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A Brief Review of FlaxFiber and Its Composites

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Abstract:

Synthetic fiber reinforced polymer composites plays an important role in the automobile industries and giving a paradigm shift in terms of fuel efficient cars etc. But due to the non-recyclability of the synthetic fibers, it evolve the major problems related to the environment and global warming. All these concerns leads to require a sustainable material which do not have any foot prints on the environment. This critical review on natural fiber reinforced polymer composites gives an insight on the benefits in structural applications, automobile applications and medical sector etc. Physical and mechanical properties and morphological analysis of flax fiber reinforced polymer composites has been discussed.

Keywords: Natural fiber reinforced polymer composite, Flax fiber, SEM

1. Introduction:

Natural fiber reinforced composites plays an important role in the advanced technology due to its tailored properties such as high strength and less weight, more specific strength etc. Because of global concerns on environment, natural fiber composites are used in majority of applications starting from house hold products, interior décor, and automobile applications and also in medical applications. Lot of automobile companies are start developing the interior products of the cars from natural fiber reinforced composites. Natural fibers are mainly categorize on the basis of their source. Figure 2.1 demonstrates a natural fibers grouping.

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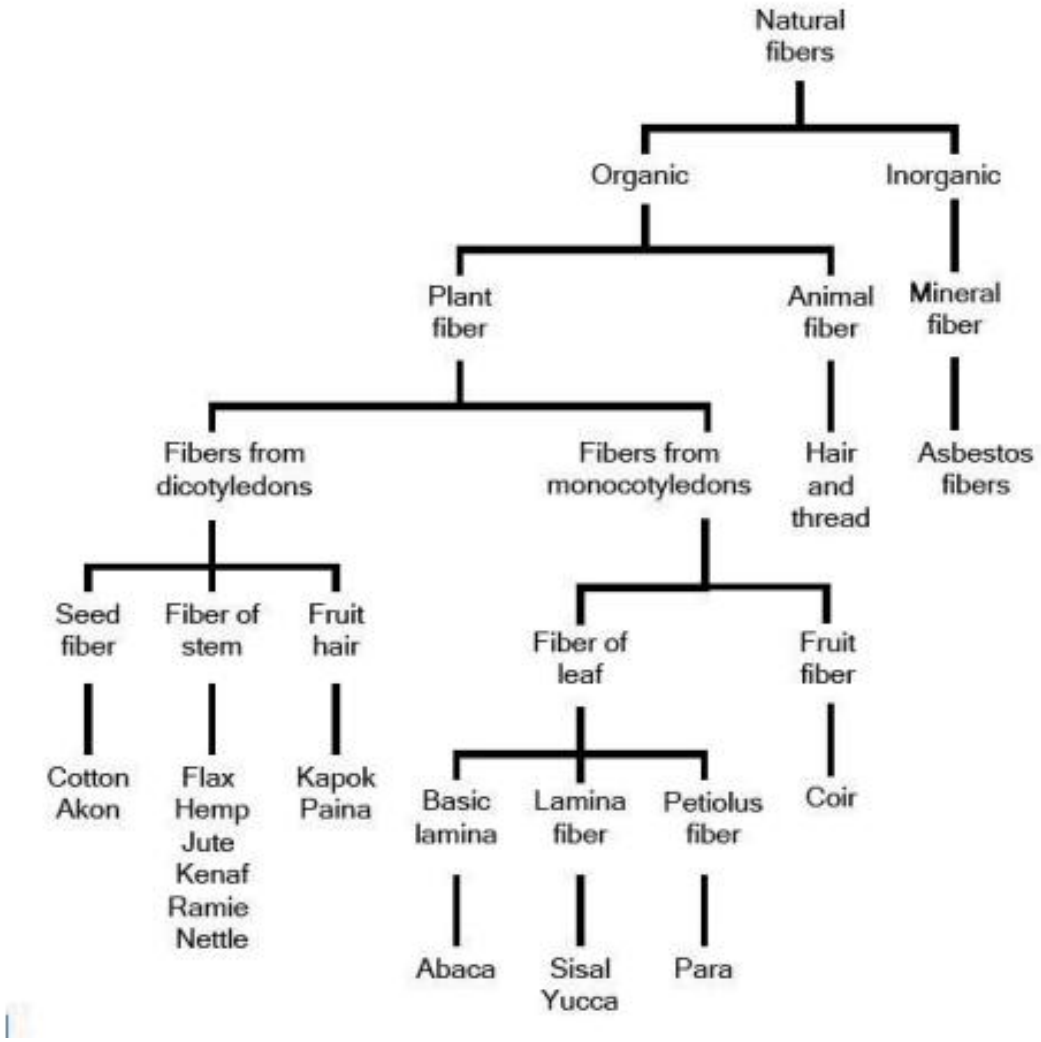

