Materials and Design 32 (2011) 2277–2283

Contents lists available at ScienceDirect

Materials and Design

journal homepage: www.elsevier.com/locate/matdes

Effects of treatment with low molecular weight phenol formaldehyde resin on the surface characteristics of oil palm (*Elaeis quineensis*) stem veneer

Yueh Feng Loh [a,b,*], Md Tahir Paridah [a,*], Yeoh Beng Hoong [b], Adrian Choo Cheng Yoong [a]

[a] Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan, Malaysia
[b] Fibre and Biocomposite Development Centre, Malaysia Timber Industry Board, Lot 152, Jalan 4, Kompleks Perabot Olak Lempit, 42700 Banting, Selangor, Malaysia

ARTICLE INFO

Article history:
Received 12 May 2010
Accepted 8 November 2010
Available online 11 November 2010

Keywords:
A. Natural materials
C. Surface treatments
E. Mechanical

ABSTRACT

Even though oil palm (*Elaeis quineensis*) stem (OPS) is highly potential as an alternative raw material in wood industry, it possesses some inferior characteristics. One of the critical weaknesses is a high degree of veneer surface roughness that resulted in high resin consumption during plywood manufacture. The objective of this study was to investigate effects of treatment with low molecular weight phenol formaldehyde (LMWPF) resin on the wettability and surface roughness of OPS veneer. OPS veneers were segregated into two categories namely outer and inner layer veneer, prior to soaking in LMWPF resin solution to obtain weight percent gain of 16–20%. The wettability of OPS veneers was assessed with contact angle measurement according to the sessile drop method. The veneer surface roughness was evaluated by determining the average roughness (R_a), mean peak-to-valley height (R_z), and maximum roughness (R_{max}) using a stylus profilometer in accordance with DIN standard 4768. The results show that the effect of LMWPF resin treatment on the surface roughness of the veneers is statistically significant. The technique used in the study was able to enhance the surface properties as well as improved the physical and mechanical properties of OPS plywood.

1. Introduction

Oil palm stem (OPS), has been identified as one of the potential biomass for wood-based industry. It is generated every year at the rate of 700,000 ha/year or 9 million trees/year [1]. Even though the stem is cylindrical and can fetch up to 8 m height, it is very hygroscopic in nature. Once processed, it shrinks and swells at a much higher rate than wood does. Even though it is similar to wood, not all parts of the OPS can be used as lumber or veneer. Economically, only the outer part of the stem is suitable for this purpose, as the centre part of the trunk contains 50% of soft parenchyma tissue.

Due to its anatomical structure, oil palm wood has some limitation such as low in strength, less durability, low dimensional stability, and poor machining [2]. The high density gradient which exists along the radial and longitudinal direction of the stem makes OPS less attractive to be used either as lumber or plywood. Being a monocotyledon, oil palm has marked structural differences from the dicotyledonous woods. Compared to wood, oil palm is a much more porous, cellular, and anisotropic in nature. Thus liquid, such as water and low molecular weight compounds can rapidly being absorbed and flow into the cell wall and lumen. Because of the way the cells are arranged, the surface of oil palm veneer has relatively higher degree of roughness than that of a normal wood veneer. Hence, bonding of oil palm veneer as a substrate is challenging since adhesive can penetrate very easily into the cells within a few minutes especially when the adhesive is applied on the loose side. Generally, OPS veneers required as much as 400 g/m^2 adhesive spread rate as compared to tropical mixed light hardwood species, 200–250 g/m^2 [3].

The use of LMWPF resin has been reported by many researchers as an additional treatment to enhance the properties, particularly the strength and dimensional stability of the lignocelluloses materials. The wood material whether in the form of strands, veneers or lumber would be subjected to vacuum impregnating or soaking in order to force the resin into wood cells. The treated raw material would undergo a normal manufacturing process, for instance, glue spreading, assembly and hot pressing for plywood, and blending, forming and hot press for particleboard and strandboard. This method is most suitable for porous lignocelluloses material like OPS. Loh et al. [4] used LMWPF resin to enhance the strength and shear bond of oil palm plywood, whilst Anwar et al. [5] used it to treat the bamboo for producing exterior-grade bamboo flooring. Kajita and Imamura [6] and Furuno et al. [7] investigated the use of LMWPF resin to improve the properties of particleboard and Sugi wood, respectively. All of these studies found that the properties increased markedly with the amount of resin used.

* Corresponding authors. Address: Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan, Malaysia. Tel.: +60 3 89471880; fax: +60 3 89471896.
E-mail addresses: loh@mtib.gov.my (Y.F. Loh), parida_introb@yahoo.com (M.T. Paridah).

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doi:10.1016/j.matdes.2010.11.014