A Review on "Fabrication And Mechanical Characterization of Flax-Ramie Reinforced Epoxy Composite"

V. H. Bendale[1], R. D. Jagtap[2], A. K. Choudhary[3], S. Maharana[4], A. S. Dahake[5]
[1, 2] Dept of Mechanical
[5]Lecturer, Dept of Mechanical
[1, 2, 3, 4, 5] JSPM's RSCOE IInd Shift, Polytechnic, Pune, Maharashtra

Abstract- *In recent days, the petroleum by-products likecarbon fiber and glass fibers are extensively used in construction and automotive industries. These products are harmful to human being and the environment as the manufacturing of such fibers evolves a lot of poisonous gases. Hence, the best alternative for this synthetic fiber can be a natural fiber like flax, jute, kenaf, sisal, etc. This work describes the fabrication and mechanical characterization of natural fiber-based polymer bio-composite of bidirectional flax and ramie fiber mat as reinforcement and epoxy resin as matrix material. The bio-composite material is fabricated by using a hand lay-up technique with the help of a closed mould. The fabricated bio-composites were tested to evaluate the mechanical and physical properties of the laminate.*

Keywords- Bio-composite, Bi-directional, Compression moulding, Epoxy, Flax fiber, HandLay-up technique, Ramie fiber.

I. INTRODUCTION

A composite material is defined as a material system which consists of a mixture or a combination of two or more different composite materials which are insoluble in each other and differs in form or chemical composition and one of these materials called reinforcing phase is in the form of fiber sheets or particles and are embedded in other materials which is adhesive called as matrix phase [1]. Composites are made by combining two or more natural or artificial materials to exploit their useful properties and minimize their limitation. Glass-fibers reinforced plastic (GRP), combines glass fibers (which are strong but brittle) with plastic (which is flexible) to make a composite material that is tough but not brittle, is one of the oldest and best-known composites [2]. Composites are typically used instead of metals because they are equally strong but much lighter. Most composites contain fibers of one material tightly bound with another material called a matrix [3]. The matrix binds the fibers together a bit like an adhesive and makes them more resistant to external damage, whereas the fibers make the matrix stiffer and stronger and help it resist cracks and fractures. Fibers and matrix are generally (but not always) made from different types of materials [4].

1.1 Problem Statement

1. Every day demand of plastic usage goes on increasing. However, most of all the plastics that we use now are made up of petroleum-based materials. Production of such products causes a huge amount of pollution to the environment. Thus, it has become a necessity to find a new product especially bio-composites which have the potential to solve this worldwide problem [5].
2. The use of natural fibers in a polymer matrix is highly beneficial because the strength and toughness of resulting composites are greater than those of unreinforced materials. Previous work on Flax and Ramie fiber bio-composite has been done and shows that these fibers possess good mechanical properties that make them suitable to compound with plastics [6].
3. The current challenge is to reduce their cost. The hard work to manufacture economically attractive composite parts has resulted in several innovative manufacturing techniques currently getting used within the composites making industry [4].

1.2 Objectives

The main objectives are:-

1. Fabrication of Flax-Ramie fiber reinforced polymer composite using bi-directional flax and ramie mat as reinforcing fiber and epoxy as polymer adhesive.
2. Characterization of the composite laminate by using experimental technique to find physical and mechanical properties.
3. To study the effect of the fiber weight fraction on physical and mechanical properties of the laminate.

4. Develop a numerical methodology with finite element software to determine the laminate properties for validation purpose.

Overall, the focus of this study is to analyse the potential of Flax-Ramie fiber to be used as bio-composite material. By the end of this study.

II. LITERATURE REVIEW

Table no.1:- Various review

Sr. no	Author	Concept
1	J. AndersonComposites Science and Technology 65 (2005).	Characterizing both the scatter of fiber failure strain and strength at a fixed gauge length and the effect of fiber length on the mentioned parameters.
2	ZHANG YangIJCET 2014.	The impact strength, crystallization rate, vicat softening temperature and CTE of composites could be improved in the presence of unmodified Ramie fiber.
3	J. Andersons, R. JoffePolymer Composites 27 (2006): 221-229.	Stiffness and strength under uniaxial tension has been obtained for flax/PP and flax/PPM composites produced from compound obtained by co-extrusion of granulated PP and flax, as well as for FFM/vinylester and FFM/acrylic resin composites manufactured by resin transfer molding.
4	K G PrakashEnergy Procedia (2013) 830 – 838.	An attempt was made to determine the tensile, impact and chemical properties of flax fiber reinforced composite.
5	Thonangi Ravi TejaVolume-8, Issue-5, (Nov-17)	Examined the physical, chemical and mechanical properties of ramie fiber
6	NoanToniniSimonassiMay 11, 2017	Flexural and tensile strengths as well as impact energies of formulated composites were measured. Fracture mechanisms were analyzed based on macroscopic view of broken specimens and SEM fractographs.

