# Fabrication and Characterization of Alkali Treated Fiber Reinforced Bio Composites

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*Abstract*— These days, immense interest is paid to new technologies dealing with environmental aspect. Upholding of natural resources such as natural fibers resins and composites lead the upcoming manufacturing industry which helps to scrutinize and produce eco-friendly materials. The use of composites in manufacturing equipment and products is taking a very important space in the industry. In general, these materials have unique physical and chemical properties when analyzed separately from the constituents which are part of them. However, it is known that proper care must been taken in their manufacturing viz. use of appropriate process, composition of each element etc. In addition to these, emphasis should be given to adherence of the fiber, which is a major factor in obtaining the final mechanical strength of the product. One should also make sure that the composites are environmental friendly. For this reason, the paper focuses on manufacturing a bio-composite fiber to improve the mechanical behaviour among its class of materials, using natural fibers as strand (cotton fibers, flax fibers and raw flax) which is a hybrid form of reinforcement and soya resin as matrix.

***Key words:*** Fiber Reinforced Bio Composites, Fabrication

## I. INTRODUCTION

A Composite which is formed by different materials is homogenous when examined macroscopically. It may have long or short fibers used in a phase of the material which is called as reinforcement. Several technological research achievements particularly those related to relevant applications in area such as aeronautic, aerospace, petrochemical, ship building, bioengineering, automotive, construction and sporting goods, etc., became possible only after the advent of structural composites .

Natural fiber reinforced composites have raised great attentions and interests among materials. The interest in natural fiber-reinforced polymer composite materials is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap and completely/partially recyclable. Bio degradable plants such as flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, etc., along with wood are more often used as source of lignocelluloses fibers which are applied as reinforcement to composites from time immemorial. Their availability, eco-friendly features, low density, economic feasibility and satisfactory mechanical properties make them attractive and are considered as alternative to glass, carbon and man-made fibers in the manufacturing of composites.

The natural fiber containing composites are more environmental friendly and are used in transportation, military applications, construction industries, building packaging and consumer products.

The versatility of the fibers which adapt to different forming processes of composites such as filament winding, lamination, resin transfer moulding, extrusion, injection, etc., give to these fibers strategic importance in development of new composites.

## II. PROCESS DESCRIPTION

The fibers, resin and hardener (glycerol) are weighed. Soya resin is made by mixing water, glycerol and soya isolate powder. Proper care is taken to avoid the formation of bubbles as their presence in the matrix may result in failure of the composite. The mould is made by polyvinyl covers which do not stick to the resin. A resin coating is applied to the mould and the fiber is placed accordingly. For uniform thickness and proper bondage, rolling is done using a cylindrical mild steel rod. This procedure is repeated until the alternating fibers are laid. Following this, a releasing sheet is put on the top and light rolling is carried out on the primary composite. Finally the laminate is placed under the sun light for 24-48 hours allowing it to dry up.

## III. FIBERS AND ITS TYPES

Fibers are very thin hair like materials which are in discrete elongated pieces like a thread. Fibers are classified as Natural fibers and manmade fibers. The advantage of natural fiber is its low cost, low density, reduced tool wear, high toughness, high specific strength and biodegradability. Another major advantage of natural fiber is it acts as a thermal insulator and exhibit reduced bulk density because of its hollow and cellular nature.

The sources of natural fibers are plants, animals, and minerals. The pioneer fibers used are cotton, wool, silk, flax, hemp and sisal.

The first manmade fiber is nylon. Both natural and synthetic fibers are now available and are being used as fillers in achieving good properties in composites.

## IV. MATERIALS USED IN MAKING OF BIO COMPOSITE FIBER

Flax is obtained from the stalk of a plant (Linum Usitatium – A literal translation is ‘ linen must useful,” ) which is from 80 to 120 cm height with few branches and small flowers of a colour which varies from white to intense blue which flowers only once a day.

Cotton is a soft and fluffy staple fiber. The plant is a shrub native to tropical and subtropical regions around the world. Cotton fiber is most often spun into yarn or thread and used to make a soft, breathable textile. It has been spun, woven, and dyed since prehistoric times and helped clothing the people of ancient India.

Soy resin made by using soy protein isolate has been used for present work. It has outstanding properties *viz.* excellent adhesion to different materials, great strength, roughness, resistance, excellent mechanical and electrical properties, odourless, tasteless completely nontoxic and negligible shrinkage.

## V. BIO COMPOSITE LAMINATE

Several combinations of composites are prepared. Tensile strength, linear and lateral strains along with poisons ratios are analysed as different cases.

### *A. Case 1: Treated Flax (Linen) With Soya Protein Resin*

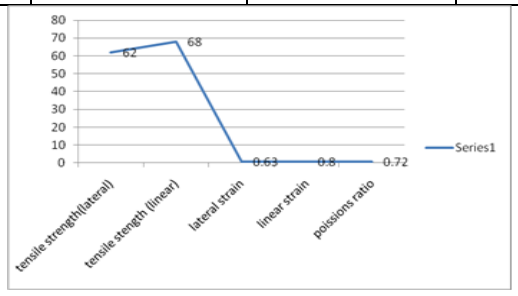
Laminates are prepared in a standard size using 210X297 mm mould. Polyvinyl is coated over the standard mould which helps the resin not to stick to the mould. Soya protein resin is layered over the mould and flax fiber is layered over it. For proper bonding of these layers rolling operation is carried out. Similar process is carried out for six layers.

