Artificial weathering effect on surface of heat-treated wood of Ayous (*Triplochiton scleroxylon* K. Shum)

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AIM OF THE WORK

Evaluate changes in Ayous wood, through:

- ✓ artificial ageing cycles under UV and water leaching
- ✓ colour measurements
- ✓ reflectance acquisition
- ✓ pH and conductivity measurements
- ✓ FTIR spectroscopy of leached material

WOOD SPECIMENS

Untreated Thermally treated

Two untreated and two heat-treated Ayous wood specimens were used for the ageing tests. The thermal modification was conducted on planks of Ayous from Cameroon in an industrial system that used a slight initial vacuum in an autoclave (Maspell WDE Model TVS 6000) and a treatment temperature of 215 °C for three hours.

WEATHERING CYCLES

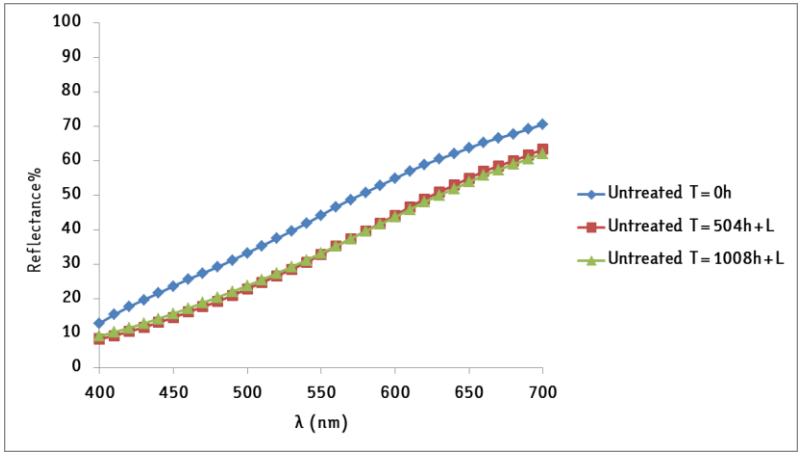
Cycle Nr.	UV irradiation	Leaching (hours)
1	72 h	5
2	1° cycle + 96 h	5
3	2° cycle + 168 h	5
4	3° cycle + 168 h	5
5	4° cycle + 672 h	5
6	5° cycle + 336 h	5

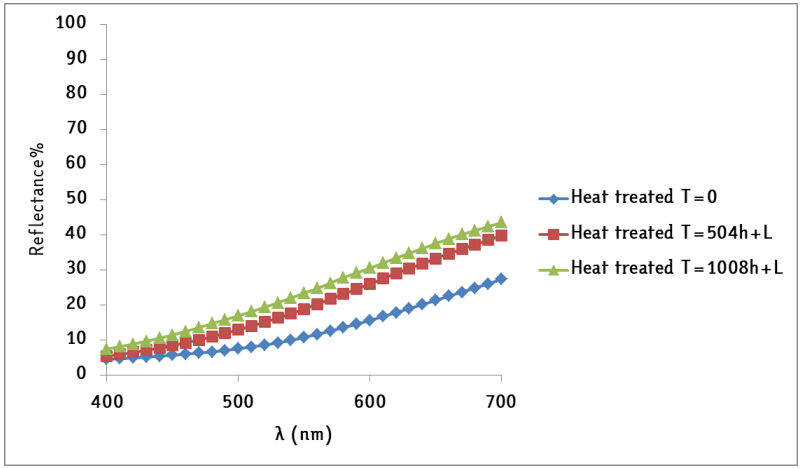
T = 0h

T = 504h

T = 1008h

COLOUR MEASUREMENTS





CIELAB colour system
Reflectance spectrophotometer in the visible range (400-700 nm)

The comparison of reflectance spectra in the visible range at three chosen times shows that the main changes occur between 0 and 504 h of ageing with a darkening of untreated specimens and a lightening of heat treated ones.

