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Mechanical Properties of Commercial Particleboard from Rubberwood (Hevea Brasiliensis) and Recycle Mix-Tropical Wood with Different Board Density

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ABSTRACT

In this study, mechanical properties of commercially manufactured hybrid particleboard from mix-tropical wood and rubberwood with four different densities at 25mm thickness have been investigated. The particleboard sample cutting and testing was in accordance to EN312:2013. The density of particleboard is identified with interval of 10kg/m^3 for different densities which include 660kg/m^3, 670kg/m^3, 680kg/m^3 and 690kg/m^3. Particleboards were made with the ratio of 40:60 for mix-tropical wood particle and rubberwood particle respectively. The particleboards were prepared with urea formaldehyde (UF) with E1 formulation with addition of wax and hardener. Increment of 10kg/m^3 density for each particleboard led to increase in internal bonding (IB), bending testing include modulus of rupture (MOR) and modulus of elasticity (MOE), surface soundness (SS) and screw edge (SE) withdrawal. It was found that with board increment of 10kg/m^3, the improvement was not statically significant except that for MOR. All panels met the minimum requirements of standard.

Keywords: *Particleboard, Mechanical Properties, Board Thickness, Board Density*

RESEARCH HIGHLIGHTS

The slight or no difference in the board performance identifies the tolerance level for density target in production. A control ranges of 40 kg/m^3 is critical as the manufacturer could target for lower density which will allow better saving in production cost.

Research Objectives

This paper focused on mechanical properties of commercial board made up of wood waste from recycled mix-tropical wood and rubberwood. The sensitivity of density of particleboard was looked at four different densities with an increment of 10kg/m^3 selected. The densities were 660kg/m^3, 670kg/m^3, 680kg/m^3 and 690kg/m^3. Local particleboard manufacturer target was to utilize waste generated from recycle mix-tropical wood with supplement of rubberwood with E1 type of urea-formaldehyde adhesive to meet the minimum board properties requirements of customer.

Methodology

Particleboards manufactured by local particleboard manufacturer and consist of two main materials, wood particle and adhesive. Wood particle were classified into two types, rubberwood and mix-tropical wood and utilized in mix-ratio of 60:40. This study used synthetic E1 typed urea formaldehyde resin. Addition of ammonium chloride as hardener, fasten curing process so as to increase board strength and wax helps reduced board's swelling. Boards were formed in 3 layers (top, core and bottom) targeting thickness of 25mm. The densities of particleboard selected were 660kg/m^3, 670kg/m^3, 680kg/m^3, and 690kg/m^3. The process of commercial production of particleboard. Board used in testing was collected after board cutting. All specimen was conditioned at 65% relative humidity at 20^{o}C for 24 hours prior to testing. The specimen is then tested and involved internal bonding (IB), bending testing include modulus of rupture (MOR) and modulus of elasticity (MOE), surface soundness (SS) and screw edge (SE) withdrawal.

Results

Mechanical testing results included modulus of rupture (MOR), modulus of elasticity (MOE), IB, surface soundness (SS) and screw edge (SE) withdrawal. All densities meet minimum requirement of EN312:2013 standard. Density of 690kg/m^3 gave the highest result with 12.26MPa (MOR), 2176.46MPa (MOE), 0.70MPa (IB), 1.1N/mm^2 (SS) and 432.15N (SE). While the lowest result was for 660kg/m^3 with 10.88MPa (MOR), 2045.50MPa (MOE), 0.63MPa (IB), 1.07N/mm^2 (SS) and 421N (SE). This is as predicted, due to lower board compaction. MOE, MOR and IB result shows increased as well as the density of board is increasing.

Summarized the analysis of variance (ANOVA) on effect of the density of particleboard interaction with properties of hybrid particleboard. The results shown the summary of 4 different densities of particleboard includes 660kg/m^3, 670kg/m^3, 680kg/m^3 and 690kg/m^3. There was no significant effect observed on summary of analysis of variance (ANOVA) on the particleboard properties (MOE, IB, SE and SS) except for MOR. The 7% differential in value is enough to make the MOR statically different.

Findings

1. Increasing of particleboard density shows increasing values for all testing which include IB, SS, SE and bending test (MOE and MOR).
2. There are no significant different shows on increment of 10kg/m^3 or 1.5% of each density except for MOR.

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