Linear Polyamidoamines as Novel Biocompatible Intumescent Flame Retardants for Cotton

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Since the middle of the last century, many industrial and academic researchers have devoted a lot of effort to the development of safe and effective flame-retardants (FR). As regards cotton, phosphorylated compounds were the predominant FR for several decades [1] despite many of them had been shown to be bioaccumulative.[1] Recently, biomolecules including proteins have been proposed as FR.[2] Many linear polyamidoamines (PAAs), a family of synthetic polymers with exceptional structural versatility,[3] have high thermal stability coupled with chain structure and side substituents reminding those of proteins.[4] These features suggested that PAAs could act as FR. This presentation reports on the results obtained with a library of eight PAAs applied as coatings on cotton fabrics from aqueous solutions. All tested PAAs warrant remarkable potential as surface-confined intumescent FR. In ignitability tests, six of them exposed to direct flame for 10 s do not burn, but produce carbonaceous crusts sheltering the underneath sample. Thermogravimetric analyses show that at $T \geq 400$ °C all PAAs leave in air substantial char residues that oxidize at $T > 500$ °C. At 450 °C they form porous carbonaceous structures indicating the tendency to intumesce. In horizontal flame spread tests, cotton stripes impregnated with most PAAs extinguish flame at add-ons ranging from 4 to 20%, whereas untreated cotton vigorously burns without leaving residues. Upon 35 kW/m^2 heat flux, all PAA-treated samples significantly reduce the main combustion parameters.

References

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