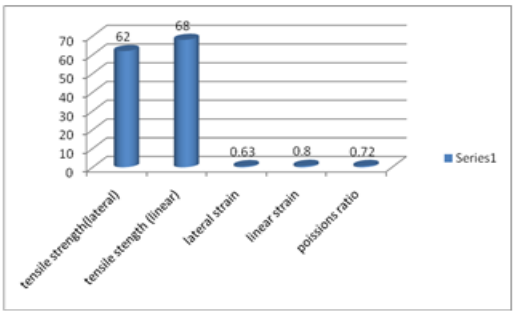
This will be treated as a single laminate and is dried up in sunshine for 24-48 hours.

The prepared six-layered laminate is undergone with the tabulated tests and following results are obtained.

Table 1:

| *S.no* | Parameters | Units of Measurements | Results |
|---|---|---|---|
| 1 | Tensile Strength (Lateral) | MPa | 62 |
| 2 | Tensile Strength (linear) | MPa | 68 |
| 3 | Lateral strain | -- | 0.63 |
| 4 | Linear strain | -- | 0.8 |
| 5 | Poisson ratio | -- | 0.72 |



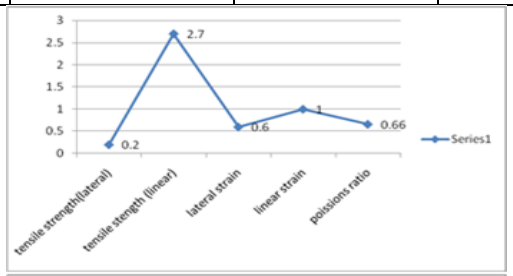



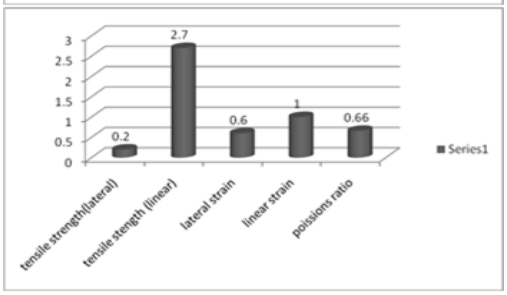

### *B. Case 2 Untreated Flax with Soya Protein Resin*

In this case, the flax is separated into different fibers and is laid up on the mould. After coating the polyvinyl, soya protein resin is applied following the laying up of fiber. The same procedure is carried out for five layers. The laminate was dried in sunshine for one to two days after the rolling operation.

Table 2:

| S.no | Parameters | Units of Measurements | Results |
|---|---|---|---|
| 1 | Tensile Strength (Lateral) | MPa | 0.20 |
| 2 | Tensile Strength (linear) | MPa | 2.7 |
| 3 | Lateral strain | -- | 0.6 |
| 4 | Linear strain | -- | 1 |
| 5 | Poisson ratio | -- | 0.66 |



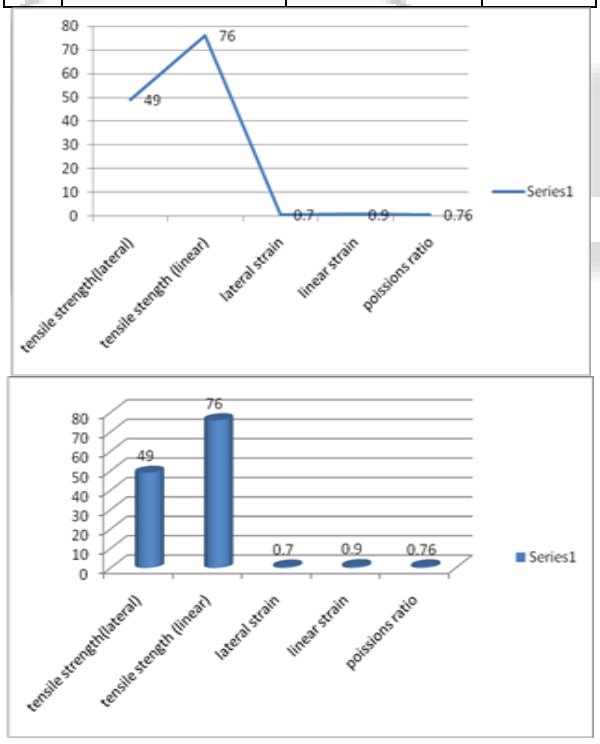

 

*C. Case 3 Three Layered Cotton Fiber with Soya Protein Resin*

The process stated above is repeated with cotton fiber (cloth) for three layers and then is dried in sunshine for 24-48 hours.

