CLAYS d-SPACINGS EFFECT ON THE FIRE RETARDANCE OF POLYMER NANOCOMPOSITES WITH AN INTUMESCENT FORMULATION

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The development of polymeric materials with flame retardant properties is becoming more important with time.[1] Organohalogenated compounds are gradually being replaced by other additives due to their high toxicity and environmental aggressiveness. Intumescent formulations and nanocomposites polymer-clays can be excellent alternatives for the development of polymeric flame retardants. However, it has been found that the exclusive addition of clays in a polymeric matrix, in spite of a polymer thermal stability increase and heat release rate decrease that is obtained, this practice does not avoid the complete degradation of the polymer. Therefore, the concomitant use of other fire retardant additives is important, especially if these additives play roles in a synergic way.

Our group has observed that both sodic and organophilic clays are able to play the role of a synergy agent in a matrix of poly[ethylene(30%)–butylacrylate] copolymer containing an intumescent formulation with ammonium polyphosphate (APP) and the pentaerythritol (PER)[2,3]. Besides, it has been found that the d-spacings of the clays have an influence on the synergy effect as well, with LOI values and UL-94 classification improving when d-spacings decrease[4].

In this work it was used the same polymeric matrix and intumescent formulation with APP and the PER. Nanocomposites containing clays and the intumescent formulation with fire retarding properties were studied and the results showed that sodium clays and organoclays with d-spacing of up to 24Å act as synergistic agents. In these cases, there was a significant improvement in the LOI, UL-94 and cone calorimetry results. However, the synergy obtained for systems with organoclays with d-spacings exceeding 30Å dropped dramatically. To elucidate this phenomenon the intumescent layer formed was studied through SEM and FTIR analysis of the burnt residues. Also, polymer-clay nanocomposites without the intumescent formulation were evaluated through the same techniques and the results revealed that an increase in the d-spacings of the clays did lead to an increase in the fire resistance of these materials. The SEM analysis results showed that the addition of clays with basal spacings larger than 30 Å led to the formation of an intumescent layer with morphology very similar to the one shown by the sample containing only the intumescent formulation, without synergistic agents. In this case, the formed char was less homogeneous and less structured than those from the materials containing clays with d-spacings of 13 and 22 Å. The FTIR analysis of the burnt residues indicated a late formation of phosphocarbonaceous species when the clays with higher basal spacing were added. These findings can justify the loss of the synergy effect and the morphology of the char formed for these materials.

References

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