

เครื่องอบไม้แผ่นบางแบบกระบวนการต่อเนื่อง

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CONTINUOUS PROCESS WOOD VENEER DRYER

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วุฒิกร อุศล : เครื่องอบไม้แผ่นบางแบบกระบวนการต่อเนื่อง (CONTINUOUS PROCESS WOOD VENEER DRYER) อ. ที่ปรึกษา : รศ. ดร. กุศลร ศิลปบรรเลง, 457 หน้า ISBN 974-633-721-1

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาถึงผลกระทบรวมทั้งความสัมพันธ์ของตัวแปรต่างๆ ที่มีต่ออัตราการลดลงของความชื้นในไม้แผ่นบาง ที่ทำการอบด้วยเครื่องอบไม้แผ่นบางแบบกระบวนการต่อเนื่อง พร้อมทั้งศึกษาถึงข้อได้เปรียบของเครื่องอบไม้แบบกระบวนการต่อเนื่องนี้เมื่อเปรียบเทียบกับห้องอบไม้แบบดั้งเดิมที่ใช้อยู่ทั่วไป โดยการวิจัยจะมุ่งเน้นไปในส่วนของ การอบไม้แผ่นบางเพื่อประโยชน์ในการทำเฟอร์นิเจอร์

เครื่องอบไม้ที่ใช้ในการวิจัยครั้งนี้ ประกอบขึ้นจากแผ่นเหล็กและเหล็กรูปพรรณมีขนาดหน้าตัด กว้าง 60 ซม. สูง 50 ซม. ยาว 163 ซม. ใช้ระบบลำเลียงแบบสายพานโลหะขับเคลื่อนด้วยมอเตอร์ไฟฟ้า ความร้อนที่ให้กับเครื่องอบได้จากการเผาไหม้ของก๊าซหุงต้ม ถ่ายเทให้กับอากาศซึ่งไหลเวียนผ่านเครื่องอบ ไม้แผ่นบางที่ใช้ในการทดลองเป็นไม้ยางพาราสด ความหนา 1.5 และ 2.0 มม. มีความชื้นเฉลี่ยเท่ากับ 85.034 เปอร์เซ็นต์ (มาตรฐานแห้ง) และ ต้องทำการอบไม้ให้ได้ความชื้นประมาณ 8-10 เปอร์เซ็นต์ อุณหภูมิของอากาศร้อนที่ใส่เท่ากับ 100 90 80 70 และ 60 องศาเซลเซียส โดยมีค่าความเร็วของลมร้อนผ่านเครื่องอบเท่ากับ 1.5 2.0 และ 2.5 เมตร/วินาที ระยะเวลาของการอบไม้ในแต่ละ 1 รอบการอบเท่ากับ 1.0 1.5 และ 2.0 นาที ตามลำดับ

ผลการทดลองพบว่า ตัวแปรที่มีผลต่ออัตราการลดลงของความชื้นในไม้คือ ความหนาของไม้ ที่นำมาอบ อุณหภูมิของอากาศร้อนในห้องอบ ความเร็วของอากาศร้อนที่ไหลผ่านผิวหน้าของไม้ และ ความชื้นสัมพัทธ์ของอากาศร้อน รวมทั้งยังพบว่า ข้อดีของการใช้เครื่องอบไม้แบบต่อเนื่องเมื่อเปรียบเทียบกับห้องอบไม้แบบดั้งเดิมคือ ได้คุณภาพของไม้หลังการอบที่ดีกว่าคือไม่มีลักษณะเป็นคลื่น และไม่เกิดรอยแตกที่ปลายไม้ ระยะเวลาที่ใช้ในการอบจนกระทั่งได้ความชื้นที่ต้องการสั้นกว่า ใช้แรงงานคนในการทำงานน้อยกว่า และยังต้องการพื้นที่ในการทำงานน้อยกว่าด้วย

ภาควิชา วิศวกรรมเครื่องกล
สาขาวิชา วิศวกรรมเครื่องกล
ปีการศึกษา 2538

ลายมือชื่อนิสิต
ลายมือชื่ออาจารย์ที่ปรึกษา
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม

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The objective of this research is to study the effects and relations of parameters to the drying rate of veneer to be dried by continuous dryer and also to study the advantages of continuous dryer over the conventional drying room. The study was focused on veneer drying used in the furniture making industry.

