NANOPARTICLES BASED ON LIGNIN

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Introduction

Lignin is a natural polymer with aromatic structure and plays an important role in cementing polysaccharides from cell walls of superior plants, improving the mechanical strength and increasing their stability on microorganisms and enzymes. Nanotechnology allows the use of physical, chemical or biological aspects which otherwise do not occur outside the nanoscale. In recent years there is particular interest to nanodispersions based on organic substances insoluble in water. Compared with inorganic substances, nanodispersions based on organic compounds are not persistent in the environment. These nanodispersions can be used to obtain: biocides, pharmaceuticals, paints, etc.

Objectives

Obtaining nanoparticles based on lignin: (1) a physical method based on using ultrasounds and (2) a chemical method using lignin hydroxymethylation

Materials and Methods

Straw lignin (unmodified) (L1), grass lignin (unchanged) (L2), were supplied by Granit Recherche Development company and modified L1sonic, L2sonic) by ultrasonic treatment and (L1Hnano, L2Hnano) by hydroxymethylation, with formation of nanodispersions, specimens of birch veneer (7.5/2.5/1.2 cm). Lignin biocide testing systems were made by immersing the specimens of birch veneer in a 5% lignin suspension, and further were introduced into soil for six months. Efficiency treatments were evaluated by determining the weight loss and contact angle.

Analysis techniques

Particle size distribution analysis of nanoparticles was determined with instrument SALD 7001. A single light source of violet laser combined with a single optical system allows the size determination of particles from 15nm to 500 µm by laser diffraction method.

Results and Discussion

Particle size distribution analysis of lignin nanoparticles is shown in Figure 1, values were recorded in the range 30-100 nm. Compared with chemical methods, the use of ultrasound allows obtaining nanoparticles with smaller sizes. It is known that secondary metabolic products (lignin, polyphenols) are included in the defense mechanism which plants have developed against pathogens or nonpathogenic microorganisms. These reasons have resulted in a first stage study birch interaction as veneer with some products based on lignin unchanged or modified. Figure 2 shows the results of the mass loss at the veneer samples treated with different products. Concerning lignin, this inhibits the process of biodegradation, in an order which is influenced by the modifying reaction type. The small weight losses are determined by lignin modification by hydroxymethylation and also by the presence of nanoparticles; as consequence of these modifications the veneer surface is penetrated more easily by lignin, which gives it strength against soil microorganisms action. Efficiency treatments of wood surface depend on the nature of the product used, modifying reaction and the amount of nanoparticles. Values recorded to determine contact angle confirms that a biological product used provides stability to the surface veneer of birch (Figure 3).

Conclusion

Lignin-based nanoparticles were obtained by physical and chemical modifications. Synthesized products were characterized regarding dimensional distribution and tested in biocides systems. Treatments were made on birch veneer and biological stability of these products was determined by evaluating the weight loss and contact angle.

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References