Improving Flame Retardant and Thermal Properties of Nature Fibers Reinforced Composites using Green Flame Retardant Treatment

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Fire safety technologies has been recently modified in order to mitigate the fire cases around the country. The standardization is employing in domestic industry related to fire safety up to the international levels. In manufacturing, the role of composites has been steadily studied by infusing the concept of flame retardancy. Furthermore, to address the issue of sustainability, an increase in demand for commercial use of the natural fibers (NF)-based composites in recent years for various industrial sectors. In nature, its advantages comprise the following characteristics: low-cost, lightweight, renewability, biodegradability, and high specific properties. However, flammability of natural fiber is one of the main disadvantages of natural fiber (NF) reinforced composite scientists have been struggling to improve for decades. Thus, new ideas and approaches for solving this issue are highly required. In this research, effect of fiber surface treatment with phosphoric acid modified chitosan on highly flammable protein (silk, wool) and lignocellulosic (Kenaf) fiber reinforced vinyl ester composite prepared through VaRTM method was studied. The improved intermolecular interaction such as peptide and hydrogen bonding between chitosan/phosphoric acid (CSPA) to the fibers resulted for the enhanced and immediate flame retardancy behavior. Thermal stabilities for the NF treated CSPA also improved as shown in the following numerical values: 237.5% (Kenaf) > 93.1% (Wool) > 57.8% (Silk). The characterizations were studied through spectral analysis using FTIR, TGA, and LV-SEM-EDX; flame retardancy was investigated using Cone calorimeter, Horizontal and Vertical burning tests; and mechanical properties through Tensile, Flexural, and Izod Impact tests. As for the mechanism, synergetic effect of CSPA treatment in condensation and gaseous phases during combusting, meliorates fire resistance of modified NF. Based on the results, this method of fiber treatment can be chosen as an effective way of improving flame retardant properties of natural fiber reinforced composites.

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