

Suitability of Wood Sawdust Waste Reinforced Polymer Composite for Fireproof Doors

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Abstract : The susceptibility of natural fibre polymer composites to flame has necessitated research to improve and develop flame retardant (FR) to delay the escape of combustible volatiles. Previous approaches relied mostly on FR such as aluminium tri-hydroxide (ATH) and ammonium polyphosphate (APP) to improve fire performances of wood sawdust polymer composites (WSPC) with emphasis on non-structural building applications. In this paper, APP was modified with gum Arabic powder (GAP) and then hybridized with ATH at 0, 12 and 18% loading ratio to form new FR species; WSPC12%APP-GAP and WSPC18%ATH/APP-GAP. The FR species were incorporated in wood sawdust waste reinforced in polyester resin to form panels for fireproof doors. The panels were produced using hand lay compression moulding technique and cured at room temperature. Specimen cut from panels were then tested for tensile strength (TS), flexural strength (FS) and impact strength (IS) using universal testing machine and impact tester; thermal stability using (TGA/DSC 1: Metler Toledo); time-to-ignition (Tig), heat release rates (HRR); peak HRR (HRRp), average HRR (HRRavg), total HRR (THR), peak mass loss rate (MLRp), average smoke production rate (SPRavg) and carbon monoxide production (COP) were obtained using the cone calorimeter apparatus. From the mechanical properties obtained, improvements of IS for the panels were not noticeable whereas TS and FS for WSPC12%APP-GAP respectively stood at 12.44 MPa and 85.58 MPa more than those without FR (WSPC0%). For WSPC18%ATH/APP-GAP TS and FS respectively stood at 16.45 MPa and 50.49 MPa more compared to (WSPC0%). From the thermal analysis, the panels did not exhibit any significant change as early degradation was observed. At 900 OC, the char residues improved by 15% for WSPC12%APP-GAP and 19% for WSPC18%ATH/APP-GAP more than (WSPC0%) at 5%, confirming the APP-GAP to be a good FR. At 50 kW/m² heat flux (HF), WSPC12%APP-GAP improved better the fire behaviour of the panels when compared to WSPC0% as follows; Tig = 46 s, HRRp = 56.1 kW/m², HRRavg = 32.8 kW/m², THR = 66.6 MJ/m², MLRp = 0.103 g/s, TSR = 0.04 m²/s and COP = 0.051 kg/kg. These were respectively more than WSPC0%. It can be concluded that the new concept of modifying FR with GAP in WSPC could meet the requirement of a fireproof door for building applications.

Keywords : composite, flame retardant, wood sawdust, fireproof doors

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