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Characterization of the Ignitability and Flame Regression Behaviour of Flame Retarded Natural Fibre Composite Panel

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Abstract : Natural fibre composites (NFC) are becoming very attractive especially for automotive interior and non-structural building applications because they are biodegradable, low cost, lightweight and environmentally friendly. NFC are known to release high combustible products during exposure to heat atmosphere and this behaviour has raised concerns to end users. To improve on their fire response, flame retardants (FR) such as aluminium tri-hydroxide (ATH) and ammonium polyphosphate (APP) are incorporated during processing to delay the start and spread of fire. In this paper, APP was modified with Gum Arabic powder (GAP) and synergized with carbon black (CB) to form new FR species. Four FR species at 0, 12, 15 and 18% loading ratio were added to oil palm fibre polyester composite (OPFC) panels as follows; OPFC12%APP-GAP, OPFC15%APP-GAP/CB, OPFC18%ATH/APP-GAP and OPFC18%ATH/APPGAP/CB. The panels were produced using hand lay-up compression moulding and cured at room temperature. Specimens were cut from the panels and these were tested for ignition time (Tig), peak heat released rate (HRRp), average heat release rate (HRRavg), peak mass loss rate (MLRp), residual mass (Rm) and average smoke production rate (SPRavg) using cone calorimeter apparatus as well as the available flame energy (ϕ) in driving the flame using radiant panel flame spread apparatus. From the ignitability data obtained at 50 kW/m2 heat flux (HF), it shows that the hybrid FR modified with APP that is OPFC18%ATH/APP-GAP exhibited superior flame retardancy and the improvement was based on comparison with those without FR which stood at Tig = 20 s, HRRp = 86.6 kW/m2, HRRavg = 55.8 kW/m2, MLRp =0.131 g/s, Rm = 54.6% and SPRavg = 0.05 m2/s representing respectively 17.6%, 67.4%, 62.8%, 50.9%, 565% and 62.5% improvements less than those without FR (OPFC0%). In terms of flame spread, the least flame energy (ϕ) of 0.49 kW2/s3 for OPFC18%ATH/APP-GAP caused early flame regression. This was less than 39.6 kW2/s3 compared to those without FR (OPFC0%). It can be concluded that hybrid FR modified with APP could be useful in the automotive and building industries to delay the start and spread of fire.

Keywords : flame retardant, flame regression, oil palm fibre, composite panel
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