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Research Article

COMPARISON OF TECHNOLOGICAL PROPERTIES OF PARTICLEBORADS PRODUCED FROM BRANCH AND STEM WOOD OF SEQUOIA

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ABSTRACT

Sequoia trees are the world's largest and longest living trees. The sequoia tree is commonly found in the United States of America. The tree is among the species that can be grown in Turkey, especially in the Black Sea Region. It is known that there are differences in technological features between the trunk and branch wood in the trees. In this study, the technological properties of particleboards produced from stem and branch woods of Sequoia species were compared. Some mechanical properties such as bonding strength, bending strength, modulus of elasticity of the particleboard panels were determined according to EN 319, EN 310, respectively. Physical properties such as density and equilibrium moisture content were determined according to EN 323, EN 322, respectively. Also, thermal conductivity of particleboard panels was determined according to ASTM C 518 & ISO 8301. As a result of the study, the technological properties of particleboards produced from branch wood were found to be higher than stem wood. In addition to, some technological properties of particleboards produced from stem and branch woods of the Sequoia, which has not been studied as much as its technological properties, have been investigated and partially tried to fill the literature space of Sequoia.

Keywords: Particleboard, branch wood, stem wood, technological properties, sequoia.

1. INTRODUCTION

The Sequoia genus, a member of the *taxodiaceae* family of *Sequia sempervirens*, is thought to originate from an arm of the *Rhombostrobus genus*, which remains in the Cretaceous period [1]. The only species present in the Sequoia genus is *S. sempervirens* D. Don. (Endl.) [2].

These trees can be 60-110 m long. The bodies are wide and have a red-brown, fibrillated shell of 35 cm thickness (these trees are also called "Redwood" because of the color of the shell) and do not contain resin channels. *Sequoia sempervirens* showing a monopodial growth has a conical crown structure. The branches hang downward and contain stomata on both sides of leaves 1 to

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30 mm in height [3-4]. Annual rings are generally narrow, annual ring boundaries are prominent, transition from springwood to summerwood is instantaneous and summer wood is short [5].

As a result of recent researches and findings made in August 2006, it was determined that the world's largest known tree belongs to *Sequoia sempervirens*. Hyperion, the longest sequestered species, has a length of 115.61 meters and is located in Redwood National Park. Helios, also a *Sequoia sempervirens* species, was discovered in Redwood Park by Chris Atkins and Michael Taylor in July 2006. Helios is found to have reached a height of 114.58 meters as a result of the measurements made, and still holds the second highest tree in the world [6]. Sequoia is a high value timber material used in building construction [5]. Coatings are used in the construction of construction timber, columns, beams, outdoor furnishings and musical instruments [7].

The current spread of the Sequoia genus is the Pacific coast of the United States (U.S.) over 60 km from the southwest Oregon to north-eastern California [4]. In the nineteenth century, these trees were introduced to Europe. In Turkey, the change in forestry policy after 1950, allowed the importation of species which are imported from abroad, and has been one of the species *S. sempervirens*. In 1972, it was observed that *S. Sempervirens,* which started to adapt to the Eastern Black Sea coast, coalesced very well [8]. *Sequia sempervirens* (Coastal Sequoia), which grows as good as 400 m in our country and grows in moist, cool and deep soils, is suitable for the Black Sea coastal sector [9].

As is known, there are differences in the anatomical structure and other structural features of wood between the same kind of trees. For this reason, the micro-environmental factors that grow in each tree are different [10]. In fact, when comparing wood samples taken from various parts of the same tree, they show differences in their anatomical structure, physical characteristics and chemical structure [11]. Wood anatomy research is usually focused on the body wood of trees. Today, however, research on the industrial use possibilities of branch wood and stem wood is also being carried out [12]. Ancestral roots, stem and branch wood have similar anatomical structures, as well as tracheid / trache cells, fibers, biofilms, longitudinal paranchotes, etc. [10,13-15] in terms of the quantitative properties of the anatomical elements such as the anatomical elements.

