

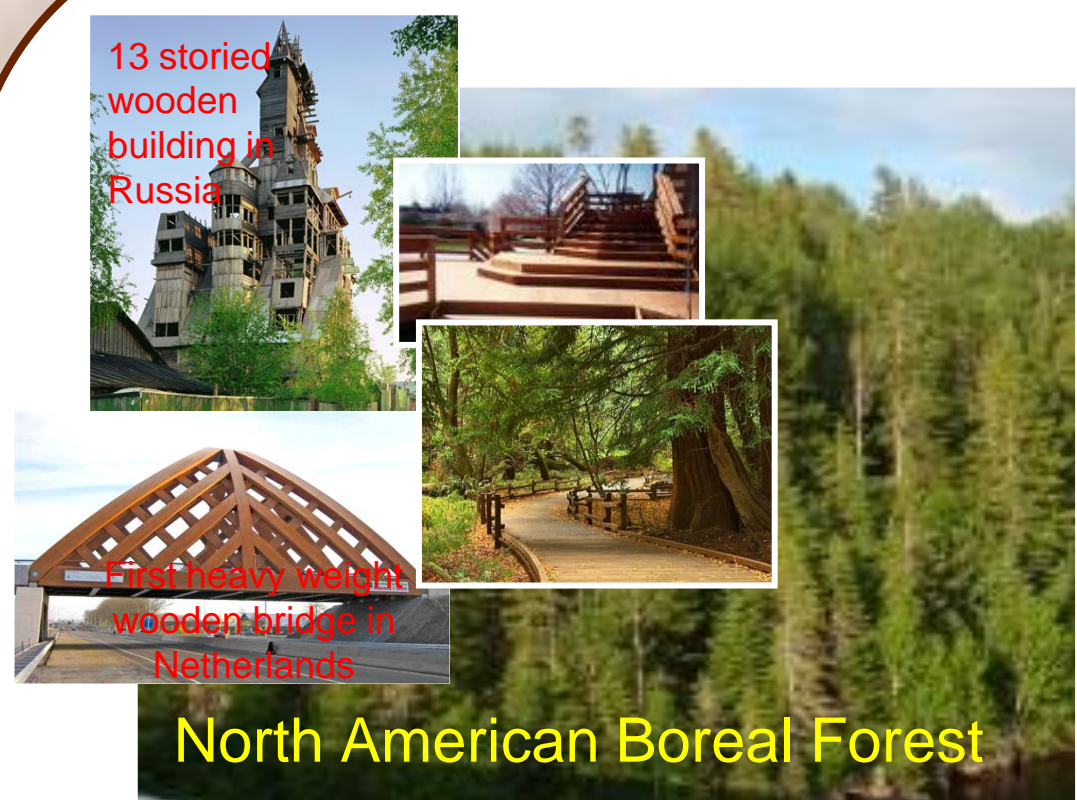
UV PROTECTION OF HEAT-TREATED JACK PINE USING TiO₂ NANO-COATINGS

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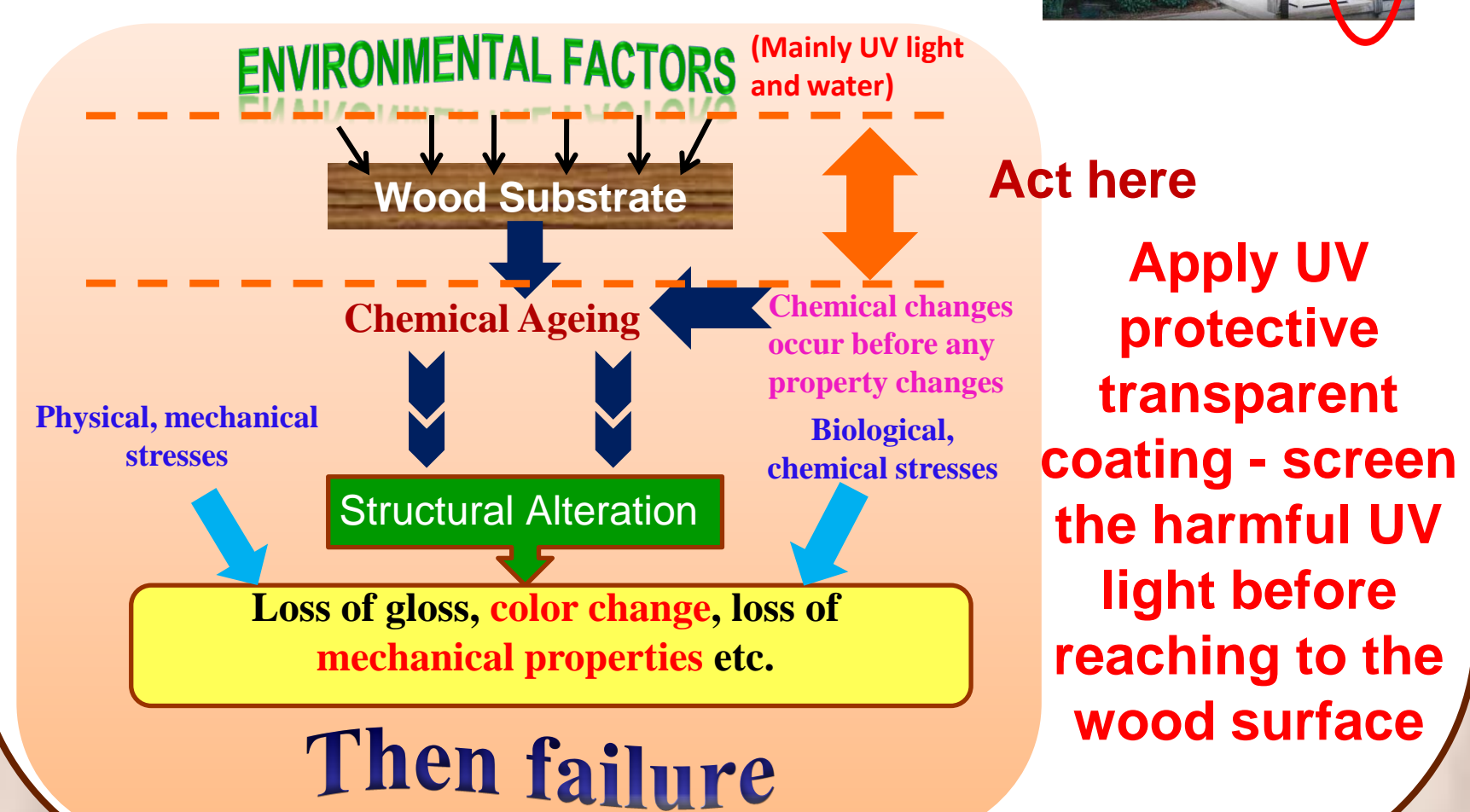
Introduction



