DIMENSIONAL STABILITY AND MECHANICAL PROPERTIES OF EPOXIDIZED VEGETABLE OILS AS WOOD PRESERVATIVES

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In recent years, some vegetable oils such as linseed oil and soybean oil, have been used to preserve wood material, and contain no environmentally hazardous chemicals or chemicals harmful to humans. However, based on early studies related to vegetable oils, it was found that vegetable oils do not chemically bond with the wood structure, but rather only fill the cavities in the wood structure. This acts only to prevent the water uptake into wood. Because vegetable oils only act as a barrier to prevent water absorption, higher oil retentions (400 kg/m^3 - 600 kg/m^3) which are not cost-effective, would be needed to be effective in protecting wood.

In this study, to reactivate oil and improve the bonding ability between oil and wood components, epoxidation of vegetable oil was targeted. Thus, more cost-effective oil retention levels between 80 kg/m^3 and 270 kg/m^3 were used due to treat the wood. With epoxidized vegetable oils, oil acids are able to bond to sites normally occupied by water molecules. This study also aimed to reduce leaching of boron compounds. Boron compounds are effective wood protection chemicals which are environmentally friendly and show both insecticidal and fungicidal characteristics. However, boron compounds have some disadvantages such as higher water solubility and an inability to fix to the wood structure. With a combination of boron compounds and epoxidized oils, boron leaching and durability against deterioration were prevented.

Two different epoxidized oils were used, epoxidized linseed oil (ELO) and epoxidized soybean oil (ESO). First, wood samples were impregnated with boric acid (BA) and then impregnated with the epoxidized oil and pure oil using an empty cell method. The variations for impregnation are below:

3 % BA + ELO
3 % BA + ESO
3 % BA + LO
3 % BA + SO

Impregnated samples were cured to facilitate polymerization of epoxidized oils at 70 °C for 14 days. After curing, the samples were conditioned at 20 °C and 65 % RH.

The target retentions used in this study were 80 kg/m^3 to 140 kg/m^3 (Ret A) and 170 kg/m^3 to 270 kg/m^3 (Ret B).

Based on water absorption, specimens with higher retention rates (Ret B) absorbed less water [1]. The lowest water absorption and highest dimensional stability values were observed in the sample impregnated with 3% BA + ESO. Second to this were samples impregnated with 3% BA + ELO. Based on these results, it is found that specimens with epoxidized oils absorbed less water than non-epoxidized oils (Fig. 1). As seen from the results, the target on fixation by epoxidation was accomplished.

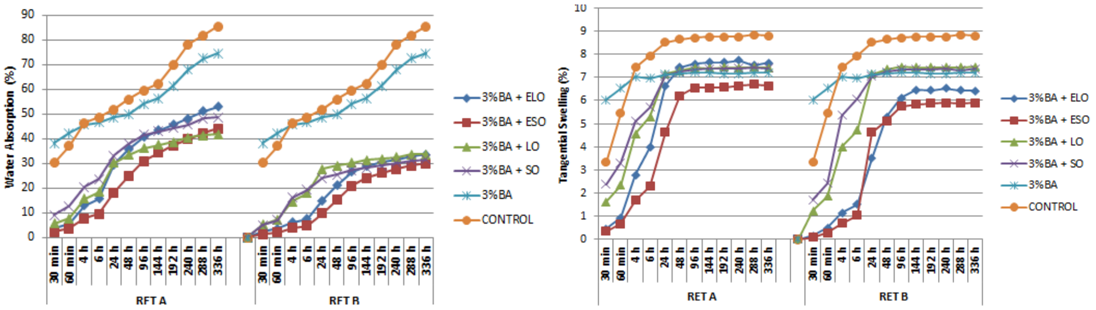

Figure 1: Results of water absorption and tangential swelling

Modulus of Elasticity (MOE), Modulus of Rupture (MOR) and Compression Strength Parallel to Grain (CSPG) were conducted and the results were listed in Table 1 for all variations [2, 3].

Table 1: Results of MOE, MOR, and CSPG

	MOE		MOR		CSPG	
	RET A	RET B	RET A	RET B	RET A	RET B
3% BA+ ELO	9777,75	6881,54	65,963	52,599	49,580	47,612
3% BA + ESO	13257,20	12244,90	101,265	92,288	60,153	59,802
3% BA + LO	15294,30	14914,60	127,268	118,979	64,469	64,971
3% BA + SO	15043,90	14549,90	119,303	118,344	62,149	61,539
3% BA	14164,80		115,869		59,283	
CONTROL	14405,40		107,193		64,396	

As shown in the Table 1, with one exception, the samples treated with un-modified oils show higher MOE, MOR, and CSPG values compared to control specimens. However, the samples treated with epoxidized oils showed lower values for all mechanical properties measured compared to control samples. This could be the result of changing the chemical structure of wood with epoxidized oils and how effectively they were fixed to the wood.

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References

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[3] TS 2595 (1977) Standard of Determining Ultimate Stress in Compression Parallel to Grain. Turkish Standard.