ONLINE ISSN 2069-7430
ISSN-L 1841-4737

PRO LIGNO
www.proligno.ro

Vol. 13 N° 4 2017
pp. 242-246

SOME PROPERTIES OF FIBERBOARDS MANUFACTURED WITH ASH (*Fraxinus excelsior* L.) SAWDUST

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Abstract:
The objective of this study was to evaluate the effect of ash (Fraxinus excelsior L.) sawdust on the some properties of Medium Density Fiberboard (MDF). The MDF panels were manufactured from pine fibers and ash sawdusts at the different ratios (10%, 15%, and 20%). Some properties of MDF panels such as surface roughness parameters (R_a, R_z), colour change (ΔE^*), water absorption (WA), thickness swelling (TS) were determined depending on the ratio of ash sawdust. As a result, it was found that the surface roughness parameters and colour change values increased with increasing the ratio of sawdust, the highest surface roughness and colour change values were obtained from the panel type C. However, the water absorption and thickness swelling values decreased with increasing the ratio of sawdust. The lowest values were obtained from the panel type C.

Key words: *ash sawdust; colour change; fiberboard; physical properties; surface roughness.*

INTRODUCTION

In the recent years, there has been a remarkable growth in the wood based panel industry in the world. This rapid industrial growth has increased the demand of wood raw materials for the manufacturing process. One of the main problems for panel manufacturers is a decrease in the resources of wood raw materials. This problem has pushed the manufacturers to find alternative solutions.

Medium density fiberboard (MDF) industry, as well as other industries, is negatively affected by a decrease in the wood raw materials (Akgül and Tozluoğlu 2008). A solution to this problem could be to find alternative raw materials or to use wood resources such as harvesting residues, annual plants, agricultural wastes, bark, furniture and lumber plant wastes, recycled paper, etc. (Akgül and Çamlibel 2008).

Shavings and sawdust have various uses such as fuel uses, chemical uses, fiber and wood-based board uses (Harkin 1969). Many studies have been carried out related to the use of some wastes and various forest residues in the manufacture of wood based panels (Chow 1979; Nemli and Aydın 2007; Akgül and Tozluoğlu 2008; Ayrilmis *et al.* 2009; Bardak *et al*. 2010; Yel *et al*. 2014).

The using areas of wood based panels such as fiberboard and particleboard are the manufacture molding, laminated flooring, overlaid panels for cabinet and furniture industry. When these panels are preferred to use as substrate for thin overlays, their surface properties have importance for quality of final products (Hiziroglu and Suzuki 2007)**.** The type of raw material, the content of resin, pressing, the size of particle, moisture content of the mat, wood dust usage, density and sanding are the mainly parameters influencing surface properties of the final products (Nemli *et al*. 2007).

In addition, wood fiber properties such as anatomical and chemical properties of fiber, fiber structure and strength, and composition of fiber are basic parameters affecting the properties of fiberboard when the wood is used as raw material (Ayrilmis 2008).

Generally, beech, oak (low quality) and pine are preferred to use as raw materials for the MDF manufacture in Turkey. These species can be used as a single or a mixture. Using the mixture of species in the manufacture process is an important factor. The mechanical and physical properties of final products are affected by this factor (Akbulut *et al*. 2000).

Ash (*Fraxinus*), birch (*Betula*), lime (*Tilia*), spruce (*Picea*), larch (*Larix*), Douglas-fir (*Pseudotsuga*) fibers are known as high quality raw material for MDF manufacture (Akgül *et al*. 2007). Ash wood is used to manufacture bentwood, tool handles, baseball bats and tennis rackets due to its high elasticity, shock resistance and splitting resistance (Zhong *et al*. 2013).

OBJECTIVE

The objective of this study was to evaluate some properties such as surface roughness parameters, colour change, water absorption and thickness swelling of MDF panels manufactured using the different ratios of *Fraxinus excelsior* L. sawdust.

MATERIAL, METHOD, EQUIPMENT

In this study, pine fibers and ash sawdusts were used as raw materials. Urea formaldehyde was used as resin. Before panel manufacturing, the sawdusts were converted into small fiber size. The fibers and sawdusts were dried in a laboratory oven until they reach 2% moisture content. Sawdusts were mixed to fibers at the ratio of 10, 15, 20% by weight, and mats were manually formed using 13% urea formaldehyde. Later, mats were pressed at a temperature of 180ºC for 7 min in a press. Before the experiments, the panels were conditioned in a climatized room at 20ºC and 65% relative humidity. Panel type and contents of panel type were given in Table 1.

