

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

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# WHY VEGETABLE OILS?



- **Copper** tolerance in a number of fungal species  
Corrosivity to metal fasteners  
High toxicity against aquatic organisms
- **Creosote** compounds such as polycyclic aromatic hydrocarbons (PAHs) are classified hazardous to the environment and pose a risk to human health as potentially carcinogenic
- But **Vegateble oils** contain no environmentally hazardous chemicals or chemicals harmful to humans

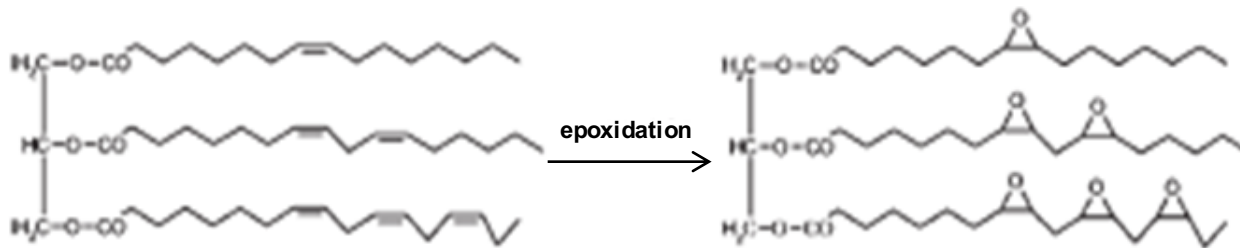
## Disadvantages to use oils as wood preservatives

- But oils not chemically bond with the wood structure, only fill the cavities in the wood structure.
- only act as a barrier to prevent water absorption, higher oil retentions ( $400 \text{ kg/m}^3$  -  $600 \text{ kg/m}^3$ ) which are not cost-effective.
- Therefore, epoxidation of oil is one of the effective methods to bond oils in the wood structure



# Epoxidation process

- The double bonds in oils are considered as reactive sites but cannot be easily polymerized to high molecular weight products without introduction of more reactive functional groups eg. Epoxy, hydroxyl, or carboxyl groups.



Organic or inorganic acid can be used as catalyst to initiate epoxidation of oils polymerization by opening oxirane groups.



# OUR AIMS

1. Fixing vegetable oils into wood structure by means of epoxidation with two different retentions.

❖ Target retentions:

Ret A: 80- 140 kg/m<sup>3</sup> (low ret)

Ret B: 170- 270 kg/m<sup>3</sup> (high ret)



2. Decrease to water uptake

3. Determine the mechanical properties

# MATERIAL

Wood species → *Pinus sylvestris* L.



Oils



Linseed Oil (LO)

Soybean Oil (SO)

Epoxidized Linseed Oil (ELO)

Epoxidized Soybean Oil (ESO)

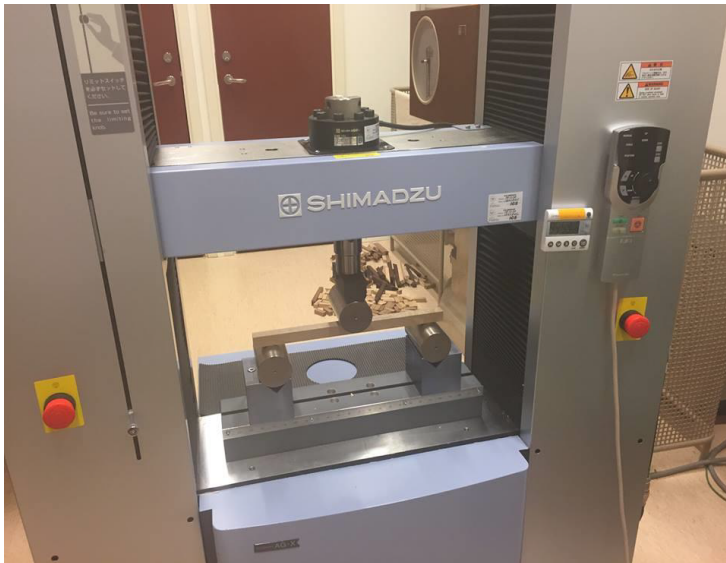


And **Boric acid (BA)**



# METHOD

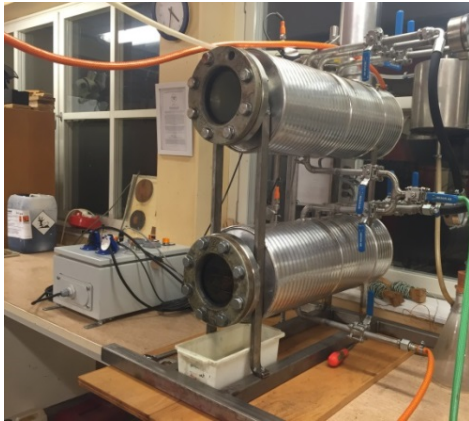
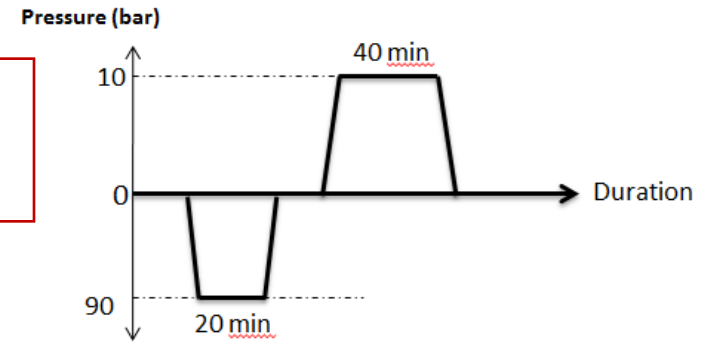
TESTS	STANDARD	DIMENSIONS
Water Absorption and Dimensional Stability	AWPA E4	15*25*50 mm
Bending Strength	TS 2478	20*20*330 mm
Modulus of Elasticity	TS 2478	20*20*330 mm
Compression Strength Parallel to Grain	TS 2585	20*20*60 mm



