
Visco-elastic properties of archaeological oak wood treated with methyltrimethoxysilane

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**„Using DMA device to characterise physicommechanical
properties of archaeological oak wood treated with
silanes”**

Host: Erik Larnøy, Norwegian Institute of Bioeconomy Research (NIBIO)

Aim:

- visco-elastic properties of archaeological waterlogged oak wood consolidated with methyltrimethoxysilane (MTMOS).

Material:

- archaeological waterlogged oak pile from the Lednica Lake in the Wielkopolska Region, Poland – one of the structural element of the early medieval bridge.

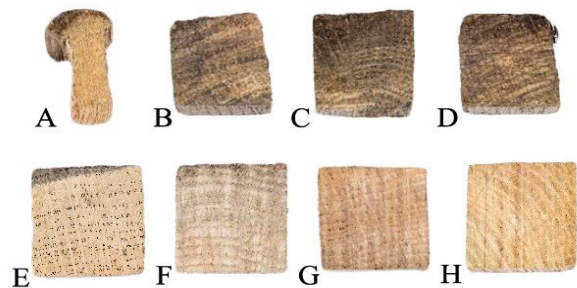
Method:

- Dynamic Mechanic Analyser 242 model DMA 242 E by NETZSCH-Gerätebau GmbH,
- specimens tested in radial direction using compression mode.

Results:

Table 1. Density and DMA parameters of air-dried samples at 60 minute of measurement; S – waterlogged sapwood, H1-H3 – respective waterlogged heartwood layers, CO – contemporary wood, t – MTMOS-treated samples

Wood sample	DMA parameters at 60' of measurement						ρ_t [kg×m ⁻³]
	E' [MPa]	E'' [MPa]	$\tan \delta \cdot 10^{-3}$	Δl [μm]	As' [μm]	F stat. s [N]	
S	146.33±52.17	18.33±9.29	0.12±0.02	-16.50±3.56	6.97±2.62	9.55±0.05	483.54
H1	134.57±38.01	20.57±8.46	0.15±0.02	-7.99±3.08	4.44±1.05	9.59±0.02	720.52
H2	163.00±65.08	29.29±18.96	0.17±0.04	-6.59±2.48	3.99±1.83	9.60±0.03	760.45
H3	165.57±68.93	32.57±21.74	0.18±0.06	-7.26±3.30	3.96±2.20	9.60±0.04	792.39
tS	43.75±18.30	3.75±2.22	0.08±0.02	-8.38±2.82	9.87±0.19	7.73±2.03	203.16
tH1	142.50±32.02	23.25±10.40	0.16±0.03	-3.08±1.19	3.78±0.99	9.60±0.02	687.44
tH2	140.25±74.08	28.00±23.62	0.17±0.08	-3.10±1.98	4.92±3.52	9.56±0.10	778.76
tH3	178.00±35.00	36.00±13.14	0.20±0.04	-3.30±1.20	3.12±0.90	9.61±0.01	840.29
CO	138.50±20.27	21.00±5.72	0.15±0.02	-6.900±1.61	4.24±0.81	9.59±0.02	624.17



Air-dried wood samples: A – untreated sapwood, B-D – untreated heartwood (H1-H3), E – MTMOS-treated sapwood, F-H – MTMOS-treated heartwood (H1-H3).

- Untreated wood – densified during drying (shrinkage, collapse), stiffness similar or even higher than of CO.
- MTMOS-treated wood – well preserved shape and dimensions, clear correlation between the level of wood degradation (translated into wood density) and mechanical strength.

CONCLUSION: MTMOS treatment did not deteriorate mechanical properties of waterlogged wood, no plasticising effect was observed, and the visco-elastic properties of silane-treated wood were statistically similar to those of contemporary wood.

MTMOS as a waterlogged wood consolidant:



Cross-section of waterlogged archaeological oak wood divided into four zones: S – sapwood, H1 – outer heartwood, H2 – middle heartwood, H3 – inner heartwood.

DIMENSIONAL STABILITY

- improved

HYDROPHOBICITY

- increased

VISCO-ELASTIC PROPERTIES

- not affected

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„THE REACTIVITY OF ORGANOSILICON COMPOUNDS WITH WOOD - FT-IR STUDY”
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