Table 3:

| S. no | Parameters | Units of Measurements | Results |
|---|---|---|---|
| 1 | Tensile Strength (Lateral) | MPa | 49 |
| 2 | Tensile Strength (linear) | MPa | 76 |
| 3 | Lateral strain | -- | 0.7 |
| 4 | Linear strain | -- | 0.9 |
| 5 | Poisson ratio | -- | 0.76 |

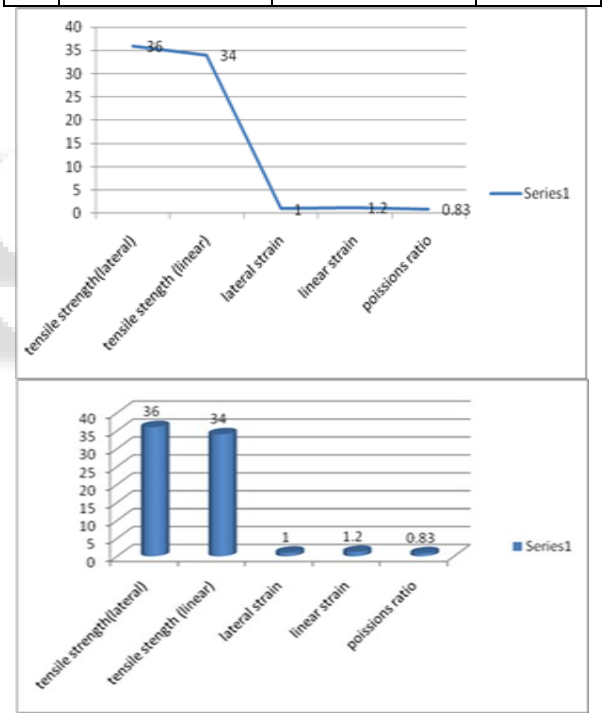



*D. Case 4 Six Layered Cotton Fiber with Soya Protein Resin*

The process above discussed is repeated with cotton fiber (cloth) for six layers and is then dried in sunshine for one to two days.

Table 4:

| S. no | Parameters | Units of Measurements | Results |
|---|---|---|---|
| 1 | Tensile Strength (Lateral) | MPa | 36 |
| 2 | Tensile Strength (linear) | MPa | 34 |
| 3 | Lateral strain | -- | 1 |
| 4 | Linear strain | -- | 1.2 |
| 5 | Poisson ratio | -- | 0.83 |

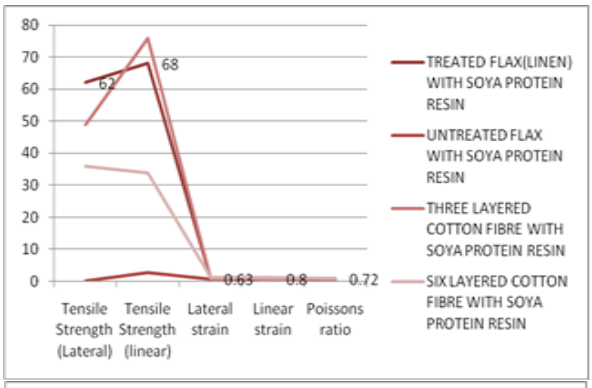


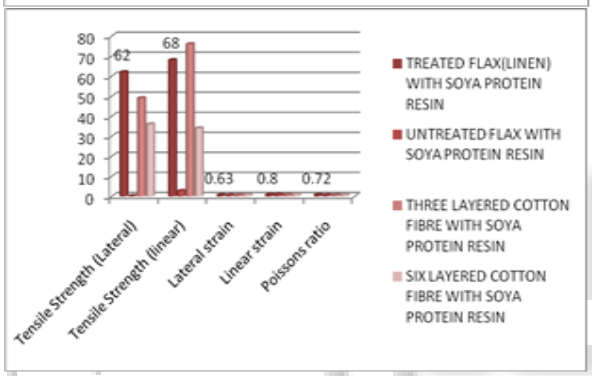

## VI. RESULT AND CONCLUSION

The advantages of natural fibers are low cost and are of high specific modulus. When compared to manmade fibers they are environmental friendly. In past few decades many trails and tests have been conducted to identify the composites which showed the advancements in material technology. In this consideration a composite laminates have been manufactured by with composition of treated flax , untreated flax, three layered cotton fiber and six layered cotton fiber with soya protein resin. It is observed that the tensile strength (lateral) is more for treated flax when compared to all the others which is 62MP. The tensile strength (linear) is more for six layered cotton fiber which is 76 MPA. The lateral strain for three layered cotton fiber is 1. The linear

strain for three layered cotton fiber is 1.2. The Poisson ratio is more for three layered cotton fiber which is 0.83.

For this reason, manufacturing a bio-composite fiber using natural fibers as strand (cotton fibers, flax fibers and raw flax and soya resin as matrix helped in achieving effective mechanical behaviour. Research in this area and development of much more varieties of natural fiber composites will definitely result in production of economical and eco-friendly materials. This will further help in manufacturing varied products for better living of mankind.

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