NOVEL NANOCOMPOSITE FIRE RETARDANTS

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ABSTRACT

Awareness of polymer nanocomposites unique properties as multifunctional materials, came with the invention of the polyamide 6-clay hybrid in 1984, although nanocomposite materials had been unknowingly prepared throughout the centuries such as in the case of carbon black filled automotive rubber tires, since early 20^{th} century.

Increasing availability of nanoscale characterization tools, lead to rapid growth of research and development of polymer nanocomposites in an ever increasing number of applications. The 1997 discovery of their reduced combustion rate, as compared to respective pristine polymers, created a strong expectancy for a new environmentally friendly control of polymers flammability, to substitute current fire retardants which turned out to be undesirable for their environmental behavior.

As far as nanoparticles are concerned, early attention was focused on phillosilicates, then layered double hydroxides, carbon nanotubes or inorganic oxides were used as they became progressively available. A general mechanism was found to explain the basic features of nanocomposites combustion behavior, involving nanoparticles migration and accumulation to create a surface protective inorganic layer mixed with char produced by nanoparticles catalytic effect.

More recently, a new generation of nanoparticles is being considered such as: halloysites, graphenes, zirconium phosphate, carbon nitride, "one pot" organo-synthetic talc or allophane, cellulose nanofibrils or nanocrystals in the attempt to shorten time to flame extinguishment and increase time to ignition which in some fire scenario are not yet satisfactory in nanocomposites combustion. Furthermore, polymer surface nanostructuration by bottom–up technologies such as Sol-Gel synthesis and Layer by Layer deposition, are showing interesting results in polymer fire retardance, besides the traditional top-down prepared bulk nanocomposites.

Now, with this wide availability of different aspect ratio, chemical composition and morphologies nanoparticles and nanocomposites, we should take the opportunity to deepen further our still unsatisfactory understanding of nanocomposites parameters which are most relevant to their combustion behavior.