

SURFACE FUNCTIONALIZATION OF CELLULOSE FIBERS WITH CALCIUM SILICATE NANOPARTICLES

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In the recent past, there is an increase in interest towards the use of cellulose fibers as an alternative fiber source in fiber reinforcing composites. The unique features of cellulose fibers such as low density, biodegradability, sustainability and abundance make it a useful biopolymer in aforementioned applications. Therefore, cellulosic fibers as reinforcements for cement composites can be an interesting option for the construction industry. However, there are some drawbacks in both mechanical and physical properties of those fiber reinforced cement composites such as, low flexural strength, low resistance to water induced damages, high water permeability and high water migration respectively. These are largely due to the presence of water conducting channels and pores in the cellulose fiber lumens and cell walls. Researchers have attempted to overcome this issue by reducing the reactive hydroxyl sites in cellulose fibers by chemical surface treatments/modifications such as esterification, etherification, urethane formation etc. In this study, the main objective was to modify the surface of cellulose fibers with calcium silicate nanoparticles (CS np) via insitu wet chemical synthesis. Unbleached, cellulose fibers extracted from softwood craft pulp was swelled with 2.0 moldm⁻³ sodium silicate, separated by filtration followed by the addition of 2.35 moldm⁻³ calcium chloride to synthesis CS np insitu on cellulose fiber surface. Resulted sample was washed until the wash-water was clear prior to oven dry at 60 °C. The resulting CS np coated fibers were characterized using scanning electron microscopy (SEM) and elemental mapping with energy dispersive X-Ray Spectroscopy (EDX) coupled to SEM. Structural characterization of the coated CS np was conducted using powder X-Ray diffraction (PXRD) techniques. Further, the extent of coating was determined by thermogravimetric analysis (TGA). The attachment of CS np into the pores of cellulose fibers can be observed in SEM image. Elemental mapping of CS np coated cellulose fibers further highlighted the uniform coating of CS np even after 3-4 washing cycles. SEM images of CS np clearly showed that the particle size was less than 100 nm. The PXRD pattern of CS np coated cellulose matches with the ICDD library data for CS which confirms its identity. Thermogravimetric Analysis data revealed that the extent of coating of CS np is about 27 % of the total weight.

Keywords: cellulose, calcium silicate, nanoparticles, surface coating