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SOME PROPERTIES OF FIBERBOARD MANUFACTURED FROM BEECH FIBER AND CHESTNUT SAWDUST

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ABSTRACT

In this study, some properties of medium density fiberboard (MDF) manufactured from mixtures of beech (Fagus orientalis) fiber and different ratios of chestnut (Castanea sativa Mill.) sawdust were investigated. The mixture ratios of fiber and sawdust were 85:15 %, 80:20 %, 75:25 %. Urea formaldehyde (UF) and melamine-urea formaldehyde (MUF) were used as resins. Water absorption (WA), thickness swelling (TS), surface roughness parameter (Rz), color change (ΔE*) values were determined for MDF panels. Consequently, it was found that the WA, TS, ΔE* and Rz values increased with increasing sawdust ratio.

Key words: Fiberboard, physical properties, sawdust, surface roughness

INTRODUCTION

In the recent years, high demand for wood as a raw material in the forest products industry has remarkably increased depending on industrial developments, new usage areas, increasing population in the world. This high demand for raw material causes a decline in existing resources. Thereby, wood industry faces a severe shortage of wood raw material. Therefore, the rational use of wood resources and optimum utilization from wood residues are quite important for effective raw material supply in the forest products industry.

Especially, the decline in raw materials negatively affects the medium density fiberboard (MDF) industry, as well as other wood panel industries (Akgül and Tozluoğlu 2008). Therefore, it is important to use other possible raw materials and wood resources such as annual plants, agricultural residues, harvesting residues, barks, furniture and lumber plant residues, etc. (Akgül and Çamlibel 2008).

Shavings and sawdust have been much used as fiber or particles for board products, or adapted to different special uses (Harkın, 1969). Many studies have been carried out related to the use of sawdust and other residues in the production of wood based composite boards (Chow 1979; Oh 2003; Bardak *et al. 2010*; Kang *et al.* 2012).

Wood based panel products such as particleboard, fiberboard are used to manufacture molding, laminated flooring, overlaid panels for cabinet and furniture industry. When these panels are used as substrate for thin overlays, their surface properties are very important for quality of final product (Hiziroglu and Suzuki 2007). Raw material type, resin content, pressing, particle size, moisture content, wood dust usage, density and sanding are the mainly parameters influencing surface properties of the final product (Nemli *et al.* 2007). Furthermore, mechanical, physical properties of wood based panels affect the quality of many products produced from these panels.

The objective of this study was to evaluate the effects of chestnut sawdust ratio on

water absorption, thickness swelling, surface roughness, color change values of medium density fiberboard manufactured using UF and MUF resins.

1. EXPERIMENTAL METHODS

1.1. MATERIAL AND PANEL MANUFACTURING

In this study, beech (*Fagus orientalis*) fiber supplied from the ÇAMSAN A.Ş. (Turkey), and chestnut (*Castanea sativa* Mill.) sawdust were used as raw materials. Urea formaldehyde and melamine-urea formaldehyde were used as resins.

Before panel manufacturing, the fiber, and small size sawdust were dried in a laboratory oven until they reach 2 % moisture content. Sawdust were mixed to fiber at the ratio of 15, 20, 25 % by weight, and mats were formed using urea formaldehyde and melamine-urea formaldehyde resins. Later, mats were pressed at a temperature of 175 ^{o}C for 6 min in a computer control press. After manufacture of the panels, specimens were conditioned and dimensioned for experiments. The experimental parameters used in this study were given in Table 1.

Table 1: Experimental parameters

Panels	Contents (%)	Panels	Contents (%)
A1	(85 fiber,15 sawdust)	B1	(85 fiber, 15 sawdust)
A2	(80 fiber, 20 sawdust)	B2	(80 fiber, 20 sawdust)
A3	(75 fiber, 25 sawdust)	B3	(75 fiber , 25 sawdust)
Control A	(without sawdust)	Control B	(without sawdust)

***A1, A2, A3, Control A: panels with UF resin; *B1, B2, B3, Control B: panels with MUF resin**

1.2. TEST METHODS

1.2.1. Water Absorption and Thickness Swelling

Water absorption (WA) and thickness swelling (TS) of panel specimens for 24-h were determined according to EN 317 (1993) standard.

1.2.2. Surface Roughness

Surface roughness of panel specimens were determined by Mitutoyo Surftest SJ-301 instrument. The R_z (mean peak-to-valley height) roughness parameter was measured to evaluate surface roughness of the specimens according to DIN 4768 (1990) standard. R_z is the arithmetic mean of the 10-point height of irregularities (DIN 4768).