COLOUR MEASUREMENTS: CHANGES OF THE COLOUR COORDINATES

Specimen	ΔL*	Δa*	Δb*	ΔE
		1° cycle		
1 (untreated)	-6.35	1.50	5.88	8.78
2 (untreated)	-7.41	2.03	7.30	10.6
3 (heat-treated)	1.97	0.18	5.43	5.78
4 (heat-treated)	0.54	0.33	4.55	4.59
		2° cycle		
1 (untreated)	-7.57	2.90	6.57	10.4
2 (untreated)	-8.37	3.07	7.02	11.3
3 (heat-treated)	5.75	0.32	7.42	9.40
4 (heat-treated)	3.74	0.82	6.57	7.60
		3° cycle		
1 (untreated)	-8.63	3.23	4.86	10.4
2 (untreated)	-9.88	3.58	5.82	12.0
3 (heat-treated)	8.09	-0.03	7.78	11.2
4 (heat-treated)	6.48	0.90	7.82	10.2
		4° cycle		
1 (untreated)	-7.88	3.17	4.39	9.56
2 (untreated)	-9.75	3.41	4.88	11.4
3 (heat-treated)	10.2	-0.82	7.26	13.1
4 (heat-treated)	8.81	0.38	7.88	11.8
		5° cycle		
1 (untreated)	-8.32	2.88	3.18	9.36
2 (untreated)	-9.74	3.11	3.69	10.9
3 (heat-treated)	12.7	-1.49	6.07	14.1
4 (heat-treated)	10.6	-0.18	7.14	12.8
		6° cycle		
1 (untreated)	-7.66	2.14	2.21	**8.25**
2 (untreated)	-9.66	2.28	2.51	**10.2**
3 (heat-treated)	15.6	-2.63	5.94	**16.9**
4 (heat-treated)	13.0	-0.94	7.35	**14.9**

HMI ACQUISITION

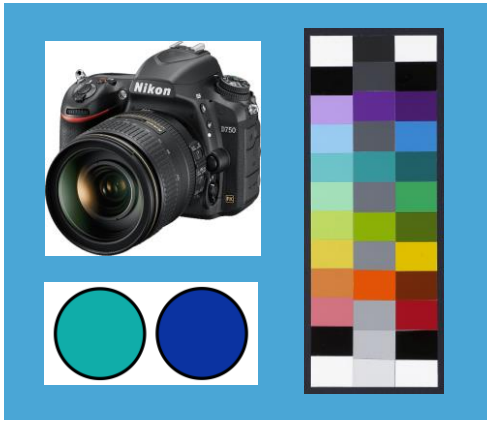
Acquisition of images

- Nikon D810FR 36 Megapixel camera, modified to obtain full-range spectral reflectance measurements
- Nikon SB910 xenon flashes after removing their front plastic lenses, thus allowing also the UV wavelength to be emitted. The UV induced fluorescence (UVF) was then obtained by filtering the flashes light with a UV band pass filter with a cut at 380 nm, and UV-IR cut filter (400-700 nm) in front of the camera
- Various white patches and a sample with 36 patches of colour-checkers built using colour samples from the NCS – Natural Colour System®© catalog were placed next to the object

Calibration was performed through SpectraPick, a software developed by Profilocolore srl.

Image processing was then performed by PickViewer®.

HMI ACQUISITION



2 shoots and calibration

7 radiometric bands
+ 1 CIELAB image

Every pixel contains:
L*a*b* colorimetric coordinates
7 radiometric values centered at
350, 450, 550, 650, 750, 850, 950 nm

