Interfacial control of cellulose nanofiber / thermoplastic resin composite

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INTRODUCTION

Microfibrillated cellulose (MFC), which is mechanically nano-fibrillated pulp into nanofibers forming a web-like network, shows much promise as reinforcement for plastic. However, the inherent incompatibility between cellulose fibers and hydrophobic thermoplastic resin usually yields poor interfacial adhesion. This study focuses on the improvement of the interfacial adhesion between MFC and the resin (poly (lactic acid): PLA and polypropylene: PP) by esterification of MFC and/or addition of maleic anhydride grafted resins.

MATERIALS and METHODS

MFC (DAICEL CHEMICAL INDUSTRIES, LTD.) was modified by acetylation, butylation or stearylation. The water in modified MFC or untreated MFC slurry was replaced by solvent (acetone for PLA and xylene for PP), and 1wt% MFC in solvent suspension was prepared. When the MFC was thoroughly dispersed in the solvent by stirring, PLA or PP was gradually added. The mixture was dried at room temperature followed by vacuum-drying and a kneader was used to obtain a homogeneous compound. The compound was hot-pressed into films. Maleic anhydride grafted PLA (MA-PLA) and PP (MA-PP) was added to the composites reinforced with untreated MFC and acetylated MFC, respectively.

RESULTS and DISCUSSION

Fig.1 shows the stress-strain curves of tensile test of esterificated MFC5% / PLA composites. Mechanical properties of the acetylated, propionylated and butylated MFC5% / PLA composites are higher than that of untreated MFC / PLA composite. FE-SEM micrographs of fractured surface for composites samples evidenced to improve the interfacial adhesion.

However, mechanical properties of PLA reinforced with stearylated MFC was decreased and FE-SEM micrographs of fractured surface for this composite confirmed the deterioration of the interfacial adhesion

Fig.2 shows the stress-strain curves of tensile test of MFC5% / PP composites to added in MA-PP as a compatibilizer. the addition of MA-PP improved the mechanical properties of all amoposites. FE-SEM micrographs of fractured surface for composites observed the improvement of the interfacial adhesion.

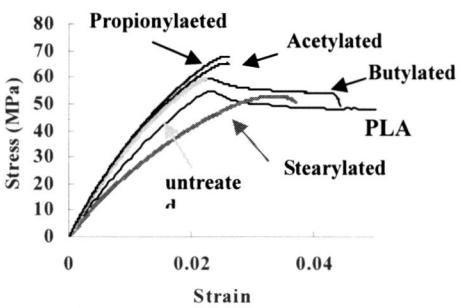

Fig.1 Stress-strain curves for composites reinforced with 5wt% acetylated, propionylated, butylated, and stearylated MFC

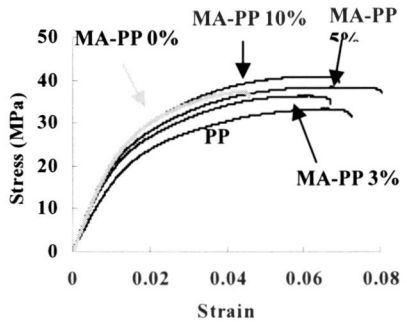

Fig.2 Stress-strain curves for composites to added in MA-PP as a compatibilizer.