

Effect of surface treatment on Natural fibers composite

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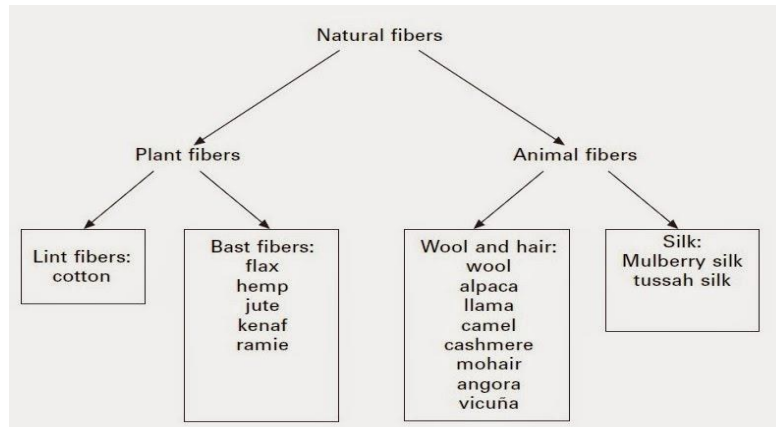
Abstract: The replacement of the synthetic fibers composite to natural fibers composites has become a key research area in the production industries. The advantage of natural fibers over a man-made fibers is low density, low cost, recyclability and biodegradability. But the natural fibers has a high level of absorption, this leads to poor wettability and insufficient adhesion within the matrix (internal adhesion) resulting degradation of composite properties. These properties hinder the potential of Natural fibers in providing successful reinforcement for polymer composites. In order to increase the potential of the Natural fibre Composites surface treatment is essential. In this paper various surface treatments and limitations are discussed, also the effects of surface treatment on the fibers are narrated. These properties will provide the base for further research in developing the Natural fibers composite without any degradation in its Characteristics.

Keywords:- Natural fibers composites, surface treatment, Synthetic fibers composites

1. INTRODUCTION

Natural fibers have provided raw materials to meet the human requirements of fibers in their life. The first utilization of natural fibre composite, made with clay in Egypt, can be dated back to 3000 years ago. With the high-tech developments of man-made fibers, Natural Fibers lost much of its interest and many of the ancient natural fibers are no longer in use. However, as a result of a growing awareness of the interconnectivity of global environmental factors, the principles of sustainability, industrial ecology, eco-efficiency, and green chemistry and engineering are being integrated into the development of the next generation of materials, products, and processes. Many companies have shifted their focus to using materials that weigh less, are durable and efficient, and have high mechanical properties. In such scenario, Natural fibers are creating great demand as they come at a very low cost, are neutral to CO₂, recyclable, biodegradable, can be separated easily, and have low density and contain desirable physical properties.





The application of natural fibers can be classed in three different ways: (i) direct utilization (e.g. textile, paper and fabric); (ii) degradation (e.g. bio-fuel) and (iii) composite. NFs are now emerging as viable alternatives to glass fibers either alone or combined in composite materials for various applications in automotive parts, building structures and rigid packaging materials. The advantages of NFs over synthetic or man-made fibers such as glass are low cost, low density, competitive specific mechanical properties, carbon dioxide sequestration, sustainability, recyclability, and biodegradability.

Table 1. Mechanical properties of natural fibre at compared to conventional reinforcing fibre.

Fibre	Density (g/cm³)	Elongation (%)	Tensile strength (MPa)	Young's modulus (GPa)
Cotton	1.5-1.6	3.0-10.0	287-597	5.5-12.6
Jute	1.3-1.46	1.5-1.8	393-800	10-30
Flax	1.4-1.5	1.2-3.2	345-1500	27.6-80
Hemp	1.48	1.6	550-900	70
Ramie	1.5	2.0-3.8	220-938	44-128
Sisal	1.33-1.5	2.0-14	400-700	9.0-38.0
Coir	1.2	15.0-30.0	175-220	4.0-6.1
Softwood kraft	1.5	-	1000	40.0
E-glass	2.5	1.5-3.0	2000-3500	70.0
S-glass	2.5	2.8	4570	36.0
Aramid (normal)	1.4	3.3-3.7	3000-3150	63.0-67.0

Carbon (standard)	1.4	1.4-1.8	4000	230.0-240.0
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Table2.Chemical composition of selected common natural fibre.