Figure 1 Categorization of natural fibers

Kenaf's entire stalk and external bast fibers have many potential particular uses, containing as paper and composite. Also particularly important from the perspective of environmental approachability is the use of kenaf fibers.A number of new applications are currently emerging for kenaf products, including paper products, building materials, absorbents, feed and livestock bedding.Flax is one of the dominant seed crops of industrial oils grown in temperate climates.As a result, flax oil easily polymerizes oxygen exposure, making it useful as an animal feed for anassortment of industrial yields, including varnish and linoleum, however pressed seed meal.Currently, oil seed flax is predominantlymature in Canada, China, the USA, India and Russia. The source of flax is South Europe, Near East or Central Asia.Some flax is grown in Western Canada in combination with cereals to prevent disease; flax crops are recommended for at least 3 years.Figure 2 shows the flax fiber structure.

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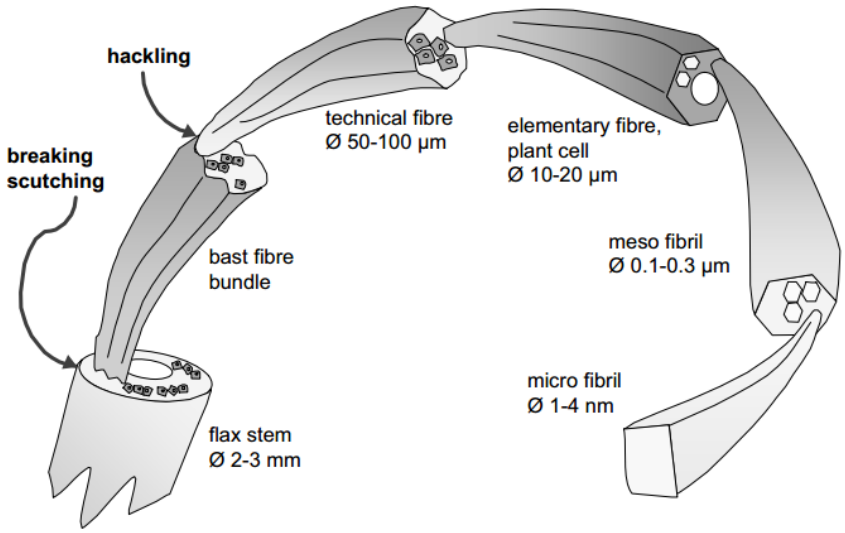

Figure 2 Flax stem configuration

2. Flax Fiber

The flax plant has a 90–125 day life cycle, including periods of vegetation, flowering and maturation. The flax stem's diameter is 1–2 mm in the distance, with a height of around 80 cm.The primary and secondary cell walls are the fundamental fibers, both of which are cellulose material. Cellulose fibrils (diameter between 0.2 µm and 0.25µm) are implanted in condensed lamella composed of approximately 3% pectins and 14% hemicellulose, resulting in thermal fiber degradation and water absorption. The flax plant grows when there is sufficient humidity in the temperate climate. There are two kinds of plants of flax seed flax and fiber flax. Flax is cultivated for both seeds and fibres. Fiber flax is designed for small, strong fiber growth. The flax plant is an annual plant that reaches a height of approximately 100 cm. The plants are pulled by hand or machine and all the fiber from the top to the root is intact. Figure 3 shows the flax plant.