Table 1

Panel type and contents of panel type

Panel type	Contents
A	90% fiber +10% sawdust
B	85% fiber +15% sawdust
C	80% fiber + 20% sawdust
Control	100% fiber (without sawdust)

Surface Roughness

Surface roughness parameters of panel samples were determined by portable surface roughness instrument. The surface roughness parameters (R_a, R_z) were measured to evaluate surface roughness of the samples according to DIN 4768 (1990) standard.

Colour Change

Colour change measurement of panel samples was carried out by using a spectrophotometer, Minolta CM-2600d, according to the CIE $L^*a^*b^*$ method (HunterLab 2008). Total colour change values (ΔE^*) were measured to determine the colour change of panel samples. In this measurement, control value of panel samples was taken as references.

Water Absorption and Thickness Swelling

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

RESULTS AND DISCUSSION

Surface roughness

The surface roughness parameters (R_a, R_z) values of MDF panel groups were represented in Fig.1 and Fig. 2.

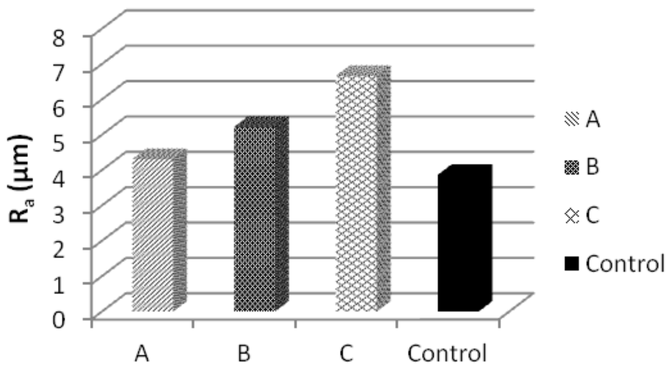

Fig. 1.
R_a values of samples.

Fig. 1 shows that the R_a values of MDF panel samples changed depending on the ratio of sawdust. R_a values of panel samples increased with increasing the ratio of sawdust. The lowest R_a value was found to be 3.87 µm for control panel. The R_a values for panel types A, B, C were determined higher than the R_a value of control panel. The R_a value of panel type A manufactured with sawdust at the 10% ratio had the lowest value (4.31 µm) among the all MDF panels manufactured with sawdust, whereas R_a value was the highest (6.67 µm) for panel type C. This could be reasoned from the differences in the structure, properties and size of raw materials. Akgül *et al*. (2012) found that the average R_a value of the manufactured panels increased with increasing the rhododendron fiber ratio in the mixture.

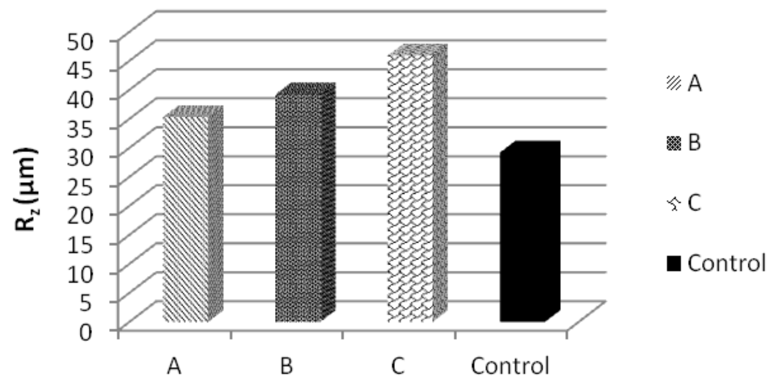

Fig. 2.
R_z values of samples.

Fig. 2 also shows that the similar trend was observed for R_z values of all MDF panel samples. The R_z values of panel samples increased with increasing the ratio of sawdust. The lowest R_z value was found to be 29.2 µm for control panel. All R_z values of panel types A, B, C manufactured with sawdust were found higher than that of control panel. The panel type C consisting of 20% sawdust had highest value (45.9 µm) among the other panel types consisting of 15%, 10% sawdust, and control panel. The rougher surface was obtained from panel type C.

These results could be attributed to fiber and sawdust properties, sawdust size. Hiziroglu and Kosonkorn (2006) reported that the shape, height and width of the irregularities affect the surface quality of a final product.

Colour Change

The colour change *(ΔE*)* of panel groups is presented in Fig. 3.

