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The physical and mechanical properties of sapwood and heartwood of Okan wood treated at 160°C, 180°C, 200°C and 220°C

Wahyu Hidayat^{1,2}, Yue Qi¹, Jae-Hyuk Jang¹, Nam-Hun Kim¹

¹ Department of Forest Biomaterials Engineering, College of Forest and Environmental Sciences, Kangwon National University, Chuncheon 24341, Republic of Korea

² Department of Forestry, Faculty of Agriculture, Lampung University, Bandar Lampung 35145, Indonesia

Introduction

Okan (*Cylicodiscus gabunensis*) is a high density wood native to the west and central Africa. Recently, the use of Okan wood for decking and flooring in Korea began to rise due to its exotic color and visual appearance that can be further optimized by heat treatment. The objective of this study was to evaluate the effect of temperature and clamping method on the physical and mechanical properties of Okan wood.

Materials and Methods

Sapwood and heartwood boards were stacked using metal clamp and without clamp for comparison. Heat treatment was performed at 160 °C, 180 °C, 200 °C, and 220 °C for 2 hours using an electric oven with a programmable controller (L-Series, JEIO TECH Ltd., Korea). The surface color changes, physical properties as weight loss, moisture content, and water absorption, and mechanical properties as modulus of rupture (MOR) and modulus of elasticity (MOE) before and after heat treatment were determined.

Results and Discussion

The sapwood of Okan has lighter color with an average lightness (L^*) value of 56.7, compared to heartwood with L^* value of 44.5. Increasing temperature significantly decreased lightness (L^*) and yellow-blue chromaticity (b^*), while the red-green chromaticity (a^*) was not significantly affected by temperature. The overall color change (ΔE^*) was increased with the increase of treatment temperature. The color change in sapwood was more obvious than in heartwood. In addition, clamping reduce the color change during heat treatment. The changes in color appeared mostly by the reduction in lightness which is related to the degradation of hemicelluloses during heat treatment (Salca et al. (2016)).

Weight loss and volume shrinkage increased with increasing temperature. Weight loss during heat treatment is attributable to the decrease of EMC and WA, the higher magnitude of weight loss resulted in the lower EMC and WA. The decrease of hemicellulose caused weight loss and increased hydrophobicity of cell wall as a result of the decrease of the hydroxyl groups by chemical change during heat treatment, resulting in less water absorption (Jamsa and Viitaniemi 2001). Density was not affected by temperature in both sapwood and heartwood due to a proportional reduction of weight and volume during heat treatment. The magnitude of weight loss, volume shrinkage, EMC and

WA in heartwood was higher than in sapwood. Density was not affected by clamping method, while weight loss, volume shrinkage, EMC, and WA tend to be affected by clamping method in both sapwood and heartwood.

MOR, MOE, compressive strength, and shear strength decreased with increasing temperature in both sapwood and heartwood. The reduction of bending properties of less than 30% occurred after heat treatment in the range of 160–200 °C, it is acceptable for most practical applications such as cladding, sound barriers or decking (Esteves et al. 2013). The reduction of MOR, MOE, and shear strength in heartwood was higher than in sapwood, while compressive strength reduction in sapwood was higher than in heartwood. Clamping during heat treatment decreased MOR, MOE, and shear strength reduction in both sapwood and heartwood, and compressive strength reduction in sapwood. Consequently, this study showed the feasibility of heat treatment using clamping method for high density wood as Okan to improve wood properties.

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