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Figure 3 Flax Plant

The stem part is taken for the process of retting after pulling. By contact with water, the fleshy part of the stem is rotted almost for a week. Eventually, on a sharp edge where fibers are loosened, the flax stem is pushed and pounded.

3. Properties of Flax Fiber

Of the organic cellulosic fibers, flax is the best. Flax is two to three times more resistant to wear and abrasion than cotton fiber. It absorbs moisture well and is a fiber that is very breathable. Due to the lack of elasticity of flax fibers, fabrics manufactured from flax do not appear to quickly lose their form.In recent years, the use of the flax fibers is increasing drastically in the automobile industry. Flax fiber is having the potential to replace the synthetic fibers in terms of the properties. Some of the researcher had investigated the mechanical properties of flax fibers. Davis et al.[1]Investigated the consequence of moisture and damage on the ductile properties of flax fibers and found the significant effect comparative humidity on the tensile modulus. Yuan et al. [2] developed the flax/PLA composites and investigated its mechanical properties using hot compression technique. It is found that 40% fiber fraction, 5% concentration of silane treated flax fibers, 190°C moulding temperature and 3 minutes of heating time are the optimum processing parameters. Bulato et al. [3] developed the light weight flax/PLA composites with the help of solvent casting method. Results revealed that the mechanical properties gets improved with the addition of 34wt% PLA in the neat Flax. Figure 4 shows the SEM images and optical view of FF/PLA at 5% fiber volume fraction.

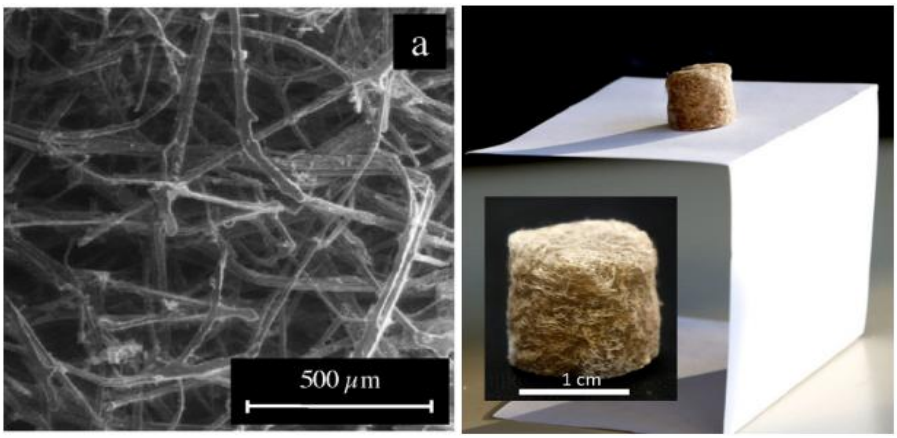

Figure 4a Show the SEM image of FF/PLA at 5% fiber fraction and b) FF/PLA sample at 5% fiber fraction[3]

Bajpai et al. [4]developed the jute/hemp/Flax reinforced hybrid composite and investigated its mechanical properties. Mechanical characterization results reveal that the ductile

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properties are more in hybrid composite as compared to the jute/epoxy, flax/epoxy and hemp/epoxy composites. Figure 5a shows the SEM images of jute/hemp/flax reinforced epoxy composites.

