Curing and thermal properties of co-polymerized tannin phenol–formaldehyde resin for bonding wood veneers

ABSTRACT

The aim of this study is to assess the curing behaviour and thermal properties of phenol–formaldehyde (PF) adhesives with different degree of tannin substitution using several thermal analysis techniques. Tannin from Acacia mearnsii bark was copolymerized with PF to form a bonding agent for plywood. The resin mixture was heated at 50 °C prior to adding 40% w/w tannin solution, followed by a continuous stirring for 2 h. The amounts of tannin substitution were 20%, 30% and 40% (w/w of PF solids) and 100% PF were used as control. The study shows that the addition of tannin quickened the gel time of the resin notably, parallel with the increase in viscosity of the resin. The dry shear bond strength of the tannin phenol–formaldehyde (TPF) co-polymer ranged between 1.71 and 2.58 MPa as compared to 3.41 MPa for PF. At higher addition of tannin, the shear bond strength reduced significantly predominantly the 40% tannin substitution. Formulation containing 20% tannin was found comparable to that of neat PF. Thermal test revealed that TPF starts to degrade at a lower temperature than PF resin. All TPF resins started to cure at about 125 °C and peaked at 160 °C compared to PF that began to cure at 145 °. The DMA of the resin showed an increase in the resin stiffness with an addition of tannin. These results imply that even though TPF starts to degrade at lower temperature, the cured TPF is relatively stronger than pure PF.

Keyword: Adhesive curing; Glass transition temperature; Rigidity; Bonding shear