In this study, it is aimed to compare some technological properties of particleboards produced from stem and branch woods of the Sequoia. In addition to, some technological properties of particleboards produced from stem and branch woods of the Sequoia, which has not been studied as much as its technological properties, have been investigated and partially tried to fill the literature space of Sequoia.

2. MATERIALS AND METHOD

In this study, Sequoia (*Sequoia sempervirens*) wood was used as a wood species and UF resin was used product of particleboards. Firstly, the bark of the Sequoia woods was robbed. Sequoia woods were cut 3cm in thickness. Wood materials were chipped using a chipper. Afterwards, the chips were reduced into suitable size particles using a knife flaker. After chipping, particles were screened on a sieve with the size of 3mm, 1.5mm and 0.5mm by alagier shaking screening machine. These particles are separated for use in surface and core layers. The boards were designed to consist of 40% particles at the surface layers and 60% at the core layer. Later, the particles were dried in an oven to a moisture content of 3% (oven temperature: 110 °C). Based on the oven dry particle weight, 10% (surface layer) and 8% (core layer) UF resin was used at particleboards. 2% Ammonium chloride was applied to the UF adhesive as based on the resin weight. Board mats with dimensions of 420mmx420mmx12mm were hot pressed for 7 minutes to achieve a target board density of 650 kg/cm³. Pressing pressure and temperature were 24-26kp/cm² and 150 °C, respectively. After pressing, the boards were stored in climate room for further 30 days at 25 °C and 65% relative humidity.

Bonding strength, bending strength, modulus of elasticity of the particleboard panels were determined according to EN 319 [16], EN 310 [17], respectively. Physical properties such as density and equilibrium moisture content were determined according to EN 323 [18], EN 322 [19], respectiv ely. Also, thermal conductivity of particleboard panels was determined according to ASTM C 518 & ISO 8301 [20].

3. RESULTS AND DISCUSSION

Technological properties test results of the particleboards panels are given in Table 1.

Table 1. Test results

Technological Properties	Stem Wood	Branch Wood
Bonding strength (N/mm²)	0.585 (0.12)	1.403 (0.19)
Bending strength (N/mm²)	9.87 (1.92)	10.45 (1.07)
Modulus of Elasticity (N/mm²)	1260 (331.15)	1175 (143.21)
Density (gr/cm³)	0.676 (0.05)	0.657 (0.05)
Equilibrium Moisture Content (%)	6.27 (0.25)	5.63 (0.60)
Thermal Conductivity (W/mK)	0.1203	0.1018

*Values in parenthesis are standard deviations.

According to Table 1, bonding strength, bending strength and thermal conductivity of particleboards produced from branch wood were found to be higher than stem wood. Modulus of elasticity of particleboards produced from stem wood were found to be higher than branch wood.

The mean values obtained for particleboards produced from branch woods (Table 1) were compared with particleboards produced from stem. Bonding strength for particleboards produced from branch woods was 1.403 N/mm², for particleboards produced from stem wood was 0.585 N/mm². Modulus of elasticity for particleboards produced from branch woods 1175 N/mm², for particleboards produced from stem wood was 1260 N/mm². Bending strength for particleboards produced from branch woods was 10.45 N/mm², for particleboards produced from stem wood was 9.87 N/mm². Thermal conductivity for particleboards produced from branch woods was 0.1018 W/mK for particleboards produced from stem wood was 0.1203 W/mK.

According to the findings obtained, it was seen that the sequoia particleboards produced from branch wood had higher technological values than the particleboards produced from stem wood. The stem and branch wood of the species show significant differences in qualitative and quantitative anatomical characteristics [12]. Due to the fact that the annual rings and cell structures are different, the specific weight of the branch wood is higher than that of the stem wood. The cell walls of the branch wood are thicker and supportive cell tissue participation rate is higher. On average, branch wood is 25% higher in needle leaves than in stem wood, and 6% heavier in leafy trees [21].

As et. al. [22], some of the tree species grown in Turkey physico-mechanical properties of in terms they have of tree species in the study called classification of physico-mechanical properties have made distributions based upon existing or created the classes group.

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