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The Effect of Adding Commercial Unsaturated Polyester Sealer as Coating Layer to Improve the Properties of Compressed Particleboard of (Olive Stone) with Sodium Silicate

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Abstract

In the context to advantage of solid waste of process of olive pressing (olive stone) to produce compressed particleboard for different applications. In continuation of our previous study to produce compressed particleboard using sodium silicate as a binding agent, where the results show weakness in cohesion between olive stone particles, which required looking for another binding agent to improve the cohesion. In this study a commercial unsaturated polyester sealer was used as coating layer on the surface of the particleboard. The results show significant improvement in resistance to water absorption and bending strength compared with particleboard produced using only sodium silicate. The properties of produced wood were in the range with the European standards (EN) for compressed wood.

Keywords: Solid waste; olive stone; particleboard; unsaturated polyester sealer; compressed particleboard; sodium silicate.

1. Introduction

Considered (olive stone), solid waste of olive pressing has negative impact on environment in terms of the damage caused to the soil or air when it burn and difficult to get rid of them easily except using as food for animals.

The ways to take advantage of the solid waste is the subject of our study as a raw material rather limited and especially in Libya. The purpose of this study is to find solutions and new opportunities for olive residues to be used as a raw material in industry with other materials.

Due to the lack of references that relate to this study, few papers have been published in 1972 Mohammed Amine and Tahir Al peshta [1] worked on same raw material with different banding agent they conclude its ineffective as compressed wood and recommended as forage only. In 2010 Ayilmis Nadir and Ksaril Umit [2] carried out investigation on olive residues blended with sawdust beech wood to produce compressed wood. In 2012 Mohamed Hammed and Ihsan Mouselly also worked with olive residue and they proved the possibility of using olive residues in the wood industry by adding sawdust another wood residue to the mixture. Eman Farag [4] investigate the possibility of producing compressed wood using olive stone bonded with sodium silicate, the results was not convincing. In this investigation different banding agent with only olive residue is carried out to produce compressed wood.

2. Material and Methods

Olive residues where collected from olive press in Misallatah city Libya. Olive residues where washed with warm water manually to remove the fat and other materials. The fat and other material float on top of the water the pulps where sink in bottom

it called olive stone which is used in this study Figure 2.1 show olive residue before and after washing. The residue was left to dry in air for 48 h. Sodium silicate a transparent solution from Najma Factory for the manufacture of soaps and detergents, ready for use shown in Figure 2.1. Unsaturated polyester sealer purchase from local market was used after mixing with catalyst and accelerator.

(a)

(b)

(c)

Figure 2.1: Olive residues before and after washing with warm water a,b) sodium silicate in solid and solution form c).

2.1. Sample preparation

Olive stone 80 wt% was mixed manually with sodium silicate 20 wt% in a plastic pot and well fluctuation, and then placed in the hydraulic pressing mold under pressure 150 bar, and then the samples carefully dried at room temperature for 72 h until dried completely and hold together. Mixing unsaturated polyester sealer with catalyst and accelerator in flat tray so that the pressed samples were immersed and turned over several time this process takes (10 to 25) minutes after the sample is left and dried at room temperature for 48 h. 92 samples were prepared where each test had 12 samples.

2.2. Physical properties

Density of compressed particleboard according to Europe standard EN323. An average value of (7 samples) was calculated using following equation:

$$d = \frac{m}{v} \tag{2.1}$$

Where:
d = density of the compressed particleboard.
m = weight of the compressed particleboard sample to the nearest of 0.01 g.
v = the volume of the compressed particleboard (length X width X depth) to the nearest of 0.001 mm.

Moisture content analysis:
Moisture content of the compressed particleboard was measured according to EN 322 by using oven dry method and following equation:

$$mc(\%) = \frac{m_{int} - m_{ad}}{m_{ad}} \times 100 \tag{2.2}$$

Where:
mc = the moisture content.
m_{int} = mass with moisture.
m_{ad} = mass after drying.

