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(57) Abstract :
Synthetic fiber reinforced polymer matrix has several disadvantages such as high density, non-degradable and also leads to other major issues like diminishment of fossil fuels and waste management. The need for environment friendly composite resulted in extraction of several natural fibers which are found to be used as potential reinforcement material. So there comes the need to identify biodegradable and sustainable source of fibrous materials namely natural lingo cellulose fibers to be reinforced with polymer matrix. Augmenting concern towards effective utilization of agro waste into useful products has formented the scientific community to look for alternate source of materials. On a circular economy contemplation, natural fibers extricated from agro waste has a potential headway towards evolution of newer materials. The ligno cellulose fibrils extracted from coconut inflorescence were subjected to three type of silane modifications namely KH550 (amino silane), KH560 (epoxy silane) and KH570 (methyl silane) before hybridization. The effect of silane modification on the functional groups were investigated. The KH570 silane modified inflorescence fiber hybridized with glass fiber and fortified epoxy composites was found to exhibit utmost tensile and flexural strength of 102.6 MPa and 166.89 MPa. FTIR analysis confirmed KH570 silane modification leads to condensation reaction between interface of fibers and matrix. SEM analysis also confronted the elimination of functional groups present in the coconut inflorescence fibers.

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Benzoylation of Coconut Inflorescence Fiber towards development of Sustainable Composite Materials

Abstract

Synthetic fiber reinforced polymer matrix has several disadvantages such as high density, non-degradable and also leads to other major issues like diminishment of fossil fuels and waste management. The need for environment friendly composite resulted in extraction of several natural fibers which are found to be used as potential reinforcement material. So there comes the need to identify biodegradable and sustainable source of fibrous materials namely natural lingo cellulose fibers to be reinforced with polymer matrix. Augmenting concern towards effective utilization of agro waste into useful products has formented the scientific community to look for alternate source of materials. On a circular economy contemplation, natural fibers extricated from agro waste has a potential headway towards evolution of newer materials. The ligno cellulose fibrils extracted from coconut inflorescence were subjected to three type of silane modifications namely KH550 (amino silane), KH560 (epoxy silane) and KH570 (methyl silane) before hybridization. The effect of silane modification on the functional groups were investigated. The KH570 silane modified inflorescence fiber hybridized with glass fiber and fortified epoxy composites was found to exhibit utmost tensile and flexural strength of 102.6 MPa and 166.89 MPa. FTIR analysis confirmed KH570 silane modification leads to condensation reaction between interface of fibers and matrix. SEM analysis also confronted the elimination of functional groups present in the coconut inflorescence fibers.

Description

The southern part of India is famous for coconut tree which is an prominent source for lignocellulose fibrils and several natural fibers have been extracted from its different parts namely husk, coir .In this connection one more lignocellulose fiber is identified from the coconut tree which is known as inflorescence. A spadix which can also be known as double sheath encloses the inflorescence which is present in each leaf axil. The length of the inflorescence may vary from 200 mm to 350 mm. The inflorescence is collected from the coconut tree and subjected to retting over a period of ten days. The primary walls of the coconut inflorescence would get softened by the process. Retting by which the water gets penetrated into the central stalk section of the inflorescence, the inner cell walls gets swollen enough, the outermost layer gets softened and decay of primary walls of the inflorescence happens. Then the inflorescence is beaten with mallet to remove the primary fleshy layers thereby fibers present inside the inflorescence is extracted. Fig 1 shows the inflorescence (yellow colour membrane) present in the coconut tree. In a single stack around 20-25 inflorescence will be present in the tree. The inflorescence is then placed in water to soften the primary walls of the inflorescence and then with the help of mallet the primary walls are broken to extract the lignocellulose fiber.

Coconut Inflorescence

The inflorescence fiber before reinforcement is exposed to surface treatment with 5% wt/vol of NaOH solution. Then the fibrils are washed well with water to remove the alkali contents in the fibrils. Then the fibrils are subjected to three types of silane coupling agents namely γ-Aminopro-pyltriethoxysilane (KH550), 3-Glycid-oxypropyltri-ethoxysilane (KH560), and γ-Methacryloxy-propyltrimethoxy-silane (KH570) for one hour. Finally, the inflorescence fibrils are washed well with water to remove silane molecules present if any.

