

Solubilities, Thermostabilities, and Flame Retardance Behavior of Phosphorus Containing Flame Retardants and Copolymers

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The flame retardance of textile materials has never been of such interest as it is today because of the introduction of stringent legislation. Methods for incorporating the flame retardant into the skeleton of the polymer by copolymerisation have been widely used. Higher purity for these flame retardants is required because they are used as co-monomers. These monomers are mostly new compounds, and their solubilities in selected solvents are necessary for the purification process. However, these properties are rarely reported. Higher thermal stability is required for the flame retardant and the copolymers due to the conditions of esterification and polycondensation of the poly(ethylene terephthalate) (PET) and the spinning process are usually carried out at higher temperature range. This work deals with some reactive flame retardants synthesized in our laboratory, such as hydroxymethyl phenylphosphinic acid (HMPPA), 2-carboxyethyl phenyl phosphinic acid (CEPPA), 3,9-(bis-2,2'-carboxylethyl)-2,4,8,10-tetraoxa-3,9-diphosphaspiro[5,5]undecane -3,9-dioxide (BCDPO), bis 4-carboxyphenyl phenylphosphine oxide (BCPPO), 4-carboxyphenyl phenylphosphinic acid (CPPPA), 4-carboxyphenyl phosphinic acid (CPPA) and hydroxymethyl phenylphosphinic acid (HMPPA). Their solubilities in selected solvents are reported. The thermal stabilities of HMPPA, CEPPA, BCDPO, BCPPO, CPPPA, and CPPA were investigated and compared by thermogravimetric analysis (TGA). The BCDPO, BCPPO, CPPPA, CPPA and HMPPA are more stable than the CEPPA. However, little difference was found for the thermal stabilities of the BCPPO, CEPPA and HMPPA incorporated copolymers (FRPET) by the TGA analysis. The temperature at 10% weight loss of the copolymers are 392.6 K for the BCPPO-FRPET, 400.51 K for the HMPPA-FRPET, 396.73 K for the CEPPA-FRPET and 384.10 K for the PET. All of these three copolymers showed good spinning character together with good flame retardance behaviour. The combustion tests of the samples on a Cone calorimeter show the advantage of FRPET. The heat release rate, the total heat released, the mass loss rate, and the effective heat of combustion of the FRPET is more significantly reduced than the PET samples.