SYNTHESIS AND CHARACTERIZATION OF NEW INTUMESCENT FLAME RETARDANT ADDITIVES IN POLYPROPYLENE

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Main message
As polypropylene (PP) has no charring ability on its own due to the lack of hydroxyl functional groups, the flame retarded system needs the addition of carbonizing agent in a relatively great amount. Ammonium-polyphosphate (APP), a conventional flame retardant additive was modified by microencapsulation (MC) with bioepoxy resin shells, in order to create an intumescent flame retardant (IFR) system with high content of charring agent for PP. The microcapsule contains all the components which are need in an effective intumescent flame retardant system, and was added to the PP at different loadings to test their efficacy on the flame retardancy of the polymer.

Keywords: polypropylene, microcapsule, ammonium-polyphosphate, bioepoxy resin, intusmescent flame retardant

Introduction
Polypropylene (PP) has no charring ability on its own due to the lack of hydroxyl functional groups in its chemical structure. When applying ammonium-polyphosphate (APP) in PP, a conventional additive in intumescent flame retardant system, in order to effectively flame retard the polymer the addition of carbonizing agent is needed in a relatively great amount. As APP is modified by microencapsulation (MC) with bioepoxy resin shells [1], it contains all the components which are need in an effective intumescent flame retardant system: it acts as the acid source, charring and blowing agent [2].

Experimental
The bioepoxy resin was consisted of sorbitol polyglycidyl ether (SEP) and T58 crosslinking agent. The bioepoxy resin microencapsulated APP was prepared with different APP and SEP ratio (APP:SEP = 10:2 and APP:SEP = 10:5), the synthesized flame retardants then were added to the PP at different loadings (5 m/m% to 35 m/m%) to test their efficacy on the flame retardancy of the polymer. The flame retarded PP samples were comprehensively evaluated through thermal (TGA) and flammability (LOI, UL94, MLC) testings.

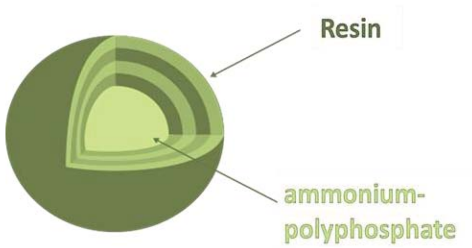

FIGURE 1. The structure of bioepoxy resing microencapsulated ammonium-polyphosphate

Results and Discussion

Increasing the shell thickness of the microcapsule and its content in the polymer significantly improve the flame retardancy of the PP composites. It was found that the microcapsule with higher shell thickness at a lower loading prominently shows excellent flame retardant properties compared to the microcapsule at lower shell thickness.

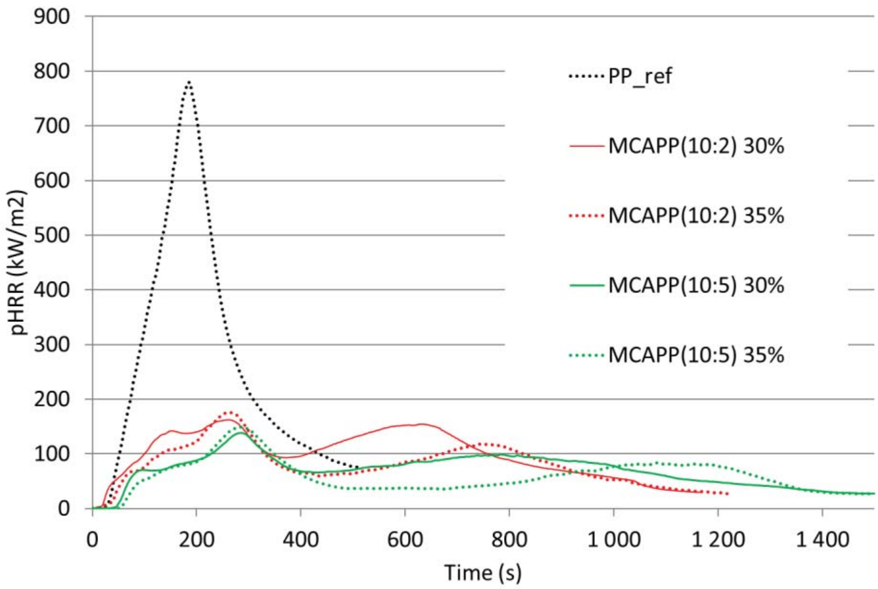

FIGURE 2. Observed heat release of PP composites

In general, with the increase of the loading content of the flame retardant in PP, higher LOI values and better UL94 classes are achieved by the samples. In the MLC test, about 80-85% of reduction was measured in the flame retarded samples' peaks of heat release rate compared to that of the neat PP reference sample, overall resulting in reduced total heat released. The burning of flame retarded samples becomes more and more prolonged over time with much less intensity, which in a real fire scenario leads to the flame being much less likely to spread over.

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