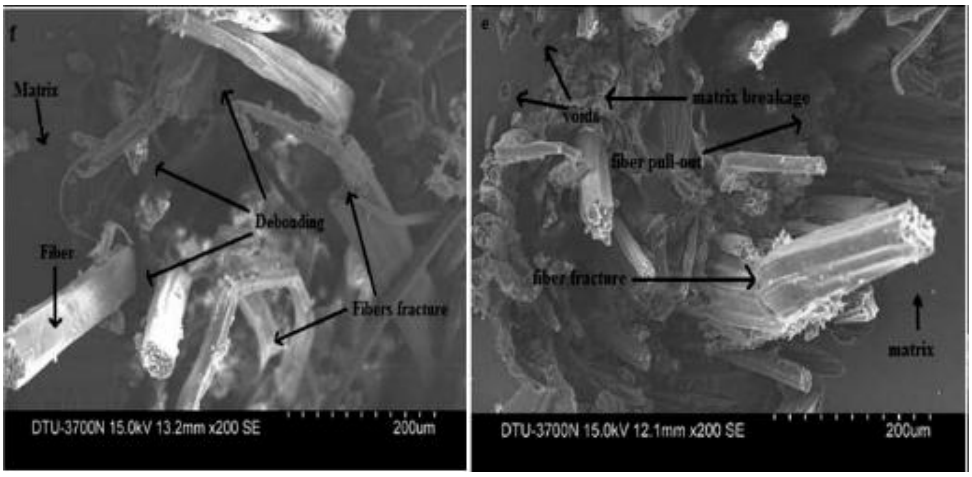

Figure 5 SEM image of a) jute/hemp/flax reinforced epoxy composites b) Hemp/Flax/Epoxy Composite [4]

Interfacial bonding among the fiber and matrix shows avitalpart for defining the mechanical properties of the composite material. Some of the findings are tabulated in the table 1.

Table 1 shows the physical and mechanical properties of flax fibers.

Diameter (mm)	Ultimate stress (MPa)	Density (kg/m^3)	Young's Modulus (GPa)	Water absorption (%)	Source
0.083	290	1400-1510	35	-	[5]
0.021	1400	1400-1550	41	14%	[6]
0.078	1410	1550	59	-	[7]
0.014	1410	1550	59	21%	[8]
0.058	860	1540	110	14%	[9]

4. Flax Reinforced Polymer Composites

Nowadays lot of researchers are working in the area of hybrid composites especially for the structural applications. Srinivasan et al. [10]evaluate the tensile and thermal properties of banana-flax/epoxy hybrid composites with the help of compression moulding machine. Mechanical properties such as tensile strength, flexural strength and impact strength have been investigated and structural morphology has been tested using SEM. Results found that the mechanical properties of glass-banana-flax based hybrid composites possesshigher values

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as compared to the glass/epoxy, banana/epoxy and flax/epoxy composites. Xiao et al. [11]studied the mechanical behavior of flax/PLA composites and found that the 35% fiber volume fraction leads to better mechanical properties. It was also found that at less fiber volume fraction, mechanical properties gets deteriorated. Poor bonding between the matrix and reinforcement was observed at higher fiber volume fraction. Apart from the mechanical properties of the flax reinforced polymer composites, researchers had also tried to study the effect of ageing on the ductile properties. In one of the study, it was found that immersion of the composites in the water effect the deterioration of the mechanical properties. Figure 6 shows the SEM images of fractured bio composites after 710 days. Daniel et al. [12]deliberate the impact of hygrothermal ageing on the ductile properties of flax fiber reinforced epoxy based composites. Results indicates that the mechanical properties were affected significantly due to the ageing process. Werf et al. [13]studied the environmental influences on the fabrication of flax textile yarn. Reducing the environmental influences associated with hemp yarn production should provide priority to reducing energy consumption in the fiber processing and yarn production phases and reducing eutrophication in the crop production phase. Pucci et al. [5]premeditated the effect of thermal treatment on flax fibers for the improvement of wetting and swelling properties. The thermal treatment has been shown to make fibers less hydrophilic.