Result and Discussion

The effect of silane modification on the surface of inflorescence fibers subjected to three silane molecules can be inferred with the help of FTIR analyzer. The analysis was done as per KBr pellet technique for a wavelength ranging from 400 cm^{-1} to 4000 cm^{-1} at 32 scans each time for a wave length of 4 cm^{-1}. Finally, morphology of the inflorescence fibrils was examined by scanning electron microscope to perceive the effect of silane molecules on the surface of inflorescence fibrils.

FTIR Analysis

FTIR analysis is used to investigate the influence of silane modification on the chemical structure of inflorescence fibers. The wave numbers and their corresponding functional group assignment are represented in figure 4. The apex at 2970 cm^{-1} corresponds to C-H stretching vibration of alkanes. The apex at 1750 cm^{-1} correlate to C=O stretching vibration of esters. The apex at 1100 cm^{-1} relates to C-O stretching vibration of alcohols. The apex at 750 cm^{-1} represents C=C aromatic stretching. In line with virgin fibers new apex were formed at 3750 cm^{-1} relating to OH stretching vibration, 3610 cm^{-1} correlates to N-H stretching vibration and 1500 cm^{-1} corresponds to stretching vibration of Si-O-C. The peaks confirm that inflorescence fibers and silane are subjected to condensation reaction [11].

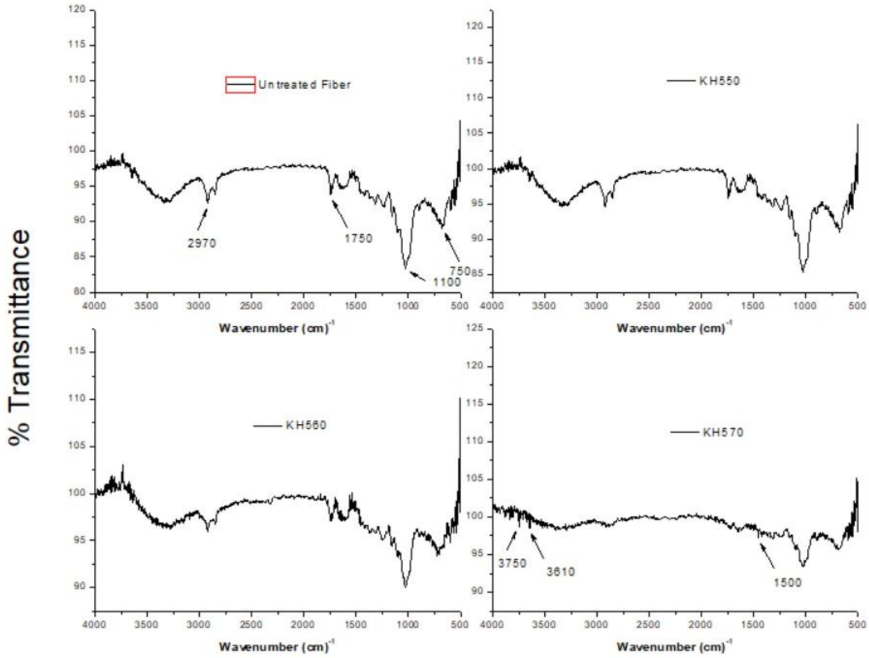

Figure 2 FTIR Spectrum Apex of Unmodified and Silane Modified Inflorescence Fibrils

The order of improvement between different silane modification is KH570>KH560>KH550> unmodified inflorescence/glass fiber fortified bybrid epoxy composites.

Claim

1. The foresaid invention in which fiber extracted from Inflorescence of coconut tree.
2. The extracted inflorescence fiber as per claim 1 must be subjected to surface treatments through suitable agents available.
3. The extracted inflorescence fiber as per claim 1 may or may not be subjected to surface treatments if not required.
4. The extracted inflorescence fiber as per claim 1 must be subjected to silane coupling agents to enhance interfacial adhesion during reinforcement with polymer matrices.