With a third shoot:
RGB colour image of the
UV induced fluorescence

High resolution calibrated images are obtained

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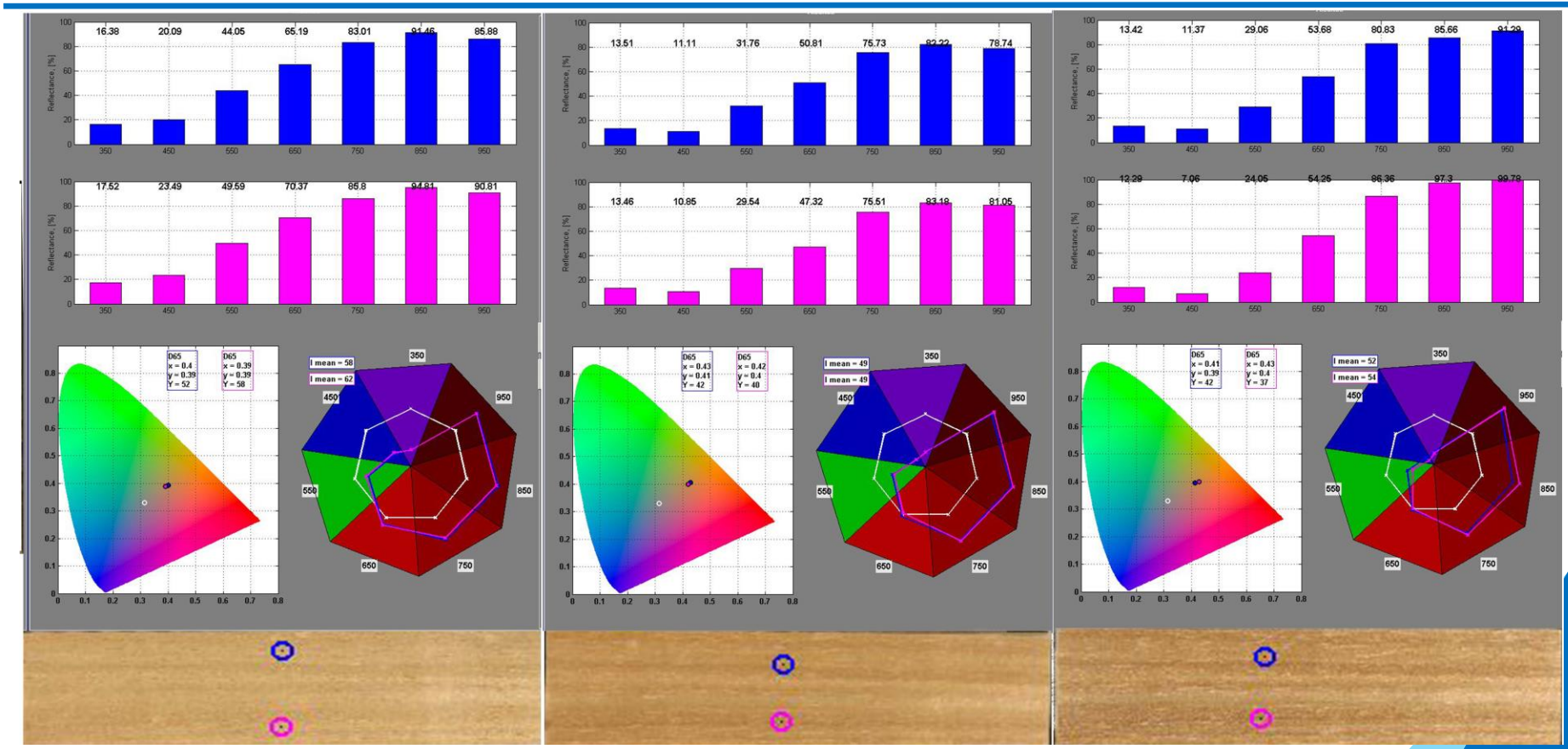
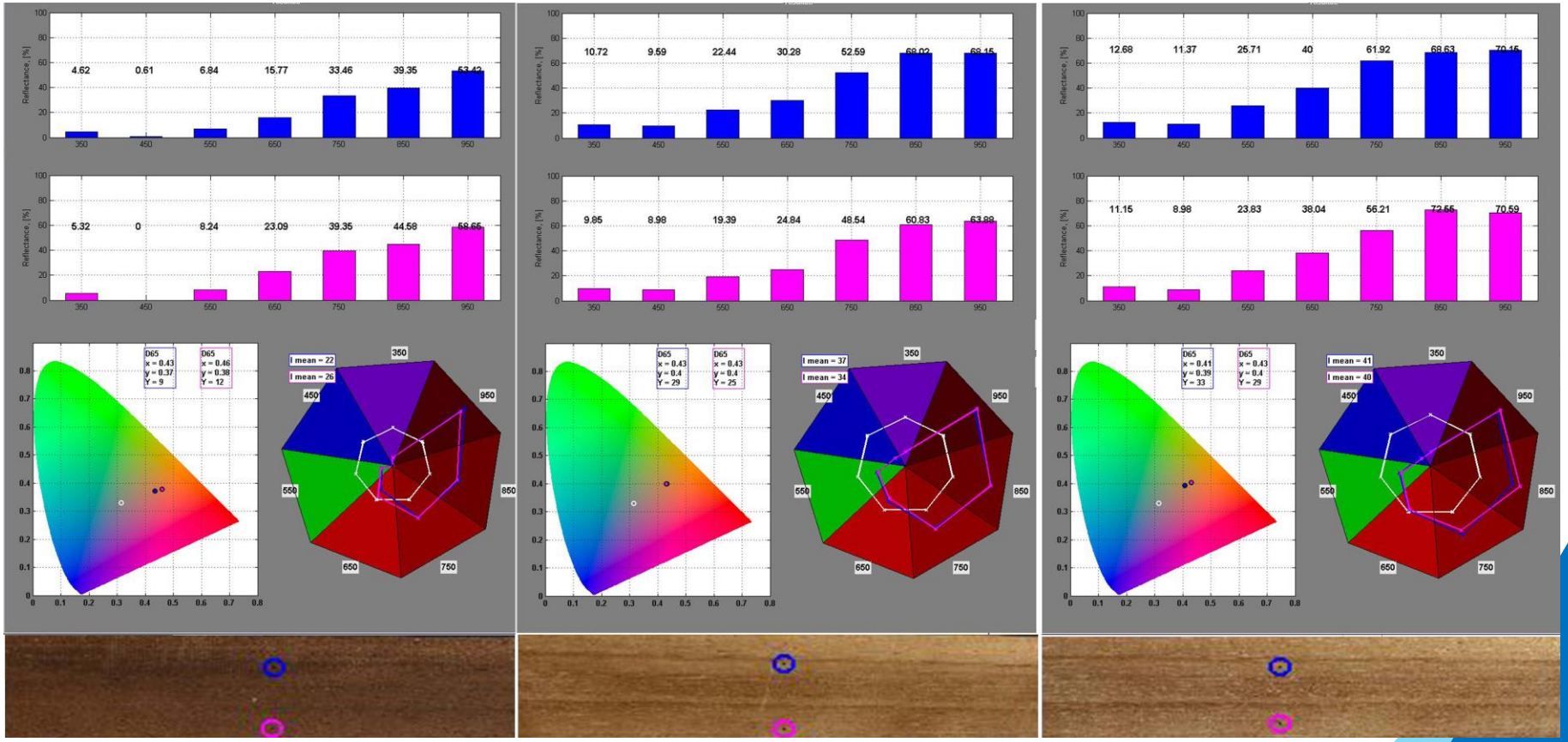
HMI ACQUISITION FOR UNTREATED SPECIMENS



