

Effects of sodium hydroxide treatment of particles on the quality properties of particleboard

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Abstract: The purpose of this study was to determine the effects of treatment of wood particles with sodium hydroxide (NaOH) (for 12 and 24 h) on the mechanical (modulus of rupture, modulus of elasticity and internal bond strength), physical (thickness swelling) and surface quality (roughness and contact angle) properties, and formaldehyde emission of particleboard composite. *Ailanthus Altissima* (Mill.) Swingle trees were used as a raw material for manufacturing of the test panels. Urea formaldehyde resin was applied as an adhesive. Ammonium chloride was added into the urea formaldehyde resin as a hardener. Mechanical and physical properties and formaldehyde emission of the panels were determined according to European standards. The surface properties of the samples were determined by employing a fine stylus profilometer. The wetting behavior of the samples was characterized by the contact angle method (goniometer method). Contact angle measurements were performed using a CAM 101 Optical Contact Angle Meter. Alcohol-benzene, hot and cold water and dilute alkali (1% NaOH) solubility's and lignin content were determined according to TAPPI standards. Hemicellulose and cellulose contents were determined by chlorite and nitric acid methods. Amount of condensed tannin was determined according to the method developed by Tisler and friends. Analysis of variance was conducted to evaluate the effects of sodium hydroxide treatment and adhesive amount on the quality properties of the panels. NaOH treatment positively affected the surface roughness, adhesion and mechanical strength properties of particleboards. However, this application increased the thickness swelling and formaldehyde emission of the panels. NaOH treatment statistically decreased the amounts of extractives and hemicelluloses. Positive effects of NaOH treatment on the surface quality and mechanical properties of the test panels are increased related to the treatment time. The results showed that particleboards made from particles treated with NaOH for 24 h had the required levels of mechanical strength properties for general purposes and furniture manufacturing. Decreasing adhesive amount in the particleboard negatively affected the surface quality, mechanical and physical properties of particleboard except for formaldehyde emission. Panels made from treated particles with NaOH for 24 h at 8-10% adhesive usage had the required levels of mechanical strength properties for general purposes.

Keywords: Particleboard, Sodium hydroxide Treatment, Mechanical and physical properties, Formaldehyde emission, Surface quality properties, Chemical properties.

1. Introduction

Particleboard is an engineered wood product manufactured from wood particles and synthetic resins at high temperature and pressure. It is widely used in the furniture, floor underlayment, cabinets, housing, interior decoration, shelving, vanities, bulletin boards, structural sheathing, electronic game consoles, table tennis, sliding doors, pool tables, lock blocks, displays, speakers, counter tops, stair treads, paneling, kitchen worktops, interior signs, wall and ceiling panels, packing materials, insulators, educational establishments, building and other industrial product applications. The demand and consumption of particleboard composite show an increase in the wood sector due to its stability and low price. The manufacturing of particleboard has positive effects on the environment and economy, due to using waste materials and residues.

Many studies have been performed on the effects of manufacturing factors and parameters on the quality properties of particleboard. Among these factors are log position (Muhcu et al., 2015), bark extractives (Nemli et al., 2004), residue type and tannin content (Moubarik et al., 2013), permeability of wood (Lynam, 1969), density of wood and particleboard, pressing conditions (Maloney, 1977), dimensions of particles (Mottet, 1967), anatomical and chemical properties of wood (Baharoglu et al., 2013), resin type (Sari et al., 2012), moisture content of wood (Baharoglu et al., 2012), moisture content of particles (Kollmann et al., 1975), additives (Heebing, 1967).

The objective of this investigation was to evaluate the effects of sodium hydroxide treatment of particles on the mechanical (modulus of rupture, modulus of elasticity and internal bond strength) and physical (thickness swelling) properties, formaldehyde emission, surface roughness of particleboard, and chemical properties (solubility's, amounts of cellulose, hemicellulose and lignin) of wood.