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Thermal stability and flame resistance of cotton fabrics treated with polyamidoamine-based coatings

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Polyamidoamine (PAA)-based coatings were used as flame retardant (FR) for cotton due to the chemical similarity found with some proteins with recognised FR properties. PAAs used here were synthetized from the reaction between N,N'-methylenebis(acrylamide) or 2,2-bis(acrylamido)-acetic acid with amines such as amino acids, linear amines or heterocyclic ones [1]. Cotton specimens were treated with PAA water solutions at pH 4.5, measuring the initial and final weight in order to determine the add-on %. Morphological and structural characterizations of the so-treated cotton fabrics were performed by Scanning Electron Microscopy (SEM) and infrared spectroscopy (FT-IR/ATR). The morphology of PAA-treated cotton showed clear add-on dependence. Fibres of both untreated and PAA-treated cotton maintained the original spiralization of cellulose fibrils. The fibre surface was generally flat and smooth, but with a significant level of inhomogeneities related to its natural origin. With 4% add-on the fibre surface was smoother than in untreated cotton and coated by a continuous thin film preserving fibre individuality. Instead, 19.0% add-on coatings filled the interstitial space and most fibres lost their individuality. Thermogravimetric analyses (TGA) were performed in order to study the decomposition mechanism concerning PAA-treated cotton with respect to the untreated fabric, demonstrating the fact that different decomposition processes occur on cotton after treatment with PAAs. TGA simulate curves were obtained by calculating the additive contribution of cotton and PAA and assuming that no chemical-physical interaction occurred. These curves demonstrated that, upon heating, an interaction between the two species occurred during their thermal decomposition in both nitrogen and air. These data were further supported by differential scanning calorimetry measurements that allowed for monitoring the heat fluxes evolved during the thermal decomposition of PAA-treated cotton fabrics. Measurements of resistance to a flame ignition by horizontal and vertical flame tests (Figure 1, 2) and to an irradiative 35 kW/m^2 heat flux by cone calorimetry (Figure 3) were performed for assessing PAA potential as FR for cotton.

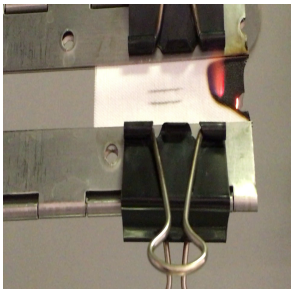

Figure 1. Horizontal flame test.

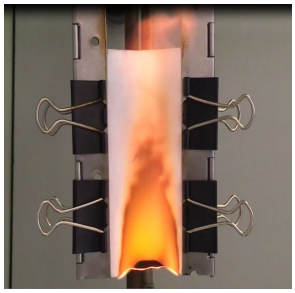

Figure 2. Vertical flame test.

Figure 3. Cone calorimetry test.

References

1. P. Ferruti, *J. Polym. Sci, Part A: Polym. Chem.*, **2013**, *51*, 2319.

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