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THRMAL ANALYSIS OF AMPREG 21 EPOXY AND Bi COMPOSITE MATERIAL USING THE CONE CALORIMETER

Organic polymers with inorganic reinforced composites are in daily use both domestically and industrially - in coating, adhesives, primers, aeronautic utilities, electro-optical devices and sensors, among others. These polymer-based materials are competing with metallic alloys in terms of cost and functionality (durability, strength, and other physical and chemical properties). However, the effect of heat on some of these polymer-based composites, brings some undesirable changes that affect product functionality. In addition, inorganic additives to organic epoxy resin have shown promising flame-retardant effects and increasing electrical conductivity. One particular epoxy polymer, Ampreg 21TM, with Bi inorganic fillers of different weight percentages (0; 0.46; 0.90; and 1.39 wt%) was the focus of this study. The Dual Cone Calorimeter was set to irradiate the samples with 35 and 50 kW/m2 external heat fluxes, yielding the thermal performances of the binary composites in terms of: the heat release rate (HRR), fire spread index (FIGRA), smoke release rate (SPR), smoke spread index (SMOGRA), time-to-ignition (TTI), and the maximum rate of heat emission (MARHE) of the composite samples.
The results show that increasing Bi content in the epoxy decrease the parametric values linked to the fire performance of the samples. Thus, the Bi powder additives, being good heat conductor, assist in spreading heat in the matrix and as a result also serve as fire retardant in the composite.
For the 35 kW/m2 irradiation, TTI decrease from 89 (neat sample) to 70 s (1.39 wt% Bi); Peak HRR decrease from 818.95 (neat) to 698.9 kW/m2 (1.39 wt% Bi); FIGRA decreases from 2.48 (neat) to 1.49 W/s (1.39 wt% Bi); SMOGRA decrease from 5.08 to 3.83 m2/s2; and MARHE decreases from 416.6 to 393.7 kW/m2.
For the 50 kW/m2 irradiation, TTI decrease from 38 (neat sample) to 31 s (1.39 wt% Bi); Peak HRR decrease from 1361.73 (neat) to 675.03 kW/m2 (1.39 wt% Bi); FIGRA decreases from 4.78 (neat) to 2.25 W/s (1.39 wt% Bi); SMOGRA decrease from 9.39 to 6.27 m2/s2; and MARHE decreases from 632.3 to 425.7 kW/m2.

Clearly, increasing Bi additives in the range used, decrease TTI, pHRR, FIGRA, SMOGRA, and MARHE values. Thus, good thermal performance of the composites are achieved with increasing wt% of the Bi additives.

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