OPPORTUNITIES AND THREATS TO NATURAL FIBERS IN TECHNICAL APPLICATIONS

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ABSTRACT

Natural fibers, such as flax, hemp, kenaf, coir, sisal and jute, are gaining increasing importance in automotive, aerospace, packaging, fiber-reinforced composites and other technical and industrial applications. This is due to the fact that natural fibers offer competitive specific tensile strength and stiffness, in some cases even better than glass fibers but fairly comparable to synthetic fibers, such as nylon, carbon and aramid (Figure 1). Besides, they offer other advantages, such as improved energy recovery, carbon dioxide sequestration, ease and flexibility of manufacturing, environmental friendliness and derived from renewable natural resources. However, the market scenario for the natural fibers is also changing due to the introduction of newer bio-degradable polymers, such as PLA synthesized from corn. Currently, some other biopolymers with properties similar to their petroleum origin counterparts, such as Bio-PET, PHA and PBT from naturally renewable resources, are under development, although they are developed with a view to replace petroleum based polymers but their fiber-forming properties may provide newer opportunities!

INTRODUCTION

To strike a balance between cost, quality, performance, environmental regulations and supply of natural fibers, such as, flax, hemp, jute, coir, kenaf and sisal, a number of composite and technical textile manufacturers are developing new facilities for utilizing alternative fibers[1,2]. To augment the resource driven approach and strategy for finding new applications for the available natural fibers, the automotive industry has taken the leadership. The automotive sector requires reasonably durable materials which must biodegrade at the end of their service-life. Reinforced composites made from lingo-cellulosic plant materials offer attractive opportunities because of their strength resulting from the strength of fiber bundles. The applications of such natural fiber reinforced composites in load bearing components as opposed to conventional composites based on wood fiber, may turn out to be one of the material revolutions of the twenty first century[3].

In order to explore value-added products, it is necessary to understand the value addition during each stage of manufacturing. Figure 2 shows a typical value addition chain for natural fiber based products. Usually, very little value addition is achieved in the early stage of the processing chain, for example, cultivation and harvesting and fiber extraction and fiber preparation. The value addition increases further during the chain, particularly in the production of products with functional attributes which can satisfy demanding technical

specifications, for example, woven fabrics for soil erosion and preforms for reinforced composites or nonwoven fabrics for insulation and filtration. Even still higher levels of value addition can be achieved when producing products that can provide multi-functional attributes, for example, composite panels with thermal and acoustic barriers and roofing products with built-in photovoltaic cells. Semi-finished and finished components can provide still higher levels of value addition, for example, automotive parts and panels, such as parcel trays and door panels. With the increasing added value across the value-addition chain, obviously, the technical complexity increases which requires careful research interventions and investment in the development process.

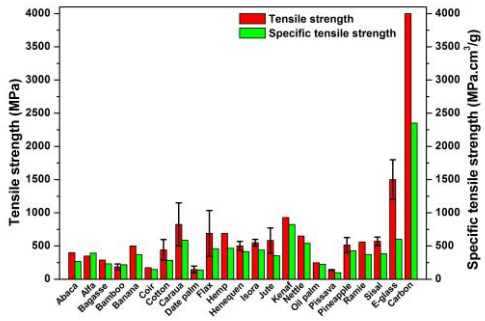

Figure 1: Specific tensile strength of natural and other fibers

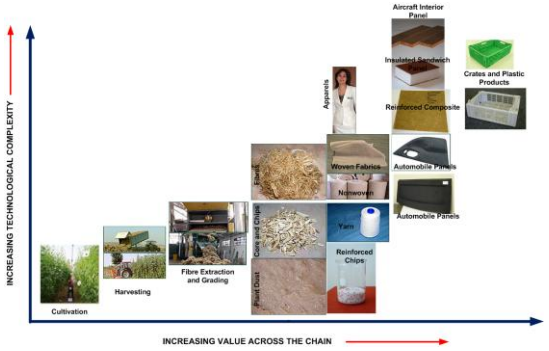

Figure 2: Value addition chain of natural fibers

It is often mentioned that the tensile properties of natural fibers are much lower than that of E-glass, Kevlar and carbon fibers. However, the advantages of natural fibers lie in their comparatively lower densities. Therefore, an effective comparison of mechanical properties should be in terms of their specific mechanical properties as shown in Figure 1, according to which it is apparent that specific tensile strength of some of the natural fibers, such as flax, kenaf, hemp and Caraua is quite comparable to that of E-glass fibers. Therefore, natural fiber based products clearly provide an opportunity to reduce component weight and are therefore widely used in technical textiles and as reinforcements in composite products for the transportation sector.

More detailed information will be provided in the presentation which will evaluate the technical performance of products in terms of the required specifications and natural fiber properties. The presentation will also address issues related to new developments in biopolymer and bio-based synthetic fibers which could provide stiff competition to natural fibers in future.

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