1.2.3. Color Change

Color change measurement of specimens was carried out using by a spectrophotometer, Minolta CM-2600d, according to CIE *L*a*b** (CIELAB) method. Total color change values (ΔE^*) were measured to determine the color change of specimens. In this measurement, control values of panels (Control A, Control B) were taken as references, and color changes occurred on surface of specimens were determined according to these reference values.

2. RESULTS AND DISCUSSION

The results of the water absorption, thickness swelling, surface roughness and color change for MDF panels manufactured with mixture of fiber and chestnut sawdust are given in Figure 1, Figure 2, Figure 3, and Figure 4, respectively.

Density values of MDF panels were found to be between 0,75 – 0,78 g/cm^3 for A group, and 0,75 – 0,79 g/cm^3 for B group.

2.1. Water Absorption and Thickness Swelling

Water absorption values for 24-h of MDF panels depending on panel type and resin type were shown in Figure 1.

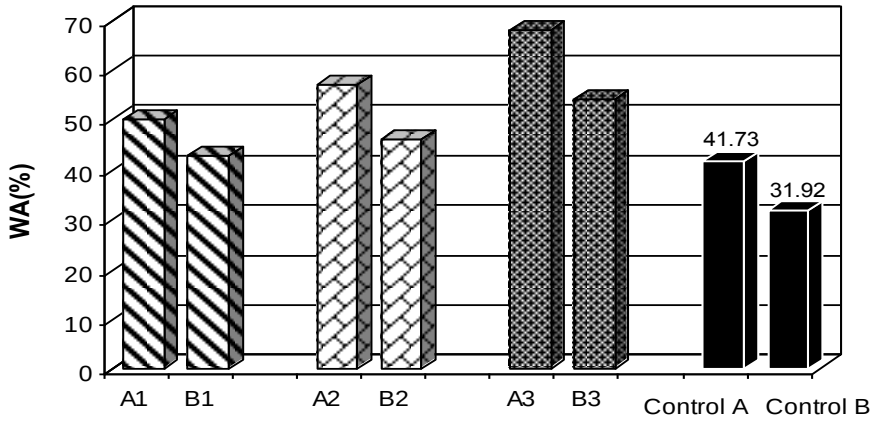


Figure 1: Water absorption values of panels

As can be seen from Figure 1, WA values of all panels increased with increasing sawdust ratio. The WA values of A and B panels were found higher than values of control groups. The control values of A and B groups are found to be 41,73 % and 31,92 %, respectively. The highest WA value (68,09 %) was obtained from A3 panel (with UF resin). In contrast to A group with UF resin, the lower WA values were obtained from B group with MUF resin. This is an expected result due to structure of melamine. It is known that the increased melamine content in UF resins improves the water resistance of wood based panels (Halvarsson et al. 2008).

The TS values for 24-h of MDF panels are represented in Figure 2.

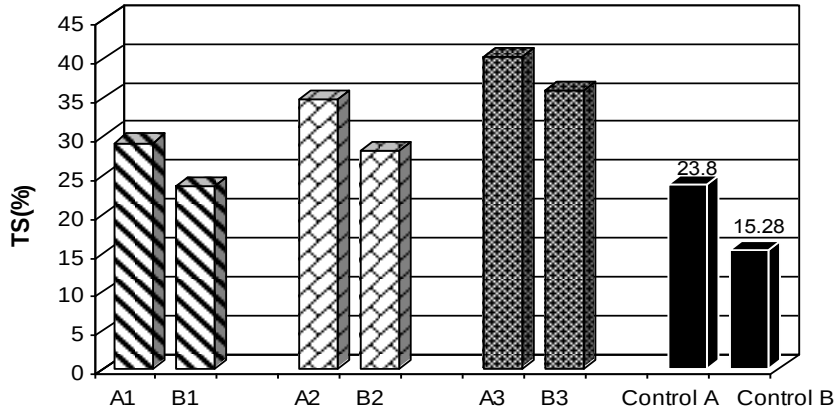


Figure 2: Thickness swelling values of panels

Figure 2 shows that the TS values of panel specimens increased with increasing sawdust ratio. The TS values of MDF panels (A1, A2, A3; B1, B2, B3) manufactured with sawdust were found higher than the TS values of control panels (control A, control B). The better results were obtained from B group manufactured with MUF resin.

