

Effects. platen temperature. moisture state. Poplar Lumber during hot-press drying

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Abstract: [Objective]. Order. provide basis. analyzing hot-press drying mechanism. Temperature, pressure. Poplar Lumber (*Populus tomentosa*). Monitored during hot-press drying, Effects. platen temperature. temperature Pressure and momentum state in the core layer of Poplar lumber were further investigated. [Method] Temperature and Pressure in the core layer of Poplar lumber were measured with the integrated probe and real-time recorded with a data logger at the same time in Hot-press Drying, And the effects of platform temperature on momentum state were further analyzed in accordance with the comparison of measured pressure and saturated pressure (Theoretical pressure) Of vapor calculated with measured temperature in Poplar Lumber. [REsult] With the increase of Platform

Temperature from 120 to 140, The peak value of pressure created from 146. 4 to 213. 1 kPa, Whereas that of temperature created from 102. 8 to 123. 7. The temperature and pressure returned peak values at the same time, And the time to peak values created from 17. 5 to 11. 6 min. The moisture in the core layer of Poplar Lumber with moisture content (MC) Beyond fiber saturation point (FSP) Was unsaturated water under overpressure condition with the Platform temperatures of 120 and 130, The final MC (48. 55% and 49. 88%) Of core layer was greater than FSP. The heat was transferred from platforms to the core layer and transformed in the vaporization of free water in Poplar lumber when the platform Temperature

Created to 140. State of the steam in core layer of Poplar Lumber changed from the saturation state to superheated state with the further increase of Steam Temperature, And the final core MC (27. 70%) Was lower than FSP. [Conclusion] It was excluded that the higher the platen Temperature was, The higher the peak temperature and pressure returned, And the short the duration time for keeping the peak pressure was in Hot-press Drying. When the Poplar lumber's MC was greater than FSP, The modern State in Poplar Lumber may be liquid state (Unsaturated Water Under overpressure condition), Saturated steam or superheated steam States depend on different platform temperature levels in Hot-press Drying.

Keywords: Poplar Lumber; Hot-press Drying; Temperature; Pressure; Moisture State

Wood Drying by hot pressing can not only improve [1--4], Drying rate and quality Can also improve the surface density of wood [5--6], It is a practical wood drying technology with great potential and has a good application prospect. Pressure is the main driving force of Moisture Migration during wood drying [7-9]

One. In the drying process, the moisture in the wood is endothermic and vaporized to generate the steam pressure. The increase of the steam pressure makes the microstructure of the wood to produce different degrees of cracks, which can open up the moisture movement in the wood [10]

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Increasing Moisture Migration rate during wood drying. The greater the pressure gradient inside and outside the wood, the greater the rate of water migration to the wood surface under the pressure gradient, the greater the drying rate of the wood.[11]

The effect of moisture migration on wood drying was more significant. The internal pressure of wood during hot-pressing Drying not only directly affects the Drying Quality of wood, but also is closely related to the heat and mass transfer of wood. At present, the study of moisture migration in wood during hot-pressing Drying is mainly to explore the moisture content driven by capillary tension and moisture content gradient^[12], Migration Law Then establish the Mass Transfer Mathematical Model of wood hot-pressing Drying[13--14]

Type. There is no study on the change law of wood pressure during hot-pressing Drying and the effect mechanism of wood pressure change on Moisture Migration in hot-pressing Drying.

Poplar (*Populus*) The total area of poplar plantations ranks first in the world, forming a large area of Poplar fast-growing high-yielding forest, which occupies an important position in safeguarding the national timber security strategic reserve. However, during the process of poplar growth, it will produce stress wood.[15]

Primary Causes of warpage and deformation in use. The hot-pressing Drying Method of hot-plate contact is conducive to reducing or eliminating the warpage and deformation of the Poplar lumber in practical use, it is an effective method to improve the evenness of the wood

A good way. Therefore, this paper studied the hot pressing Drying of Poplar lumber, explored the influence of hot pressing plate temperature on the temperature and pressure of the core layer of the Poplar Lumber during the hot pressing Drying Process, and the change law of the water state of the Poplar lumber, the purpose is to provide theoretical basis for improving Drying Quality and exploring Moisture Migration Mechanism during hot-pressing drying.

