A new process for the preparation of nanocomposites of cellulose fiber/microfibrils and thermoplastic starch

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Cellulose microfibrils are promising materials for the production of green nanocomposites due to its high mechanical strength, which are compared to Kevlar and its renewable and biodegradable character. However due to the strong hydrogen bond interaction between microfibrils this material shows the tendency to form agglomerates rendering poor dispersion in the polymer matrix. In this work a new process for cellulose microfibrils dispersion in thermoplastic starch (TPS) was studied and the resulting materials evaluated for its mechanical properties and fiber dispersion. The microfibrils were produced from bleached wood pulp which was washed with 5% KOH solution at 90 C for the removal of hemicelluloses followed by ultrasound and Ultra-Turrax. After this treatment the fibers were frozen in liquid nitrogen and grinded. The composites were produce by dispersing native starch in the suspension of microfibrils in water followed by gelatinization of starch drying and extrusion of the produced mixture in a single screw extruder. The correct proportion of glycerol was adjusted by adding glycerol before extrusion. 30 wt% glycerol with respect of starch was used. The composites were characterized in the form of thin film by visible microscopy to evaluate fiber dispersion and the absence of agglomerates and by tensile stress mechanical tests. In Figure 1 are presented the visible microcopy of thin films.

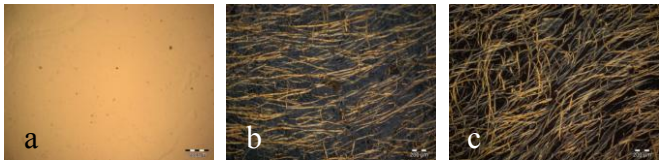

Figure 1. Light visible transmission microscopy of thin films of composites, (a) matrix (b) 5% fiber and (c) 10 % fiber.

The conversion of the wood pulp into microfibrils is not complete. However is possible to observe the fiber dispersion by light microscopy under polarized light. Figure 1 shows these images where is possible to observe the excellent fiber dispersion. The mechanical tests shows a pronounce increase in modulus and tensile strength. The modulus increase from 3,2 MPa for the matrix to to 6,07 and 5,17 for the composites with 5 and 10wt 5fiver, respectively. respectively. The tensile strength increases from 2,5 MPa for the matrix to 4,1MPa and 2,85MPa for the composites with 5 and 10 wt% fiber. These properties show that the process used is a promising process for the production of high resistant composites of TPS. Keywords: green nanocomposites, microfibrils, composites materials, TPS matrix.
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