A detailed review of the literature survey illustrate that the Flax-Ramie fiber reinforced composites have a lot of potential as advanced materials in numerous diverse sectors such as automotive, structural, aerospace and marine applications.

III. METHODOLOGY AND MATERIALS

Untreated bi-directional flax fiber and ramie fiber mat is ordered from Go Green Products, Chennai, India. The matrix used for manufacturing the Flax-Ramie fiber specimen was ESDEE epoxy of density 1.16 g/cm3, mixed with its hardener. The ratio of a weight of mixing epoxy and hardener was 3:1. The composite laminates were fabricated by using the hand layup process and compression moulding for the development of new composite materials for lightweight structures. A specific mould was used for the fabrication of composite laminates so as to get better mechanical properties The prepared composite laminates were subjected to 72 hours curing at room temperature.

Below we will see the details of materials used and methodologies adopted during the sample fabrication, mechanical testing and characterization of the composites.

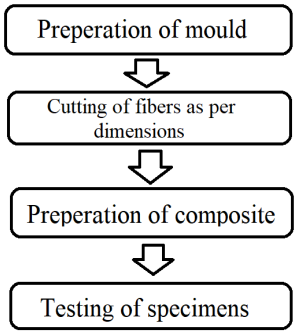

Fig.1- Methodology

3.1 Materials.

Raw materials used in this experimental work are:

1. Flax fiber.

Cultivated flax plants growsapproximately to 1.2 m (3 ft 11 in) tall, with slender stems. The leaves are slender lanceolate,glaucous green, 20–40 mm long, and 3 mm broad. The flowers are pure pale blue, 15–25 mm in diameter, with 5 petals. The fruit is round in shape, dry capsule 5–9 mm in diameter, containing several glossy brown seeds which shapes like an apple pip, 4–7 mm long.[7]

Table no.2-chemical constituent of flax fiber[8]

Fiber	Cellulose	Lignin	Hemicellulos	Wax
Flax	56.5%	2.5%	15.4%	1.3%

Table no. 3 - Physical properties of flax fiber[9]

Fiber	Tensile Strength (MPa)	Youngs modulus (GPa)	Elongation at break (%)
Flax	345-1035	27.6-80	2.7-3.2

2. Ramie fiber.

It is a flowering plant which grows to 1.0–2.5 m (3 ft 3 in–8 ft 2 in) tall;[10] the leaves are heart-shaped, 7–15 cm (2.8–5.9 in) long and 6–12 cm (2.4–4.7 in) broad, and white on the underside with dense, small hairs—this gives it a silvery appearance; unlike stinging nettles, the hairs don't sting. The true ramie or China grass is also additionally called as Chinese plant or white ramie.

Table 4- Chemical constituent of ramie fiber[11]

Fiber	Cellulose	Lignin	Hemicellulos	Wax
Ramie	68-75%	0.8-1.5%	14-16%	1-2%

Table 5- Physical properties of ramie fiber [9]

Fiber	Tensile Strength (MPa)	Youngs modulus (GPa)	Elongation at break (%)
Ramie	220-938	44-128	1.2-3.8

IV. PROPOSSED TEST

Characterization of the bio-composite using various methods:-

4.1 Physical characterization
4.1.1 Water absorption test
4.2 Mechanical characterization
4.2.1 Tensile strength test
4.2.2 Impact energy test
4.2.3 Flexural test
4.2.4 Hardness test

V. SUMMARY

The bidirectional Flax-Ramie fiber reinforced with epoxy composite was successfully fabricated by hand lay-up process with the help of a compressionmoulding. The flax-ramie epoxy composite specimen was prepared according to ASTM standards subjected to physical and mechanical testing.

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