1. Materials and Methods

1.1 Test Materials

Populus tomentosa (*Populus tomentosa*) Collected from Guan county, Shandong Province, diameter

25~40 cm After logging, the log is cut into specifications 200 (Axial) X 120 (Chord direction) X 25mm (Radial) The sawn timber is stored in a cold storage (Temperature stays -6.) In order to maintain the high moisture content of the raw materials. Before the hot-pressing Drying Test, the Poplar lumber was 400 (Axial) X 120 (Chord direction) X 25mm (Radial) The initial moisture content is 30%~60%.

1.2 Instrument Equipment

The hot platen of the Hot Press is 500x500 The total pressure of the Hot Press 100 t; Integrated probe diameter is 2mm 380, Each integrated probe is integrated 1. Pressure Transmitter and 1. Bar K The temperature and pressure of a certain point in the wood can be measured simultaneously. 0~500 kPa, Test accuracy is 1.0 Level; K Type thermocouple temperature test range is -200~1300, Test accuracy is I Level; Sin-R6000c Series color paper free recorder 16 The channel universal signal input is used to record and display the temperature and pressure changes of the Poplar Lumber core during hot-pressing Drying. 1 s; The electronic balance is used to measure the quality of the Poplar Lumber 0.01g; The electronic scale is used to measure the quality of Poplar Lumber samples before and after hot pressing Drying. 1g; The temperature range of the electrothermal blast drying oven is 0~300 For dry Treatment of Poplar Lumber with moisture content.

1.3 Test Method

1.3.1 Hot pressing Drying Test of Poplar Lumber

Will specifications be 400 (Axial) X 120 (Chord direction) * 25mm (Radial) The samples of the Poplar lumber were placed in the Hot Press, and 120, 130 and 140 Hot-pressing Drying test was carried out under (Figure 1.). In the process of hot-pressing drying, the final thickness of Poplar lumber was controlled by thickness gauge. Material thickness 24mm In

order to ensure the close contact between the Poplar lumber and the hot pressing plate during hot pressing and Drying. Press after hot pressing Drying GB/T 6491-2012 《Sawn Timber Drying Quality》It is stipulated that the final moisture content of the Poplar lumber and the final moisture content of the surface core layer are measured by the absolute dry method.

1.3.2 Measurement of temperature and pressure of Poplar Lumber Core

Two-component High Temperature Resistant Epoxy Resin Adhesive for Poplar Lumber

The surface area of the dried Poplar lumber was much larger than that of the side surface. Drill in the center of the side geometry of the Poplar Lumber after curing the adhesive 1. Diameter

2mm The hole (Figure 2a), The depth of the hole is half the width of the specimen 60mm (Figure 2b) The integrated probe was embedded in the hole to realize the synchronous measurement of the temperature and pressure of the Poplar Lumber core. Sin-R6000c Real-time recording of poplar wood saw during hot-pressing Drying by series color Paperless Recorder

Core temperature and pressure. And then, the relationship between the temperature and pressure of the core layer of the Poplar lumber was used to judge the water state (Saturated or Superheated Steam state).

2. Results and Analysis

2.1 Effect of Hot platen Temperature on temperature change of core layer of Poplar Lumber

3. The temperature curve of the core layer of Poplar Lumber varies with time under different hot platen Temperature, the temperature of the core layer of the Poplar Lumber gradually increases with the drying time and reaches a peak value. When the hot plate temperature

