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Composite materials with bast fibres: Structural, technical, and environmental properties

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ABSTRACT

Natural abundance, low density, high strength per unit weight, and biodegradability of lignocellulosic materials, specifically natural fibres, render them attractive for reinforcement of engineered polymer systems. However, poor thermal stability and water resistance, coupled with poor interfacial adhesion to petroleum based polymers, has bottlenecked the application of natural fibres in composite materials. Hence, a number of different methods to improve their adhesion to polymers have been studied. In this review, an overview of the most common and simple modification systems for bast fibres from 2005 to 2015 is summarized. Also, a portion of the communication has been devoted to polymer systems, specifically examining the established petroleum based platforms and promising biopolymers. Finally, economic and environmental awareness has forced researchers to model their systems using different methodologies to assess the potential impacts. As a result, a comprehensive section discussing life cycle analysis and techno-economic analyses are presented.

Contents

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1. Introduction

The industrial age has brought technologies that are efficient with unprecedented productivity empowered by the use of non-renewable hydrocarbon feedstocks at enormous scales. Over the past few decades, a better characterization of the environment and how anthropogenic factors affect it have been documented. As a result, humans have been searching for technologies that are still economically competitive, but also provide more environmentally friendly footprints. Hence, research has been undertaken to develop renewable technology platforms that mimic fossil fuel based technologies with the hope that these new technologies can supplement or replace those that are currently being used. One area of great interest has been the production of biobased materials from lignocellulosic material [1]. In fact, significant progress has been made in the field of renewable polymers, where we have seen replacement of conventional materials in various applications.

The use of natural fibres in composite applications has also received widespread attention of late. These fibres are low-cost if sourced locally, have low density, and have high specific mechanical properties [2]. In addition, these fibres

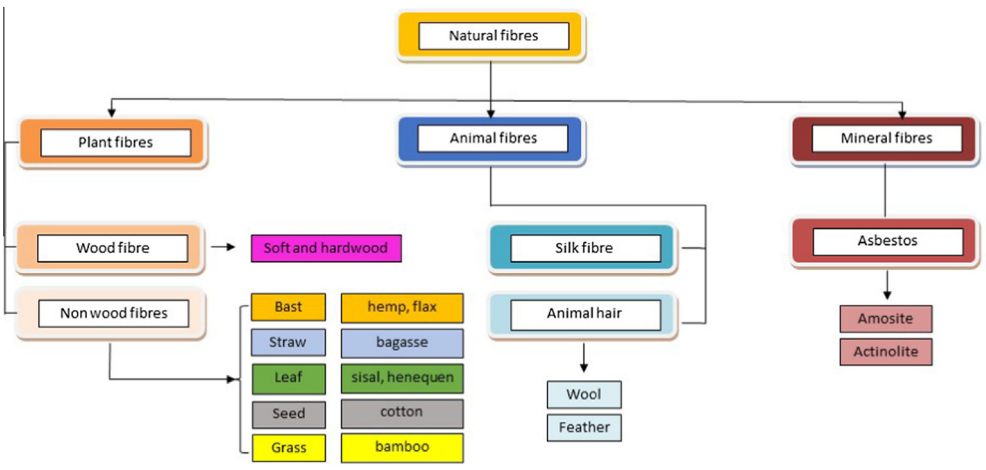

Fig. 1. A basic classification of some of the main fibre types. The colour-coding illustrates each class with examples [4].