ONLINE ISSN 2069-7430
ISSN-L 1841-4737

PRO LIGNO
www.proligno.ro

Vol. 9 N° 4 2013
pp. 536-539

THE DETERMINATION OF THICKNESS SWELLING OF ORIENTED STRAND BOARD (OSB) MANUFACTURED FROM SCOTS PINE BY USING CAST-POLYAMIDE

Huseyin YORUR
Assist.Prof.Dr. - Karabük University - Forestry Faculty - Department of Forest Industry Engineering, Karabük, Turkey
E-mail: huseyinyorur@karabuk.edu.tr

Raşit ESEN
Assist.Prof.Dr. - Karabük University - Technical Education Faculty - Department of Furniture and Decoration Education, Karabük, Turkey
E-mail: resen@karabuk.edu.tr

Fatih YAPICI
Assoc.Prof.Dr. - Karabük University - Forestry Faculty - Department of Forest Industry Engineering, Karabük, Turkey
E-mail: fyapici@karabuk.edu.tr

Abstract:
This study was carried out to determine the effects of using cast-polyamide on the thickness swelling (TS) of oriented strand board. All of test panels were bonded with phenol-formaldehyde resin at (6%) with three-layer cross-aligned OSBs. Strands used for the production of test panels were made up 50% of core layer and 50% of outer layers. Test panels were pressed in 6min, 4N/mm^2 press pressure and 185±3°C press temperature by aiming for a target density of 700kg/m^3. Firstly, control panels was manufactured, and also four OSBs produced by adding cast-polyamide with 20% - 30% ratio compare with weight of oven dry wood particle both out layer and inner layer of test panels. It was showed that thickness swelling ratio values were changed between 28.47% –36.61%, and the value of TS decrease as the ratio of cast polyamide increase.

Key words: *oriented strand board; phenol-formaldehyde; cast-polyamide; physical properties; thickness swelling.*

INTRODUCTION

The timber resource has declined during the past decades. Current timber is now smaller in diameter and lower in quality. Due to the decreasing supplies of high quality wood there is an increase in demand for reconstituted wood products in which called wood composite materials (McKeever 1997). One of the most important wood composite panels is oriented strand board (OSB), because OSB panels are made of compressed strands lined up and arranged in three to five layers that are oriented at right angles to each other (Maloney 1996). It can said that OSB is generally similar to three-layered symmetric laminate. While the outer layers of strands are orientated with the long dimension, the inner layers are orientated at right angles to the outer layer (Green *et al*. 1998).

Avramidis and Smith (1989) and Tang *et al*. (1984) stated that mechanical properties of OSB increased as resin ratio increased from 4 to 5 then 6%. In addition, water absorption, thickness swelling and linear expansion properties improved with increasing resin ratio.

Generalla *et al*. (1989) stated that, generally, increasing liquid PF resin content improved the mechanical properties of the commercial southern OSB after 48-h water-soak and 48-h water-soak then reconditioned at normal standard condition. Deppe and Hasch (1990) used foamed melamine-UPF (amino plast) resins in OSB manufacturing with Scots pine strands. It was found to reduce the thickness swelling of boards by approximately 50%. Winistorfer and Dicarlo (1988) investigated that the effect of resin (absolute solid resin without water) nonvolatile content (50.8-54.8-and 58.8%) on dimensional stability. Increasing resin nonvolatile content yielded significantly greater thickness swelling values due to inadequate resin distribution. Maldas *et al*. (1999) indicated that water was absorbed firstly into the transverse surface of untreated and water-treated wood, and then into radial and tangential surfaces. An obvious difference shown that effect was found on the adhesive wetting behavior between the two wood grain directions (Shupe *et al*. 1998).

In this study, the aim is to evaluate the effects of cost polyamide which is used in many industrial applications on the thickness swelling of OSB panels.