# WOOD SAMPLES



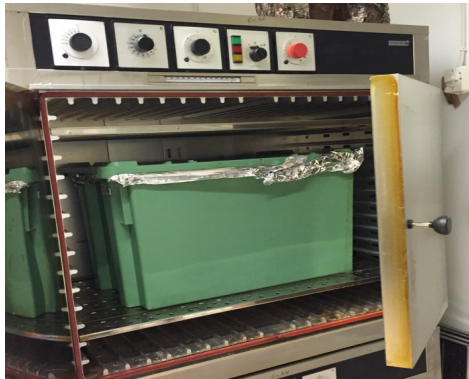
**Impregnation with 3% BA  
(Bethell method)**



**Impregnation with Oils  
(Rueping method)**

- LO
- SO
- ELO
- ESO

Different **pressure and time** schedule were applied on the wood samples for **each** different size, each oil and for **both** retentions.

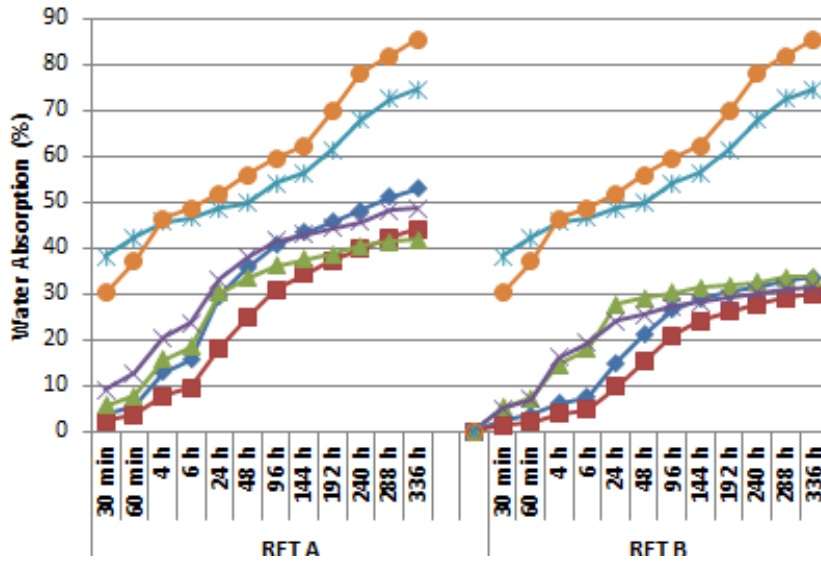


**Curing to polymerization  
(14 days at 70°C in acetic acid)**



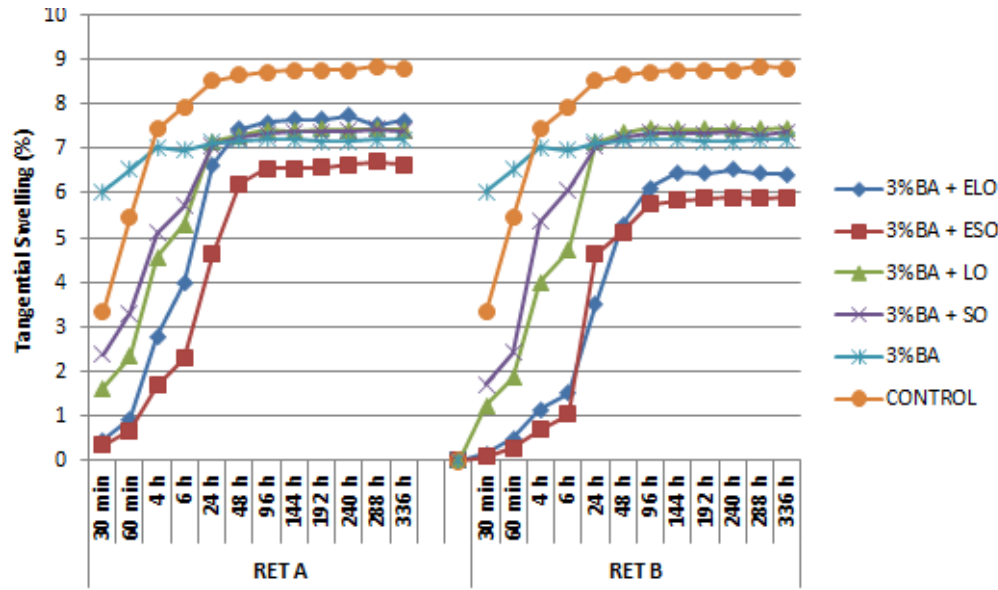
# RESULTS

## Water Absorption and Dimensional Stability Test



Ret B (high ret.) absorb less water.  
 $3\%BA + ESO < 3\%BA + ELO$

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



# RESULTS

## Mechanical Tests

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

➤ Oil modification of wood influences negatively on mechanical properties of wood tested. Reason for that could be long curing time (14 days) after treatment process, a fact that emphasizes the importance of long post-curing time.



**THANK YOU**



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