

Title: Thermal Degradation and Chemical Analysis of Flame-Retardant-Treated Jute Fabrics

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Abstract: Jute is an inherent lignocellulosic fiber, consisting of hemicellulose, α -cellulose, and lignin. Industrial ventilation, automotive composites, upholstery, carpets, military uniforms, hospital furnishings, and curtains necessitate the integration of flame-retardance properties into jute fibers. In this investigation, seven weave-structured jute fabrics were treated using an organophosphorus-based flame-retardant (FR) chemical (ITOFLAM CPN) and a crosslinking agent (KNITTEX CHN) by the pad-dry-cure method. The thermal stability, degradation and pyrolysis behavior of jute was measured using a thermogravimetric analyzer (TGA). Surface morphology and element distribution were scrutinized utilizing a scanning electron microscope (SEM) and an energy-dispersive spectrometer (EDS). The ATR-FTIR (Attenuated Total Reflection-Fourier Transform Infrared Spectrometer) technique has been employed for analyzing the composition of chemicals in the jute fabrics. According to the protocols specified in ISO 14184-1, free formaldehyde detection was carried out on the jute fabrics. The flame-retardance property was significantly improved on all of the jute fabrics after FR treatment. FTIR and SEM-EDS studies revealed the presence of FR chemical deposition on the surface of the jute fabrics. TGA analysis indicated that the fabrics treated with FR exhibited premature degradation, leading to the generation of more char compared to untreated samples. The jute fabrics specifically demonstrated a notable enhancement in residual mass, exceeding 50% after FR treatment. However, it is noteworthy that the FR-treated fabrics exhibited an elevated level of free formaldehyde content, surpassing the permissible limit of formaldehyde in textiles intended for direct skin contact. The residual mass loss percentage after ten washes of FR-treated fabrics remained in a range from 32% to 36%. Twill weave designed fabrics (FRD4 and FRD5) clearly showed a lower thermal degradation temperature than the other weaves used in this study.

Keywords: jute; flame-retardance; TGA; residual mass; free formaldehyde; ITOFLAM CPN

<https://doi.org/10.3390/polym16142049>

<https://www.mdpi.com/2073-4360/16/14/2049>