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Influence of Calcium Silicate and Hydrophobic Agent Coatings on Thermal, Water Barrier, Mechanical and Biodegradation Properties of Cellulose

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Abstract

Thin films of cellulose and cellulose–CaSiO3 composites were prepared using 1-ethyl-3- methylimidazolium acetate (EMIMAc) as the dissolution medium and the composites were regenerated from an anti-solvent. The surface hydrophilicity of the resultant cellulose composites was lowered by coating them with three different hydrophobizing agents, specifically, trichloro(octadecyl)silane (TOS), ethyl 2-cyanoacrylate (E2CA) and octadecylphosphonic acid (ODPA), using a simple dipcoating technique. The prepared materials were subjected to flame retardancy, water barrier, thermal, mechanical and biodegradation properties analyses. The addition of CaSiO3 into the cellulose increased the degradation temperature and flame retardant properties of the cellulose. The water barrier property of cellulose–CaSiO3 composites under long term water exposure completely depends on the nature of the hydrophobic agents used for the surface modification process. All of the cellulose composites behaved mechanically as a pure elastic material with a glassy state from room temperature to 250 ◦C, and from 20% to 70% relative humidity (RH). The presence of the CaSiO3 filler had no effect on the elastic modulus, but it seemed to increase after the TOS surface treatment. Biodegradability of the cellulose was evaluated by enzyme treatments and the influence of CaSiO3 and hydrophobic agents was also derived.

Keywords:

α-cellulose; CaSiO3 ; ionic liquid; coatings; hydrophobic agent coatings; biodegradability

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