Type of fibre	Cellulose (%)	Lignin (%)	Hemicellulose (%)	Pectin (%)	Ash (%)
A. Bast fibre					
Fibre flax	71	2.2	18.6-20.6	2.3	-
Seed Flax	43-47	21-23	24-26	-	5
Kenaf	31-57	15-19	21.5-23	-	2-5
Jute	45-71.5	12-26	13.6-21	0.2	0.5-2
Hemp	57-77	3.7-1.3	14-22.4	0.9	0.8
Ramie	68.6-91	0.6-0.7	5-16.7	1.9	-

2. Surface treatment of Natural Fibre

NFCs are being produced that could profit by an exhaustive and basic comprehension of the fiber and its surface. A portion of the inadequacy and restrictions of NFs, when utilized as fortification for composites, are identified with the lower quality properties, bring down interfacial attachment, poor protection from dampness ingestion, constrained most extreme preparing temperature (around 200°C), and bring down toughness and dimensional dependability (shrinkage and swelling). To beat the deficiency, different procedures have been produced to alter NFs. There are four sorts of techniques used to treat the NFs, physical method, chemical method, organic method and nanotechnology (NT) technique. These adjustment techniques are of various efficiencies for enhancing the mechanical properties of strands, the grip amongst framework and fiber and result in the change of different properties of conclusive items

2.1 Physical Method

The surface of the fibers can be modified by physical methods. So what this physical treatment means? It is method to physically treating the surface physically. In other words we can define physical treatment as to roughen the surface so as to enhance the contact area and facilitate mechanical interlocking.

2.1.1 Plasma Treatment

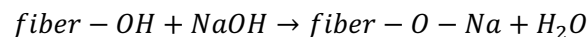
Plasma surface activation is the process by which surface polymer functional groups are replaced with different atoms from ions in a plasma to increase surface energy. Plasma activation is often used to prepare a surface for bonding or printing. Surface exposure to energetic species breaks down the polymer at the surface, creating free radicals. Plasma contains UV radiation at high levels, creating additional free radicals on the natural fiber surface. Free radicals quickly react with the material itself because they are unstable. This allows the surface to form stable covalent bonds, which are able to be printed on or bonded to.

2.2 Chemical Method

The major problems of natural fibre composite is the hydrophilic nature of the fibre and hydrophobic nature of the matrix. As a result, there is an inherent incompatibility between fibre and matrix. Chemical treatment on reinforcing fibre can reduce hydrophilic tendency and thus improve compatibility with the matrix. There are several methods of chemical treatment on natural fiber here we discussed few methods only.

2.2.1 Alkaline treatment

Alkaline treatment is one of the most used chemical treatment of natural fibers when used to reinforce thermoplastics and thermosets. The important modification done by alkaline treatment is the disruption of hydrogen bonding in the network structure, thereby increasing surface roughness.



Thus, alkaline processing directly influences the cellulosic fibril, the degree of polymerization and the extraction of lignin and hemicellulosic compounds.

2.2.2 Acrylation and Acrylonitrile Grafting

Acrylation reaction is initiated by free radicals of the cellulose molecule. Cellulose can be treated with high energy radiation to generate radicals together with chain scission.

Acrylonitrile (AN, $(CH_2 = CH - C \equiv N)$) is also used to modify fibers. The reaction of AN with fiber hydroxyl group occurs in the following manner



2.3. Biological treatment

Biological treatments involve the use of naturally occurring microorganisms, namely bacteria and fungi. These treatments occur in aqueous environments and are relatively cheap to perform, but tend to be time consuming and water polluting. One commonly used biological fibre treatment is retting treatment. Retting is the controlled degradation of plant stems to free the bast fibers from their fibre bundles, as well as to separate them from the woody core and epidermis. During the retting process, bacteria (predominantly Clostridia species) and fungi, release enzymes to degrade pectic and hemicellulosic compounds in the middle lamella between the individual fibre cells.

3. Conclusion

The natural fiber surface treatment is the key research area for many researcher. The effect of surface treatment on the natural fiber better there property in various application. The hydrophilicity of the natural fiber is reduces in the reinforcement and there is increase in bond with the matrix in the reinforcement due to surface treatment. Surface treatment provides the better increment in mechanical, adhesion, andhydrophobicity property of the natural fiber composite.

4. References

- [1]. S.Mukhopadaya, R.Fanguiro, Journal of thermoplastic composite, Physical Modification of Natural Fibers and Thermoplastic Films for Composites
- [2]. K. E. Perepelkin, Fibre Chemistry March 2005, Volume 37, Issue 2, pp 123–140
- [3]. Rob Neilley, Corona and Plasma Treatment Processes
- [4]. Plasma ETCH, What is Plasma Surface Activation?
- [5]. ASSDA, Chemical Surface Treatments
- [6]. Wikipedia, Plasma Processing, Alkaline treatment