Don't be 120, 130 And 140 The peak temperature of the core layer is 102. 8, 110. 7 And 123. 7. Analysis of the Reasons: the surface temperature of the Poplar Lumber increases rapidly to the boiling point of water after the hot pressing plate is in contact with the surface of the Poplar lumber, the

water vapor and the liquid water within the evaporation surface of the poplar sawn timber are migrated to the core layer along the thickness direction under the steam pressure driving effect, and the heat of the hot pressing plate is transferred to the core layer in the form of heat conduction, the core poplar timber and liquid water absorb a lot of heat and the temperature rises rapidly until the peak temperature is reached. The higher the hot platen Temperature is, the greater the temperature difference between the hot platen and the poplar timber, and the more heat transferred from the hot platen to the poplar timber within the unit time; the more heat absorbed by the surface water of the Poplar lumber at the same time, the more water vaporized, and the more heat absorbed by the core layer, the higher the peak temperature of the Poplar Lumber core layer is. See chart 3. You can also see: When the core temperature of the Poplar Lumber increased to the maximum, the core temperature gradually decreased with the continuation of hot pressing Drying and gradually reached a stable value. May be part of the steam from the side of the poplar timber (not sealing surface) to move out caused by heat loss, resulting in a gradual reduction in the core temperature, when the heat transfer of hot pressing plate is close to the heat loss caused by steam emigration from the Poplar lumber, the water and heat changes in the Poplar Lumber are in a dynamic equilibrium state, which makes the temperature of the core layer of the Poplar Lumber reach a stable value. The higher the temperature of the hot pressing plate, the larger the steam output from the side, the more obvious the decrease of the temperature of the Poplar Lumber core.

2. Effect of Hot platen Temperature on the pressure change of Poplar Lumber core layer

The change curve of the pressure of the core layer of the Poplar Lumber with time under different hot platen temperatures is shown in Fig. 4. From which you can see: Hot Pressing plate temperature the higher the poplar saw core pressure peak the higher the peak time (peak time refers to hot pressing Drying Process in Poplar saw internal pressure rise to pressure peak used of Time) The short, corresponding poplar saw core temperature the higher. When hot pressing plate temperature respectively 120, 130 And 140 When poplar saw core of pressure peak respectively 146. 4, 190. 8 And 213. 1 kPa Corresponding temperature peak respectively 102. 8, 110. 7/ And

Table-Core pressure gradient drive along the thickness orientation to Poplar saw internal migration will pressure transfer to Poplar saw core makes poplar saw

Core pressure gradually increase. Hot Pressing plate temperature the higher the hot pressing plate and poplar saw between the temperature difference the greater the unit time in hot pressing plate transfer to Poplar saw surface of heat the more poplar saw surface unit time in absorption of heat the more, surface Liquid Water Vaporization the more full of steam of also the more poplar saw core pressure the greater Transfer to Poplar saw core the caused by pressure to peak time also

Wood saw core pressure to the peak the higher the peak pressure keep time the short peak appear after pressure decreased amplitude the greater. May be the reason is: in hot pressing Drying Process in from Poplar saw surface to evaporation surface between migration to Poplar saw core of steam from Poplar saw side (not sealing surface) move out, caused by water pressure decreased; hot pressing plate temperature the higher the poplar saw core pressure the greater the poplar saw table-Core pressure gradient the greater the steam in pressure gradient drive under from side moved out of rate the greater the poplar saw in steam to the outside world to move out of the flow the greater the core pressure reduce amplitude the greater. In addition poplar saw in steam pressure the greater the poplar saw in Pit Membrane Damage of quantity and damage the greater the degree of Poplar saw of permeability better steam moved out of the poplar saw

2.3 Hot pressing Drying Process in Poplar saw water State Analysis

This study will poplar saw core pressure change divided into two order

Section : (1) When poplar saw core water temperature lower 100 When poplar saw water divided into saturated moist air poplar saw in water vapor partial pressure value that is for steam pressure theoretical value poplar saw of moist air in the total pressure value close to in atmospheric pressure ; (2) When poplar saw core water temperature

Increased 100 After poplar saw in liquid water heating vaporization Formation Water Vapor produce steam pressure. With the Drying Test continue to Poplar saw core pressure gradually increase steam pressure leading role at this time poplar saw in water vapor saturated steam pressure (P_s) The steam pressure mechanism

Steam Pressure Formula Calculation steam pressure theoretical value its calculation formula- In: P_s For saturated steam pressure, kPa; P_0 For standard atmospheric pressure its value 101.325 kPa; T_s For saturated Temperature, .

