

# ADVANCES IN FIRE RETARDANT POLYMER MATERIALS

**Giovanni Camino\*, Alberto Fina, Fabio Cuttica, Alberto Frache**

Polytechnic of Turin, Alessandria Campus, Viale Teresa Michel 5 - 15121 Alessandria, Italy  
giovanni.camino@polito.it

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## ABSTRACT

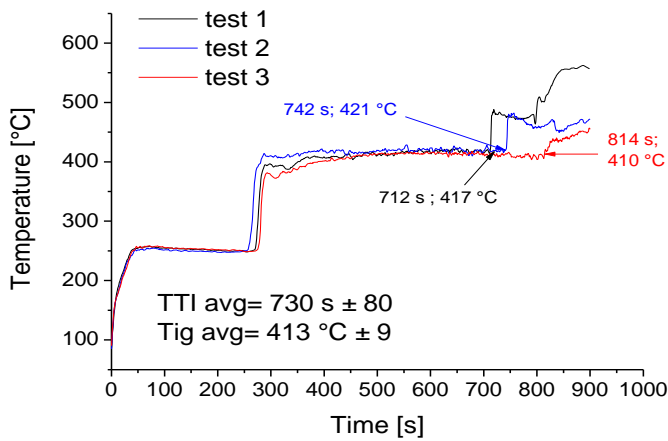
Fire and flame retardants have been used so far as synonyms to indicate polymer additives which should reduce polymers fire risk (probability of fire occurrence) and fire hazard (fire consequences to people and property). In a fire, these additives role is that of increasing time to flashover above time required for people to escape from the fire scene and/or to allow for extinguishing means intervention.

Flame propagation was mostly involved in the research work carried out in this area in the past, whereas little attention has been devoted to the ignition step. However, time to ignition accounts for a significant part of the overall time to flashover, since the polymer material is accidentally exposed to a heating source. On the other hand, temperatures involved in the pre-ignition polymer thermal volatilisation and hence its rate, are lower than when flame is established, making thus easier contrasting processes that supply combustible volatiles to the gas phase prior to ignition occurrence.

The polymer degradation scenario before and after ignition is very different e.g. being respectively aerobic or very much oxygen depleted. Furthermore, after ignition, heat from volatiles combustion adds to that from the ignition source, affecting polymer heating rate. Since polymers thermal decomposition may be strongly affected by the degradation scenario, a detailed knowledge of physical/chemical evolution of polymers in the pre-ignition step is necessary to develop a successful strategy to delay ignition.

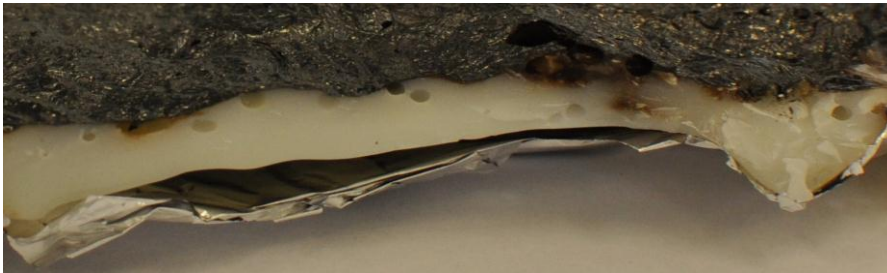
It would thus be convenient to define **flame retardants**, those additives which delay ignition and **fire retardants** those which slow down combustion/flame propagation.

In this work, thermal evolution of the polymer surface exposed to radiant heat in the Cone Calorimeter was monitored by thermocouples measuring surface and bottom temperature of exposed specimens as shown in figure 1 in which time delays due to polymer melting and volatiles flux growing to reach flammability limits, are shown



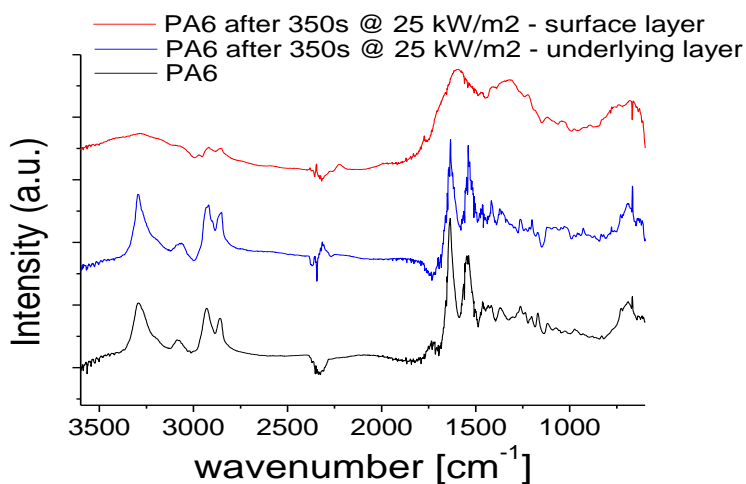
**Figure 1.** Surface temperature-time plot: PET copolymer exposed to 25 kW/m<sup>2</sup>.

Physical polymer modifications were visually observed as shown in Figure 2 where build-up of surface char and bulk voids due to bulk volatilisation can be seen.



**Figure 2.** Polyamide 6 at ignition time on exposure to 25 kW/m<sup>2</sup>.

Chemical polymer evolution on heating before ignition occurs was studied by infrared spectroscopy as shown in figure 3.



**Figure 3.** Infrared spectra of surface and bulk Polyamide 6 at ignition time (350s) on exposure at 25 kW/m<sup>2</sup>, compared to original sample.

## References

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- (2)Fina A., Cuttica F., Camino G., “Ignition of polypropylene/montmorillonite nanocomposites”, submitted