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FUNDAMENTAL STUDY ON THE EFFECT OF ALKALINE TREATMENT ON NATURAL FIBERS STRUCTURES AND BEHAVIORS

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ABSTRACT

In composites, chemical treatment caused better adhesion interface between fibers and polymer. Thus, in this research, alkaline treatment was performed on jute and kenaf fibers in an alkaline solution containing 5wt % sodium hydroxide diluted with distilled water, at room temperature for 30 minutes. The pH levels of the alkaline solution were maintained approximately at pH 11 to pH 12. The untreated and treated fibers were analyzed using Fourier transform infrared (FTIR) spectroscopy in the range of 4000 cm^{-1} to 400 cm^{-1}. It is found out that change in the structure and the removal of outer cell layers, cellulose, hemicellulose, lignin, waxes and other impurities during the alkaline treatment that affected the improvement on the adhesion interface between fibers and polymer.

Keywords: fourier transforms infrared spectroscopy, natural fiber, alkaline treatment, composites.

INTRODUCTION

Increasing environmental awareness regarding on non-biodegradable types of polymer waste has caused the search for renewable and biodegradable resources. The development of biodegradable polymers has become one of the main areas of interest for researchers. It may come from different perspectives such as process-ability, compatibility, durability, and wear-ability. Due to its relatively high cost, natural polymer such as poly-lactic acid (PLA) cannot compete economically with conventional polymers such as polypropylene (PP) [1]. Thus, to reduce the high cost, combining the natural polymer with inexpensive filler such as natural fibers can indirectly produce a cost effective composite.

According to Abdul Razak *et al.* [1], natural fibers are used because it may offer both economic and ecological advantages. Besides that, natural fibers normally used as filler in the composites are because of its non-abrasive behavior during the process, biodegradable, had low density and high specific mechanical properties [2]. Jute and kenaf are widely available in different parts of the world. It is normally used as low-cost reinforcements for composites. The natural fibers mainly consist of carbohydrate components, such as hemicellulose, cellulose and lignin [3]. Some fibers may consist of oil and wax components. Natural fibers are amenable to chemical modification due to the presence of hydroxyl groups. Thus, the adhesion interface between natural fibers and polymer matrices has often been a vital issue in several natural composite materials.

The distinction properties between natural fiber and natural polymer cause poor adhesion interface when both materials were combined, that either because of the natural fibers tend to be hydrophilic or hydrophobic due to chemical treatment. Furthermore, the natural polymer also may tend to be either hydrophilic or hydrophobic depending on the chemical molecular structure behavior it has. Therefore, the surface of the fiber has to be treated in order to promote better adhesion interface. Results from studies using acetylation treatment [4], silane treatment [5,6] and bleaching treatment [1] showed that the treatment on the surface of the fiber can improve the mechanical properties of composites.

A strong understanding of the complex nature of fiber is needed to optimize the modification processes that increased the utility of fiber as part of the component in composites. According to George *et al*. [5], as it is known that the polymers and fibers have different chemical properties that provide strong adhesion at their interfaces for an effective transfer of stress and bond distribution throughout the interface. Thus, several theories were created based on the adhesion phenomena that includes chemical bonding, wetting diffusion, electrostatic and acid/base interaction that act as a driving force for bonding interface. In this study, the effect of alkaline treatment using sodium hydroxide (NaOH) on the fibers properties were investigated using Fourier transform infrared spectroscopy analysis.

METHODLOGY

Materials

Jute (*corchorus capsularis*), and kenaf (*hibiscus cannabinus*) were obtained directly from a local market in Kuching and Kota Samarahan, Sarawak, Malaysia. Caustic soda types of sodium hydroxide with product code 'S/4920/AP1' and Universal Indicator Solution were supplied by Fisher Scientific, UK.

Methods

Fiber preparations

Raw jute and kenaf fibers were chopped into small size varied from 1 mm to 10 mm. After chopped, the natural fibers were sieved to remove the dust. The natural fibers were cleaned and washed using distilled water to