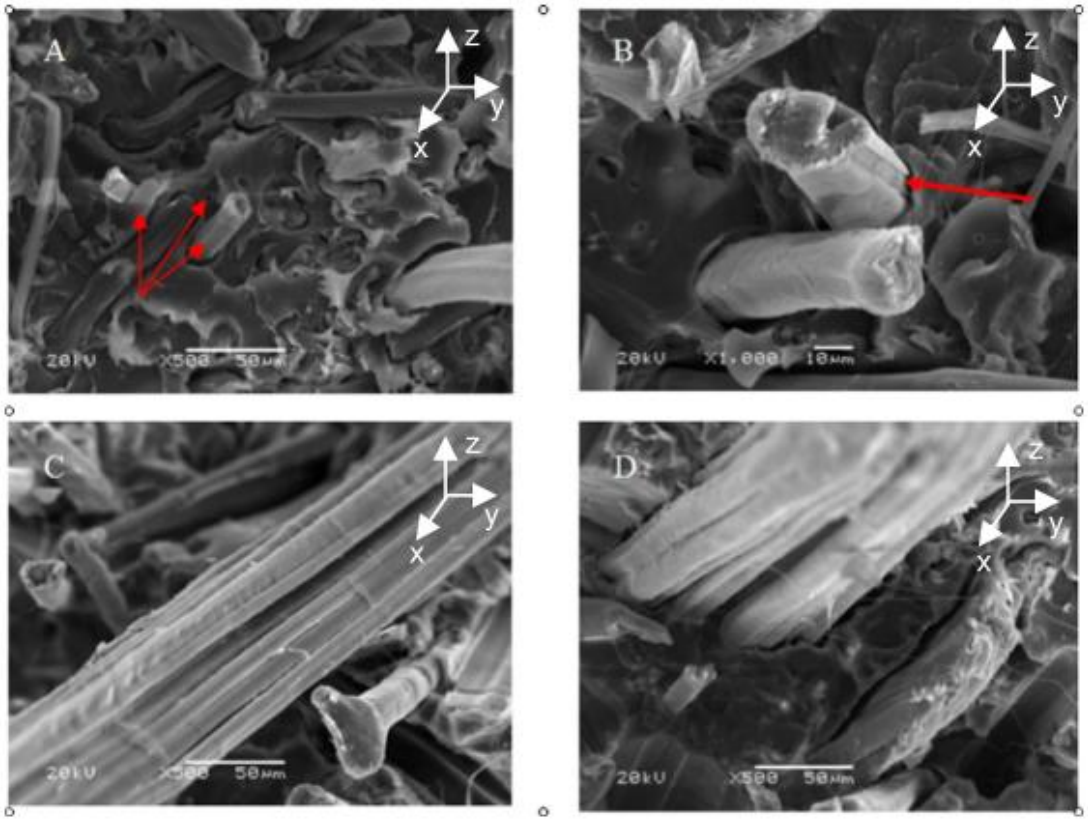

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Figure 6 shows the SEM images of fractured bio composites after 710 days. [14]

5. Conclusions

The complete study, focus on the critical review for the reinforcement of flax fibers in the polymer composites. Because of eco-friendly and sustainable material, natural fiber reinforced polymer composites have increased broad interest. Different polymer composites of flax fiber were deliberately the potential material for replacing polymer composites of synthetic fibers. Flax fiber is one of the natural fiber having a more mechanical properties as compared to other fibers. The complete review also touched upon the different mechanical properties of flax fibers and its applications.

6. Future Developments

From the highlighted different studies quoted by the various researchers on the mechanical properties of flax fiber reinforced polymer composites. The outcome of these research studies leads to provide the future scopes in the following areas

1. Lot of research scope is in the area of improvement of mechanical properties with the use of surface treatments of fibers.
2. Less study has been done in the area of improvement in the surface finish of natural fiber reinforced polymer composites.

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