the increase in fiber length and the volume of PALF and OATS added up to 30 % of total volume. Since the Young's modulus and tensile strength are high related to other natural fibers and these properties are suitable for its application as building and construction

materials, furniture's, automotive components etc. This kind of polyester resin can be used as wall fixtures considering ergonomics and in automobile industries armrests, head rests, door panels and parcel shelves.

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