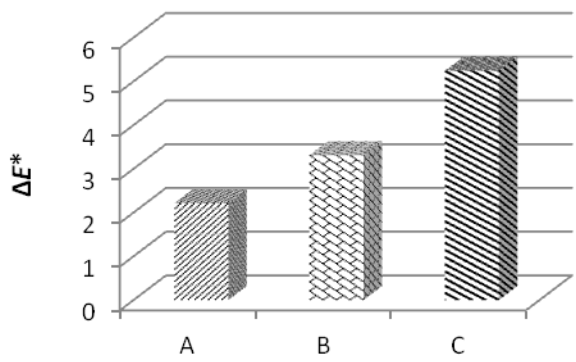

Fig. 3.
Colour change values of panel samples.

As can be seen from Fig. 3 the ΔE^* values of MDF panel samples changed depending on the ratio of sawdust. The colour change (ΔE^*) values of panel samples increased with increasing the ratio of ash sawdust. The highest colour change value (5.24) was obtained with panel type C with 20% sawdust ratio. The lowest ΔE^* value (2.21) was found in the panel type A with 10% sawdust ratio.

Water Absorption and Thickness Swelling

The results of the water absorption and thickness swelling for 24h of MDF panel samples depending on the ratio of sawdust were given in Fig. 4. and Fig. 5.

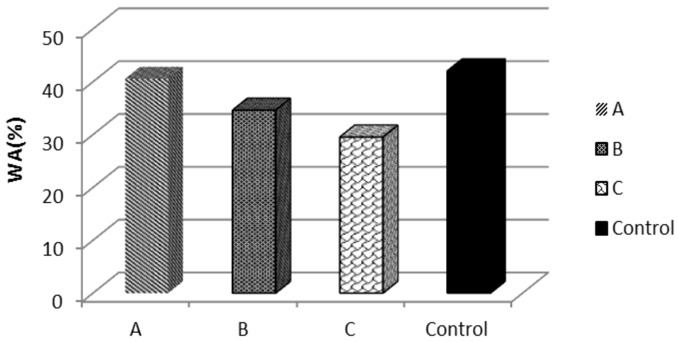

Fig. 4.
Water absorption values of panels.

As can be seen from Fig. 4, the WA values of MDF panel samples decreased with increasing the ratio of sawdust. The WA values of panel types A, B, C were found lower than the WA value of the control panel. The highest WA value was recorded from control panel. This value was found to be 42.05%. The lowest WA value was obtained to be 29.54% from panel type C manufactured with sawdust at the 20% ratio.

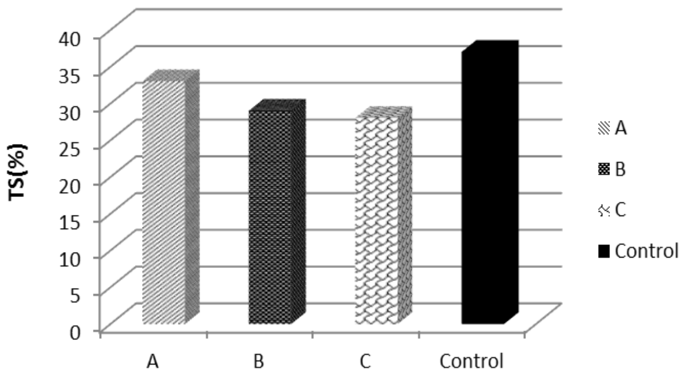

Fig. 5.
Thickness swelling values of panels.

Fig. 5 shows the TS values of MDF panel samples. The tendency of TS values was found similar to the WA values. It was determined that the TS values also reduced with increasing the ratio of sawdust. The highest TS value was found to be 37.04% for control panel. The panel type C had the lowest TS value. This value was recorded to be 28.43%.

Based on these findings (Fig. 4 and Fig. 5), it appears that the WA and TS values changed depending on the ratio of ash sawdust. The highest WA and TS values were determined from the control panels. Water absorption and thickness swelling values improved with increasing sawdust ratios. This trend in WA and TS values could be attributed to raw material properties, sawdust size, the ratio of mixture of raw material species. Akbulut *et al.* (2000) reported that the mixture of species in the panel manufacturing affects the physical and mechanical properties of products.

CONCLUSIONS

As a conclusion, it was found that the ratio of sawdust has effects on the panel properties. It is clear that all the values of MDF panels showed differences depending on the ratio of sawdust. While the surface roughness parameters (R_a, R_z), colour change (ΔE^*) values of panel samples increased with increasing the ratio of ash sawdust, the water absorption (WA) and thickness swelling (TS) values of panel samples decreased. The highest R_a, R_z, ΔE^* values were obtained from panel type C consisting of 20% ash sawdust. Especially, an improvement was observed in WA and TS values. The lowest WA and TS values were determined from the panel type C.

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