Based on these findings (in Fig. 1 and Fig. 2), it appears that the WA and TS values changed depending on the sawdust ratio and resin type. The highest WA and TS values were found with A3, B3 panels consisting of 75% fiber-25% sawdust. The control MDF panels (without sawdust) gave lower WA, and TS values. This trend in WA and TS values could be attributed to resin type, raw material properties and sawdust size.

2.2. Surface Roughness

Surface roughness values (R_z) of MDF panels are given in Figure 3. R_z values of panel specimens changed depending on panel type, and resin type.

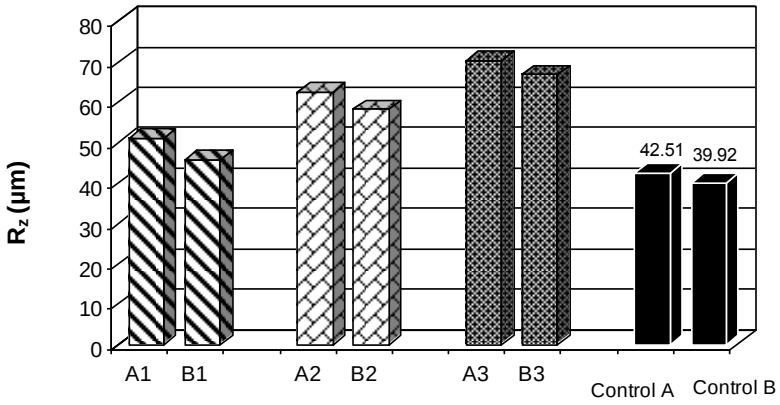
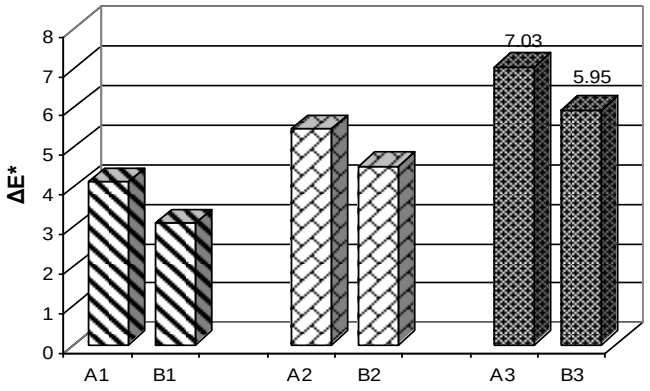


Figure 3: R_z values of panels

As can be seen from Figure 3, surface roughness values of panels increased with increasing sawdust ratio. Control values for A and B groups were found to be 42,51, and 39,92 µm, respectively. The R_z values of panel groups manufactured with sawdust were found higher than that of control groups. Especially, MDF panels (A3, B3) consisting of 25 % sawdust gave higher values than MDF panels (A2, B2 and A1, B1) consisting of 15 %, and 10 % sawdust. The highest R_z values were found to be 70,22 µm for A3 panel and 66,80 µm for B3 panel. Furthermore, as can be seen from Figure 3, B group gave better results than A group. Smoother surfaces were obtained from B group with MUF resin. These results could be attributed to resin type, sawdust properties and sawdust size. Hiziroglu and Kosonkorn (2006) stated that the shape, height and width of the irregularities affect the surface quality of a final product.

2.3. Color Measurement

Color change (ΔE*) values of MDF panels depending on panel type and resin type were given in Figure 4.



*In the measurements, Control A and Control B were taken as reference values

Figure 4: ΔE* values of panels

Figure 4 shows that ΔE* values of panel specimens increased with increasing sawdust ratio. While the highest color change value (7,03) was obtained from A3 panel,

the lowest color change value (3,09) was determined from B1 panel. The lower ΔE* values were found for B group with MUF resin. The more color change was observed on the surface of A panels manufactured with UF resin. This trend in color change values might be resulted from structural properties of resins and chestnut sawdust.

CONCLUSIONS

The results of this study showed that the water absorption (WA), thickness swelling (TS), surface roughness parameter (R_z), color change (ΔE*) values increased depending on increasing the sawdust ratio. The highest values were obtained from MDF panels (A3; B3) consisting of 25 % sawdust. Especially, an improvement was observed in WA, TS, R_z and ΔE* values of MDF panels manufactured with MUF resin. It is clear that the all values of MDF panels showed differences depending on resin type, raw material type and size.

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