Chemical Modification of Hemp, Sisal, Jute, and Kapok Fibers by Alkalization

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Abstract
Plant fibers are rich in cellulose and they are a cheap, easily renewable source of fibers with the potential for polymer reinforcement. The presence of surface impurities and the large amount of hydroxyl groups make plant fibers less attractive for reinforcement of polymeric materials. Hemp, sisal, jute, and kapok fibers were subjected to alkalization by using sodium hydroxide. The thermal characteristics, crystallinity index, reactivity, and surface morphology of untreated and chemically modified fibers have been studied using differential scanning calorimetry (DSC), X-ray diffraction (WAXRD), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM), respectively. Following alkalization the DSC showed a rapid degradation of the cellulose between 0.8 and 8% NaOH, beyond which degradation was found to be marginal. There was a marginal drop in the crystallinity index of hemp fiber while sisal, jute, and kapok fibers showed a slight increase in crystallinity at caustic soda concentration of 0.8–30%. FTIR showed that kapok fiber was found to be the most reactive followed by jute, sisal, and then hemp fiber. SEM showed a relatively smooth surface for all the untreated fibers; however, after alkalization, all the fibers showed uneven surfaces. These results show that alkalization modifies plant fibers promoting the development of fiber–resin adhesion, which then will result in increased interfacial energy and, hence, improvement in the mechanical and thermal stability of the composites.