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Flame retardancy effect of combined ammonium polyphosphate and aluminium diethyl phosphinate in acrylonitrile-butadiene-styrene

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Abstract

The present work investigates the fire retardancy mechanism of ammonium polyphosphate (APP) and aluminium di-ethyl phosphinate salt (AlPi) in an acrylonitrile-butadiene-styrene copolymer (ABS) by analysing the pyrolysis, flammability and fire behaviour. Evidences of synergy in flammability by combining both flame retardants were discussed and related to flame retardant mechanisms assessed by means of TGA and FT-IR analysis of the pyrolysis gases. Specifically, the ABS flame retardant formulation with a 12.5 wt% APP and 12.5 wt% AlPi (ABS-APP/AlPi) reached a UL-94 V-0 classification, unlike the ABS with 25 wt% APP (ABS-APP) and ABS with 25wt% AlPi (ABS-AlPi) formulations, which completely burned. Under forced flame conditions, APP and AlPi showed, respectively, a main condensed and gas phase-based mode of action in the ABS matrix, whereas, a combined gas and condensed mode of action was identified when both additives were simultaneously incorporated. Also, the ABS-APP/AlPi formulation showed the higher reduction of the peak heat release rate (74 %) and of the maximum average rate of heat emission (65 %), obtained from cone calorimeter tests. As well as, a protective fire residue with an improved microstructure assed by SEM.

Keywords: ABS, phosphorous flame retardants, flame retardancy.

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