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Surface characteristics of spruce veneers and shear strength of plywood as a function of log temperature in peeling process

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Abstract

The objective of this study was to determine the effect of temperature of spruce (*Picea orientalis* L.) logs during peeling process on surface roughness, adhesive wettability, colour variation of veneer, and shear strength of plywood made from these veneer sheets. Veneer samples were manufactured from the logs after they were kept for 3 h and 24 h to reach to average temperatures of 52 °C and 32 °C, respectively. A fine stylus method was used for surface roughness evaluation of the veneer produced from two types of the logs and it was found that the samples peeled from the logs with a temperature of 52 °C had significantly better roughness values than those of manufactured from the logs with 32 °C at a 95% confidence level. Wettability of veneer samples was determined with contact angle measurements according to the sessile drop method. Urea formaldehyde (UF) and phenol formaldehyde (PF) resin drops were used in contact angle measurements. Contact angles of PF resin drops on veneers were similar for each peeling temperature while the contact angles of UF glue resin on veneers produced from the logs with 32 °C were lower than those of produced from the logs with 52 °C. Small colour difference was measured (indicated by a low ΔE value) on veneer samples depending on the log temperature. The highest shear strength value was determined for the plywood manufactured from veneers obtained from the logs with 52 °C by using UF glue.

Keywords: Surface roughness; Wettability; Surface colour; Veneer; Plywood; Log temperature; Shear strength

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1. Introduction

Heating of logs with steam is one of the most important processes during the veneer manufacturing. The main function of steam heating is to soften veneer log temporary and making it more plastic, pliable, more readily peeled, and improving the quality and quantity of material recovered from the log. Steam heating is more efficient than water heating in terms of its safety aspects and shorter heating time (Baldwin, 1995). Some of the other advantages of steam log heating include decrease in energy use during the peeling, reducing cracks on the veneer due to knife checks, improve tensile strength, and produce veneers having small colour variations. Surface characteristics, uniform thickness of veneer, and bonding quality for plywood manufacture are influenced by steaming temperature and duration between steaming and peeling processes (Berkel et al., 1969; Bozkurt and Goker, 1986; Goker and Akbulut, 1992; Lutz, 1978; Ozen, 1981). Above benefits can also be reached by determining the optimum steaming temperature, steaming time as function of wood density and log diameter.

Gupta and Bist (1981) found that the optimum heating temperatures of logs for obtaining higher shear strength of plywood varied by wood species. In a previous investigation, quality of veneer obtained from Canadian pine and Norway spruce logs was also influenced by the temperature of the logs during the peeling (Anon., 1998). Another study showed that surface roughness and the quality of the veneer obtained from Douglas fir logs harvested following heavy rainy days were better than those of harvested during dry times in summer (Hecker, 1995). In the same study, it was also reported that Douglas fir logs left in the rain for 13 days after harvesting produced veneer with smoother surface. Resch and Parker (1979) stated that optimum peeling temperature of Douglas fir logs ranged from 49 °C to 60 °C to have veneer with better quality. In general peeling temperature of the softwood logs are lower than that of hardwood logs due to their higher density. Currently there is no comprehensive information about the quality of veneer and plywood manufactured from spruce logs peeled at different temperature levels. Therefore, the main objective of this work is to determine the influence of two different log temperatures on surface roughness, wettability, and colour variation of the veneer sheets. Shear strength of the experimental plywood panels made from veneer samples was also evaluated as function of log temperature to provide an initial data to plywood manufacturers to enhance the overall quality of the final product.

2. Material and methods

Spruce logs with and average diameter at breast height of 38 cm were harvested from Trabzon region/Turkey for the experiments. Logs were debarked and bucked into 55 cm long sections for veneer manufacture. Each section of the logs was steamed at a temperature of 80 °C in a vat for 12 h. The logs were classified into two groups, the logs in the first group logs were kept for 24 h to reach an average core temperature of 32 °C while logs of the other group were only kept for 3 h to have a target core temperature of 52 °C prior the peeling process. A commercial rotary type peeler with a maximum horizontal holding capacity of 80 cm was used for veneer production. Horizontal opening was 85% of veneer thickness and vertical opening was 0.5 mm in the peeling process. Veneer sheets with dimensions of 50 cm × 50 cm × 2 mm were clipped from each group and dried at 100 °C to a target moisture content of 6% in a continuous dryer.

A fine stylus type profilometer, Mitutoyo Surftest SJ-301 was used for roughness evaluation of the samples. The device consisted of the main unit and the pick-up. The pick-up has a skid-type diamond stylus with a radius of 5 μm and a tip angle of 90°. The stylus traverses the surface and its vertical displacement is converted into an electrical signal. Numerical surface roughness parameters can be calculated form digital information, which is transmitted into a computer. Cut-off length (λ_c) and tracing length were 2.5 mm and 12.5 mm, respectively. Three roughness parameters, average roughness (R_a), mean peak-to-valley