The model of dryer used in this research was 60 cm. wide, 50 cm. high and 163 cm. long, fabricated from steel plates and profiled steel bars using metallic belt to convey the veneers to the dryer. The conveyor was driven by electrical motor. Heat source used to evaporate moisture from veneer was from the combustion of LPG gas transferred to circulating air. The veneer used in this research were Para wood 1.5 and 2.0 mm. thick respectively with moisture content registered at an average of 85.034% (dry basis) and the required final moisture content after drying was about 8-10%. This moisture content is the most suitable for making furniture. The temperature of hot air was varied from 60 to 100 deg. C. while the velocity of hot air was varied from 1.5 to 2.5 m/s. with resident time ranging from 1.0 to 2.0 minutes per one pass of drying.

From the experiments, it was found that the parameters affecting the rate of drying were thickness of veneer, hot air temperature, velocity of hot air flowing over surface of veneer and relative humidity of hot air in dryer. The results also showed the advantages of continuous dryer compared to conventional drying room. A better quality veneers have been obtained where waviness and cracks are minimised. Shorter drying times to arrive at veneers' required moisture content are obtained. In addition, less manpower is required as a result of using this continuous process dryer.

ภาควิชา.....วิศวกรรมเครื่องกล.....

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SYMBOLS AND ABBREVIATIONS

- C_{pa} - specific heat of dry air (J/kg. K)
- C_{pg} - specific heat of dry gas (J/kg. K)
- C_{ps} - specific heat of water vapour (J/kg. K)
- d_t - resident time one pass of drying (min.)
- D - density of air-water vapour mixture (kg/m^3)
- D_a - Density of dry air
- D_m - density of total mixture (kg/m^3)
- D_o - density of air at specified reference temperature and pressure (kg/m^3)
- G - dry gas flow rate (kg/s)
- G_v - rate of vaporization (kg/s)
- h_{fg} - latent heat of vaporization (J/kg. K)
- H - relative humidity
- H_{gw} - moisture vapour enthalpy (J/kg. K)
- I_{ga} - enthalpy of ambient air (J/kg)
- I_{ge} - enthalpy of air hot air inlet (J/kg)
- I_{go} - enthalpy of air at solid outlet (J/kg)
- I_{so} - enthalpy of solid inlet (J/kg)
- I_{sz} - enthalpy of solid outlet (J/kg)
- L - dry solid flow rate (kg/s)
- m - mass of wet sample (kg)
- m_a - mass of dry air (kg)

- m_g - mass of dry air (kg)
- m_i - initial mass of wet veneer (kg)
- m_o - mass of dry matter in sample (kg)
- m_w - mass of moisture vapour (kg)
- m_v - mass of water vapour (kg)
- M_g - molar mass of dry air (kg/mol)
- N - volume of moist-air per unit mass of dry air (m^3/kg)
- p_g - partial pressure of dry air (kPa)
- p_v - partial pressure of water vapour (kPa)
- p_{vs} - saturated vapour pressure (kPa)
- p_w - partial pressure of water vapour (kPa)
- P - total pressure (kPa)
- P_o - standard reference pressure (kPa)
- q - heat (W)
- Q_h - heat input rate (W)
- Q_l - heat loss rate (W)
- r - air recycle ratio
- R - universal gas constant
- R_a - gas constant for dry air
- t - thickness of veneer (mm.)
- t_d - drying period (min.)
- T - temperature (K)
- T_a - absolute temperature (K)
- T_c - temperature (C)

- T_d - dry bulb temperature (C)
 T_{ga} - hot air inlet temperature (K)
 T_{ge} - hot air outlet temperature (K)
 T_o - standard reference temperature (K)
 T_w - Wet bulb temperature (C)
 U_d - moisture content dry basis (%)
 U_e - equilibrium moisture content of veneer (%)
 U_f - final moisture content of veneer (%)
 U_i - initial moisture content of veneer (%)
 U_w - moisture content wet basis (%)
 V - specific molar volume (m³/mol)
 V_a - volume of dry air (m³)
 V_a - velocity of hot air (m/s)
 V_c - speed of conveyor (m/s)
 V_t - volume of air-vapour mixture (m³)
 V_v - volume of water vapour (m³)
 W_f - fan work (W)
 W_s - conveyor work (W)
 X - absolute humidity
 Y_g - mole fraction of dry air
 Y_{ga} - humidity ratio of ambient air
 Y_{go} - humidity ratio of hot air inlet
 Y_{gz} - humidity ratio of hot air outlet

- Y_s - saturation humidity
- Y_w - mole fraction of water vapour
- Z - compressibility factor of gas