MATERIAL AND METHODS

PREPARATION OF THE TEST PANELS

Mature Scots Pine wood (*Pinus sylvestris* L.) was used in the production of the oriented strand boards (OSB). The strands dimension in usage was approximately 80mm long, 20mm wide and 0.7mm thick. First, the wood strands were dried to 3% moisture content before adhesive was sprayed on them for three minutes. Then, adhesive material - a solid content of 47% liquid phenol- formaldehyde resin- was applied in 5 percent based on the weight of oven dry of wood strands.

The press periods were 6 minutes and pressure was applied under 4N/mm^2, respectively. The shelling was 50% for core layer and 50% for face layer, and density of the boards was aimed at 700kg/m^3 density. OSB panels, which were dimensioned as 56x56x1.2cm were made for experiments, in the five conditions. Hand formed mats were pressed in a hydraulic press. These panels were labeled from 1 to 5. All mats were pressed under automatically controlled conditions at 185±3ºC. After pressing, the boards were conditioned to constant weight at 65±5% relative humidity and at a temperature of 20±2 ºC until they reached stable weight (TS 642 1997). The density, moisture content and thickness swelling were determined according to the related standards (TS-EN 323 1999; TS-EN 322 1999; TS-EN 317 1999).

DATA ANALYSES

Data for each test were statistically analyzed. The analysis of one-way variance was used ($\alpha<0.05$) to test for significant difference between factors. When the ANOVA indicated a significant difference among factors, the compared values were evaluated with the Duncan test was used to determine whether the differences have any significant level.

RESULTS AND DISCUSSION

The density (D) and moisture content (MC) values of OSBs were determined according to the related standards. The average density and moisture content of panels were obtained as 710kg/m^3 and 7.4%, respectively. It was seen that the aimed and acquired D and MC values within the ranges specified in the related standards. Thickness values were determined according to related standard; too. The average and standard deviation of the value of the thickness swelling of OSBs are shown in the Table 1.

Table 1

Thickness swelling of the OSBs

Type of OSBs	Mean (%)	Std. Deviation
1-(Control-non cast polyamide)	36.61	2.81
2-(Cast polyamide only core layer with 30%)	35.14	4.31
3-(Cast polyamide only outer layer with 30%)	30.84	6.63
4-(Cast polyamide only core layer with 20%)	34.63	3.38
5- (Cast polyamide only outer layer with 20%)	28.47	4.01

One of the physical properties thickness swelling that is very important in the many applications such as moist places. Is was seen that obtained thickness swelling values were changed between 36.61% and 28.47% after the test sample had been kept in water for 24 hours. While the highest TS value was obtained from control panels, the lowest value of TS was obtained from 5th OSBs that were produced by adding cast polyamide at the only outer layer of panels. The variance analysis of thickness swelling ratio of OSBs was done by using one-way variance analysis (Table 2).

Table 2

The result of variance analysis

	Sum of Squares	Df	Mean Square	F	Sig (p<0,05)
Between Groups	317.23	4	79.30	4.03	0.00
Within Groups	589.00	30	19.63		
Total	906.23	34			

According to the variance analysis, the effects of using cast polyamide on the thickness swelling values of test samples were statistically significant. Duncan test conducted to determine the importance of the differences between the groups are given in Table 3.

Table 3

Duncan test Results

Type of OSBs	Mean	HG
5- (Cast polyamide only outer layer with 20%)	28.47	A
3-(Cast polyamide only outer layer with 30%)	30.84	AB
4-(Cast polyamide only core layer with 20%)	34.63	BC
2-(Cast polyamide only core layer with 30%)	35.14	BC
1-(Control-non cast polyamide)	36.61	C

*HG: Homogenous Group

It can be seen that TS values changed between 28.47% and 36.61% according to Duncan's test, and they were given the different homogenous groups, on the other hand, both second and fourth panels were given the same group.