Determination of water absorption :
Water absorption was done according to EN 52351. The samples were placed in a container of water at room temperature for 2 h and 24 h. The weights of the samples were measured at different time intervals during the long period of immersion. After 2 and 24 h of submersion, the samples were removed from the water all surface water were wiped off with a dry cloth, and weighed to the nearest 0.01 g. The amount of water absorption was calculated using following equation:

$$WA_t(\%) = \left(\frac{W_a - W_b}{W_b}\right) \times 100 \qquad (2.3)$$

Where:
WA_t = the water absorption (%) at time t.
W_a&W_b = sample weight after and before soaking in water respectively.
(7 samples) were used to get average value for each test.

Determination of thickness swelling:
Thickness swelling was done according to EN 317. Same samples used in water absorption were used to measure thickness after 2 h and 24 h of immersion. The values of the thicknesses swelling TS as percentages were calculated with equation:

$$TS_t = \frac{T_t - T_0}{T_0} \times 100 \qquad (2.4)$$

Where:
TS_t = thickness swelling at time t.
T_t&T_0 = sample thickness after and before soaking in water respectively.

2.3. Mechanical properties

Determination of flexural properties (bending strength):
Flexural strength was carried out according to EN 310. The flexural strength of a material is its ability to resist deformation under a load. Expressed by following equation:

$$\sigma = \frac{3FL}{2bd^2} \times 100 \qquad (2.5)$$

Where:
F = the load (force) at the fracture point (N).
L = the length of the support span (mm).
b = width (mm).
d = thickness (mm).
(7 samples) were used to get an average value of flexural strength samples dimensions were (length, width, thickness) length of the support span distance 40 mm.

3. Results and Discussion

Compressed particleboard of olive stone, sodium silicate and unsaturated polyester sealer results shown in Table 3.1 a significant improve in resistance to water absorption and moisture content compared with the results reported in previous study and shown in Table 3.1. However, the

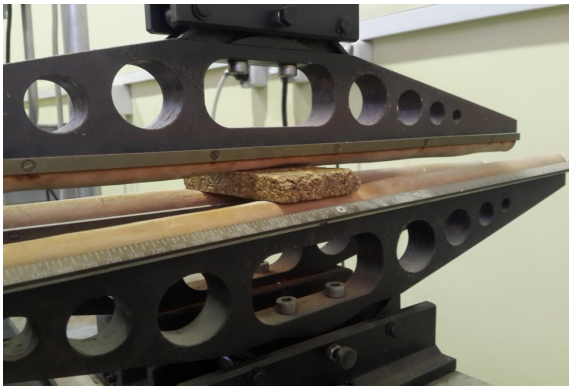

Figure 2.2: Sample under investigation bending strength.

produced compressed particleboard of olive stone was also compared with international standards of compressed wood EN the results are shown in Table 3.1. The density of olive stone is higher than EN that due to the density of olive stone wood and banding materials itself used in this study on the other hand, the moister content, water absorption and bending strength are below the limit of the EN standard for compressed wood which is good results for such material that was consider as waste. Thickness swelling on the other hand shown slightly increase in value after 24 h immersion, but this does not affect the overall properties of produced compressed wood.

4. Conclusion

Compressed particleboard of olive stone, sodium silicate coated with unsaturated polyester sealer shown improve in physical and mechanical properties in contrast with olive stone sodium silicate alone.
These compressed particleboard of olive stone are considered economical and environmentally friendly because they are from the olive stone which are leftovers of olive pressing in addition to the price inexpensive and availability annually. The properties of this new material are considerably good and offer opportunities of using local material in wood industry.

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Table 3.1: Average data of physical and mechanical properties of compressed particleboard of olive residue compared with EN standard.

Test	Test method	Unit	Data of EN	Compressed particleboard olive stone with sodium silicate	Compressed particleboard olive stone with sodium silicate and polyester
Density	EN323	g/cm^3	1.0206	1.1893	1.3929
Moisture content	EN322	%	13	11.891	11.83
Water absorption after 2 h	EN52351	%	30	Sample failed	7.886
Water absorption after 24 h	EN52351	%	40	Sample failed	19.3885
Thickness swelling after 2 h	EN317	%	8	Sample failed	2.2
Thickness swelling after 24 h	EN317	%	10	Sample failed	11.6
Bending strength	EN319	N/mm^2	15.2	1.13	3.145

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