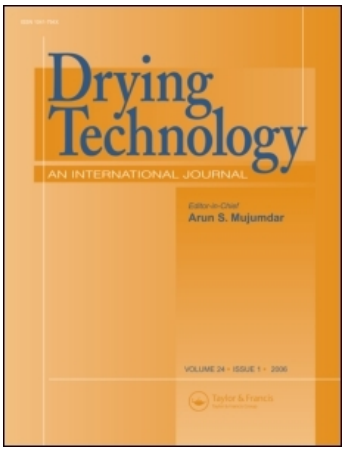

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Changes in Specific Gravity and Equilibrium Moisture Content in Heat-Treated Fir (Abies nordmanniana subsp. bornmülleriana Mattf.) Wood

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Changes in Specific Gravity and Equilibrium Moisture Content in Heat-Treated Fir (*Abies nordmanniana* subsp. *bornmülleriana* Mattf.) Wood

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The goal of this study was to determine the changes in specific gravity and equilibrium moisture content of fir (*Abies nordmanniana* subsp. *bornmülleriana* Mattf.) wood after heat treatment at different temperatures and durations. In this study, the effects of three different temperatures and three different durations were investigated. The temperatures were 170, 190, and 210°C, and the durations were 4, 8, and 12 h. The equilibrium moisture contents of the heat-treated specimens were determined at 20°C at relative humidities of 35, 50, 65, 80, and 90%, and the results were compared with control specimens. The results indicated that increasing temperatures increased the weight loss of the specimens. With respect to dimensional stabilization, the heat-treated specimens had lower equilibrium moisture contents than did the control specimens.

Keywords *Abies bornmuelleriana*; Equilibrium moisture content; Heat treatment; Humidity; Specific gravity

INTRODUCTION

In the last two decades, many methods have been tried to improve the dimensional stability and durability of wooden material without using chemicals that are harmful to humans and the environment. One of these methods is the use of temperatures above 180°C and atmospheric air pressure.[1] It is well known that, after wood is subjected to heat treatment, the specific gravity of wood is reduced, resulting in decreased mechanical properties. On the other hand, the dimensional stability of the wood is improved because the shrinkage and swelling are reduced. The goal of this research was to determine how heat treatment affects the specific gravity and the equilibrium moisture content of the fir wood. When wood absorbs moisture from its surroundings, wood molecules penetrate between and within the wood polymers (cellulose, hemicellulose, and lignin), and hydrogen bonds are formed. This phenomenon makes the wood swell. During heat treatment, the number of hydrophilic hydroxyl groups is decreased because the hydroxyl groups are replaced by hydrophilic oxygen-acetyl groups.[2] The latter creates cross-links between wood fibers and, thus, the ability of the water to penetrate into the wood is significantly reduced.[3] Thus, the wood becomes more stable dimensionally than the untreated wood. The elimination of hydroxyl groups also reduces the number of potential anchor points for fungi. During heat treatment, many chemical changes occur, including the degradation of the hemicellulose components of the wood.[4–6] As a consequence of chemical changes in the wood structure, the physical properties of wood are also modified. In general, as the heat-treating temperature rises, mass loss increases, but the density and compression strength decrease. The main objectives of industrial heat treatment are to increase biological durability, enhanced weather resistance, and decreased shrinking and swelling of the wood.[1,7–15] Other expected results during heat treatment are reduction of equilibrium moisture content, darkened hue, and increased thermal insulation. On the other hand, the wood becomes more brittle, and bending strength and tensile strength decrease in relation to the level of heat treatment.[4,16,17] Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) are the main wood species for industrial-scale heat treatment in Finland, but birch, aspen, alder, and other wood species are also heat treated. There is a growing market for heat-treated wood in outdoor applications such as exterior cladding, window and door joinery, garden furniture, and decking. There are also many indoor applications for heat-treated wood where stability is important, such as flooring, paneling, kitchen furnishing, and interiors of bathrooms and saunas.[18] However, as a consequence of loss of strength properties, heat-treated woods are not recommended for use in load-bearing construction.[4]

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