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# Utilization of High-density Raw Materials for PanelProduction and Its Performance

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**Abstract**

The residues generated in the furniture industry have not yet been optimally used for panel production. One reason for this is that residues from the furniture industry contain high-density hardwood, which is not considered suitable as a raw material in panel production. In this study, the possibility of high-density hardwood species for panel production was investigated. Matoa, one of high-density hardwood species, was utilized for panel products targeted for interior application in flooring heating systems. Methylenediphenyldiisocyanate (MDI) resin was applied as adhesive in a rotating blending box at 6% based on oven dry weight. The mat panel was hot pressed for 5 minutes at a press temperature of 180 ºC and an initial pressure of 3 MPa. This study showed that matoa can be used for panel products with limited purposes in non structural and interior uses. It has sufficient physical properties of thickness swell and moisture content, but low quality of water absorption. In term of mechanical properties, the boards manufactured had adequate bending properties and internal bonding which met the requirement of JIS type-8, except for particleboard made from planer shavings. It is known that particle shape and size significantly affect the panel properties of matoa.Hammer-milled matoa from mill residue can be an alternative for panel production in the future.


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## 1. Introduction

In recent years, there has been an increasing trend toward developing technologies in which renewable materials are used as replacements for non-renewable materials. We have become aware of the need to utilize resources in a sustainable manner. The initial concept for this was taken from the idea of sustainable yield as applied in forestry. The declining wood supply has led to innovations in the use of all parts of the wood resource with the goal of reducing and even eliminating wood waste.Wood waste materials such as flakes, particles, sawdust, and planer shavings, which are common residues from the furnitureindustry, can be utilized to manufacture many composite wood panels. The residues generated in the furniture industry have not yet been used for panel production. One reason for this is that residues from the furniture industry contain high-density hardwood, which is not considered suitable as a raw material in panel production [1]. A study by Setunge et al. [2] showed that 100% utilization of hardwood residues is feasible for particleboard production, but it has not been possible to achieve a quality comparable to that of softwood. Hoover et al. [3] studied the manufacturing of flakeboard using several hardwood species with specific gravity under 0.6.

In this study, the possibility of high-density hardwood species for panel production was investigated. Matoa, one of hardwood species, which has specific gravity of about 0.8 [4], was utilized for panel product targeted for interior application in floor heating systems. Matoa particles considered as low quality particle because the original density is high, thus it has negative effects on the mechanical properties of particleboard [5, 6]. Besides the density of wood species, the shape and size of particles can also affect particleboard performance. For instant, hammer-milled, knife-milled, planer shaving particles and strands are widely used for particleboard production.

With respect to environmental issues, manufacturing of wood products should minimize or even eliminate materials, which are non-environmentally friendly. Non-environmental friendly products can be mentioned as products that can cause emissions to the environment. Currently, biodegradable polymers, bio-based materials and composites have become an area of focus in developing environmentally friendly products [7]. As the utilization of formaldehyde-based adhesive in panel production may cause sick house syndrome and disadvantages to the environment, it motivates the producer to minimize or change this type of adhesive with non formaldehyde-based resins. The practical use of methylene diphenyldiisocyanate (MDI) resin is increasing because of this issue [8]. Advantages of this resin are faster press cycles or rapid polymerization, to be tolerant of higher moisture content in the furnish up to 22 percent MC [9,10], possible to achieve equivalent IB strength using a considerably lower dosage compared with that required in PF boards and more stable than PF boards for the same resin content level [8, 11].

The main purpose of this study was to investigate the utilization of high-density raw materialsand low-quality particles in panel production and its effect on board performance. Hammer-milling and planer shavings of matoa as residue from furniture mill were used to fabricate laboratory-scale boards using MDI resin as binder. Attention to the environmentwas represented by the utilization of mill residue and non formaldehyde-based adhesive.

## 2. Materials and Methods

### *2.1. Board fabrication*

Wood wastes from matoa (*Pometiapinnata*) with three different furnish types (M-, Mt- and Ms-type) were used as raw materials to manufacture experimental particleboard panels. M-type was hammer-milled particles from sound matoa lumber. Mt-type was hammer-milled particles obtained from matoa slabs (trimmed) in a commercial mill, which possibly contain low quality parts such as pith, compression failure and some decay. Ms-type was matoa planer shavings. MDIresin (Cosmonate M-201W, Mitsui Chemical) was applied as adhesive in a rotating blending box at 6% based on oven dry weight. The resulting wood particles mat was then hand-pressed with a flat plywood panel and then hot-pressed.The mat was hot pressed for 5 minutes at a press temperature of 180 ºC and an initial pressure of 3 MPa. Three board types with dimensions of 320 × 340 × 10 mm and target density of 0.72 g/cm³ were manufactured for experimental particleboard panels with three replications.