T = 0h T = 504h T = 1008h

HMI ACQUISITION FOR THERMALLY TREATED SPECIMENS



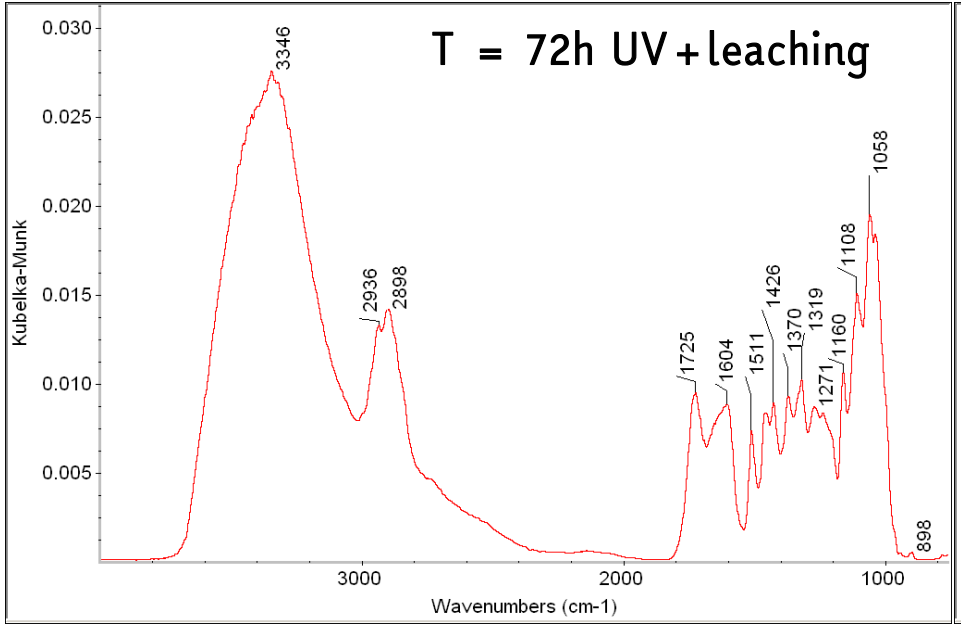
T = 0h T = 504h T = 1008h

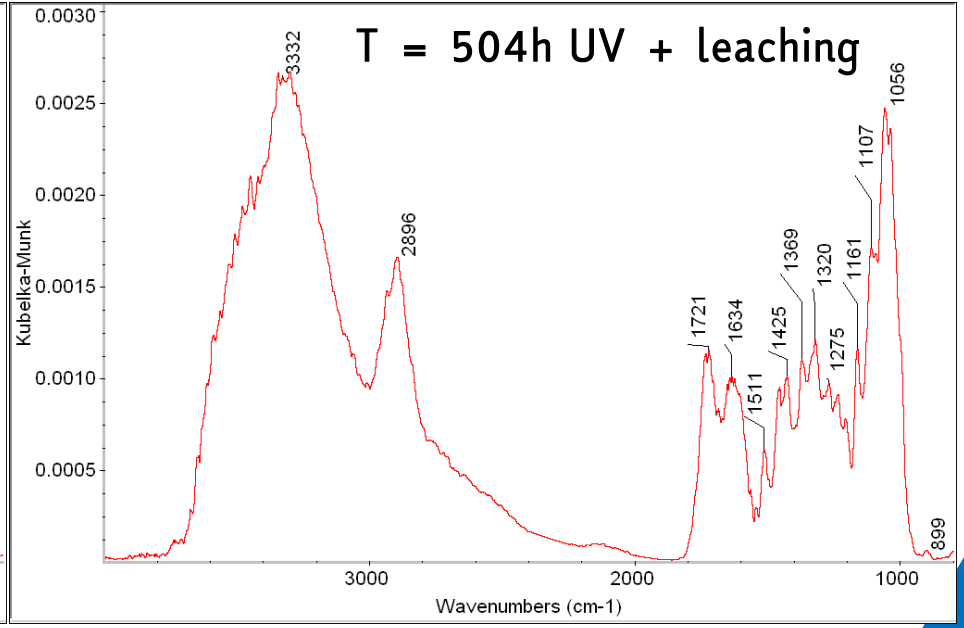
pH AND CONDUCTIVITY

Cycle Nr.	pH		Conductivity (µS/ cm)	
	1-2	3-4	1-2	3-4
1	4.43	4.58	318	136
2	4.38	4.37	110	94
3	4.17	4.01	105	179
4	4.14	4.03	203	96
5	4.34	4.18	165	114
6	4.12	4.25	168	135

pH values were in the acid range of the water scale indicating the presence of weak acids in solution produced during ageing.
Conductivity values were quite low suggesting the presence of few charged species in the leaching solution. Generally they were higher in the water used for leaching untreated specimens (1-2) in respect to that used for thermally treated ones (3-4).

FTIR SPECTROSCOPY (HEAT TREATED SPECIMENS)





FTIR spectra revealed the main signatures of wood components, mainly polysaccharides (main bands at cm^{-1}: 1370, 1160, 1108, 1056 and 898). Bands of lignin are also visible (the main at 1511 cm^{-1}), demonstrating that the leaching caused the removal of wood micro-particles from the degraded surfaces in the heat treated specimens.

CONCLUSIONS

- The weathering cycles changed significantly the colour and the spectral reflectance of the specimen surface.
- Solar box irradiation causes darkening of the untreated specimens, whereas it causes lightening of the thermally treated ones.
- The measured values of conductance were generally higher in the leaching water of untreated specimens and tend to decrease after the first cycles. The values of pH are similar in untreated and treated specimens.
- FTIR spectroscopy demonstrated that water leaching caused loss of materials from the thermally treated specimens.

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Thank you for your kind attention

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Chaired by **ANGELA LO MONACO**, **CATE MACINNIS-NG** and **OM P. RAJORA**

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