In this study of Cavdar *et al*. (2008) strands for OSB panels were manufactured from poplar logs using a laboratory type flaker. They determined Bending properties including modulus of elasticity, modulus of rupture, internal bond strength, thickness swelling and water absorption of the samples. Morever, two hours thickness swelling of the panels made with kraft lignin phenol formaldehyde resin(KLPF) had only 21% higher than that of the panels made with phenol formaldehyde. In contrast thickness swelling water absorption values of values of KLPF bonded samples had 13% lower than that of phenol formaldehyde bonded samples.

In their study Ayrilmis *et al*. (2009) used two resin types, phenol–formaldehyde (PF) and polyisocyanate, in the experiments.The tire rubber improved water resistance of the OSB panel due to its almost hydrophobic property. The test results showed that both the wood strands to tire rubber chips ratio and resin type influenced the mechanical properties and thickness swelling of the OSB. The waste tire rubber improved water resistance of the OSB due to its hydrophobic property. Hydroxyl groups in OSB were reduced by increasing rubber chips fraction that decreased the thickness swelling.

CONCLUSIONS

While thickness swelling of control samples, that is, produced from without adding cast polyamide the higher thickness swelling then other test samples manufactured by adding cast polyamide. The results showed that the values of thickness swelling decrease by using cast polyamide. The thickness swelling ratio of OSBs improve when the outer layer of panel of cast polyamide were especially used at the both 30% and 20%. This situation can be made due to using cast polyamide blocked against to water on the surface layer. To obtain the higher thickness swelling and the other mechanical properties higher temperatures of press can be proposed.

REFERENCES

Avramidis S, Smith LA (1989) The effect of resin content and face-to-core ratio on some properties of OSB. Holzforschung. 43(2):131-133

Ayrilmis N, Buyuksari U, Avci E (2009) Utilization of waste tire rubber in manufacture of oriented strandboard. Waste Management 29:2553–2557

Cavdar AD, Kalaycioglu H, Hiziroglu S (2008) Some of the properties of oriented strandboard manufactured using kraft lignin phenolic resin. Journal of materials processing technology 202:559–563

Deppe HJ, Hasch J (1990) Using foamed resin materials for OSB production (German with English Abstract). Holz-als-Roh-und-werkstoff. 48(3):101-103

Generalla NC, Biblis EJ, Carino HF (1989) Effect of two resin levels on the properties of commercial southern OSB. Forest Prod. J. 39(6):64-68

Green DW, Hermandez R (1998) Standards for Structural Wood Products and Their Use in the United States, A Journal of Contemporary Wood Engineering, 9(3):8-9

Maldas DC, Kamdem DP (1999) Wettability of extracted southern pine, Forest products journal, 49(11/12):91-93

Maloney TM (1996) The Family of Wood Composite Materials Forest Products Journal, 42(2):19-26

McKeever DB (1997) A Response to the changing Timber Resource, USDA Forest Service, Report, No.123, 5-6

Shupe Te, HSE CY, Choong ET, Groom LH (1998) Effect ofwood grain and veneer side on loblolly pine veneer wettability . Forest products journal, 48(6):95-97

Tang RC, Hse CY, Zhou ZJ (1984) Effect of flake-cutting patterns and resin contents on dimensional changes of flakeboard under cyclic hygroscopic treatment. Durability of Structural Panels. Southern Forest Experiment Station. General Technical Report SO 53:43-52

TS 642/ISO 554 (1997) Standart atmospheres and /or testing; Specifications

TS-EN 323 (1999) Wood-Based panels,-Determination of density, TSE, Ankara

TS-EN 322 (1999) Wood-Based panels,-Determination of moisture content, TSE, Ankara

TS EN 317 (1999) Particleboards and fiberboards - determination of swelling in thickness after immersion in water, TSE, Ankara

Winistorfer PM, Dicarlo D (1988) Furnish moisture content, resin nonvolatile content, and assembly time effects on properties of mixed hardwood strandboard. Forest Product J. 38(11/12):57-62