Effect of Surface Coating and Plasma Treatment on Mechanical Properties of Wood Plastic Composites

Abstract

Mechanical properties of plasma-irradiated and surface-coated wood plastic composites (WPCs) have been investigated in this paper. WPCs were developed by injection molding technique using wood fiber (WF) as reinforcement and polypropylene (PP) as matrix. The short, discontinuous WF was compounded with thermoplastic PP at varying weight fractions of 0 wt%, 25 wt% (WP25), and 50 wt% (WP50) to yield tensile test specimens in accordance with JIS K7139-A32 standards. Subsequently, plasma treatment was performed on the test-pieces, followed by surface coating by immersion in acrylic resin liquid containing homogeneously dispersed TEMPO-oxidized cellulose nanofibers (CNF). The results indicate an increase in surface roughness after plasma irradiation, but surface coating of the specimens with acrylic paint and CNF decreased their surface roughness by ∼50% in comparison to the untreated specimens. Plasma treatment and surface coating also increased the tensile strength of neat PP, WP25 and WP50 specimens by 5.4–7.1%, 3.5–3.7% and 3.0–3.6%, respectively, whereas their fracture strains tended to decrease. Compared to the untreated specimens, the surface-coated specimens generally displayed higher tensile strength. This finding is a corroboration that the observed increase in strength is highly contingent on the adhesion between the specimen surface and the coating layer than on the improvement in surface roughness. Thus, it is inferable that surface coating could be of great importance in enhancing the mechanical performance of WPCs.