According (1) And (2) Calculation different temperature conditions under poplar saw core saturated steam pressure theoretical value (P_T) And and poplar saw core pressure measured value (P_M) Through comparative analysis, to explore the change law of water state in Poplar Lumber during hot-pressing Drying. Figure 5. Is different

Pressure Measurement of core layer of Poplar lumber at Hot platen Temperature (P_M) The saturated steam pressure calculated with the measured temperature theory (P_T) Contrast. Table 1. Moisture Content Distribution of Poplar lumber before and after hot pressing and Drying. Slave chart 5. And table 1. Know: In the second stage, the water vapor between the surface of the poplar and the evaporation surface and the liquid water of the poplar sawn timber are in the table. -The core pressure gradient is driven to migrate along the thickness direction to the Poplar Lumber core layer, and the heat and pressure are transferred to the interior of the Poplar lumber, which makes the temperature and pressure of the Poplar Lumber core layer increase rapidly; but the boiling point of free water in the core layer of the Poplar Lumber increased with the increase of the core pressure.

120 And 130 The saturated vapor pressure theory calculated by the measured temperature theory during the hot-pressing Drying Process (P_T) Always below the core pressure measurement (P_M) The results indicate that the temperature of free water in the core layer of Poplar lumber is lower than the boiling point of water under measured water pressure.

Water, table 1. Moisture Content of core layer after drying of middle poplar (48.55%

49.88%) Higher than fiber saturation point (FSP) This is also explained. When the hot plate temperature rises 140 Poplar Lumber core layer

Wood sawn timber P_T Greater P_M Water vapor changes from saturated to superheated. At this time, the free water

evaporation is completed, and the moisture content of the core layer of the Poplar lumber is reduced. Below, Table 1. The final moisture content of the core layer of the Poplar is 27.70%. This is also explained in Figure 5.

Available: When the hot plate temperature rises to 140°C, the water vapor of the core layer of the Poplar lumber was transformed from saturated state to overheated state.

Due to pressure and time respectively 20.2, 6 kPa and 9.3 min. Analyze the reasons: The boiling point of free water increases with the increase of pressure. When the moisture temperature in the core layer of the Poplar lumber is lower than the boiling point of the water under the measured water pressure, water is over-pressure unsaturated water, core final water content is higher (Table 1); On the other hand, the water temperature in the core layer of the Poplar lumber is higher than the boiling point of the water under the measured water pressure, and absorb more heat of the hot plate, so that the water vapor temperature is higher than the saturated steam temperature.

The final moisture content of the core layer of Poplar is shown in Table 1. Moisture Content Distribution of Poplar lumber before and after hot-pressing. Drying Table 1. Moisture Content (MC) Distribution in Poplar lumber before and after hot-press Drying.

3. Knot On

1.) In the process of hot pressing drying, the higher the temperature of hot pressing plate, the faster the temperature rise and pressure rise, the greater the peak temperature and pressure reached, and the shorter the time it takes to reach the peak temperature and pressure.

When the hot plate temperature changes from 120°C to 140°C, the peak pressure of the core layer of the Poplar Lumber varies from 146.4 kPa to 213 kPa, corresponding

Peak temperature from 102.8°C to 123.7°C, and temperature and pressure at the same time to peak time also from 17.5 min to 11.6 min.

11.6 min.

2) Hot pressing Drying Process in water content higher than that of the fiber saturation point of Poplar saw water state in accordance with hot pressing plate temperature different for liquid water (over-voltage of not saturated water), Saturated Water Vapor or overheating steam-

Theoretical pressure (P_T). Core layer. Poplar Lumber

Under different plate temperatures

State. When hot pressing plate temperature 120°C and 130°C, when poplar saw core of water for over-voltage of not saturated water dry after core final moisture content higher than that of the fiber saturation point. When hot pressing plate temperature increased to 140°C, when with the drying of continuous poplar saw core water temperature higher than the measured water pressure water of boiling point free water heating vaporization formation water vapor and in steam temperature and pressure 20.2 and 201.6 kPa. Of conditions under by saturated state transformation for overheating state dry after core final moisture content lower than the fiber saturation point.

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