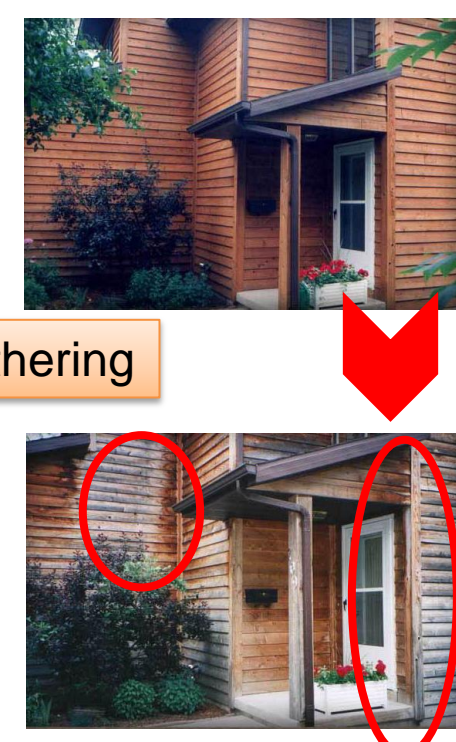
Wood, one of the major building materials in world

WEATHERING the biggest problem for wood industries

Influence the rate of degradation

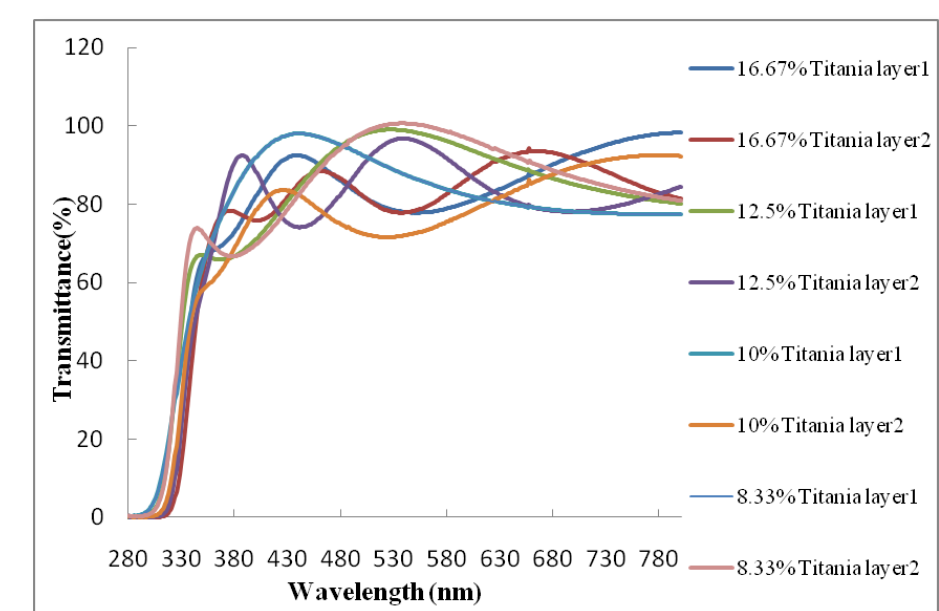


After weathering



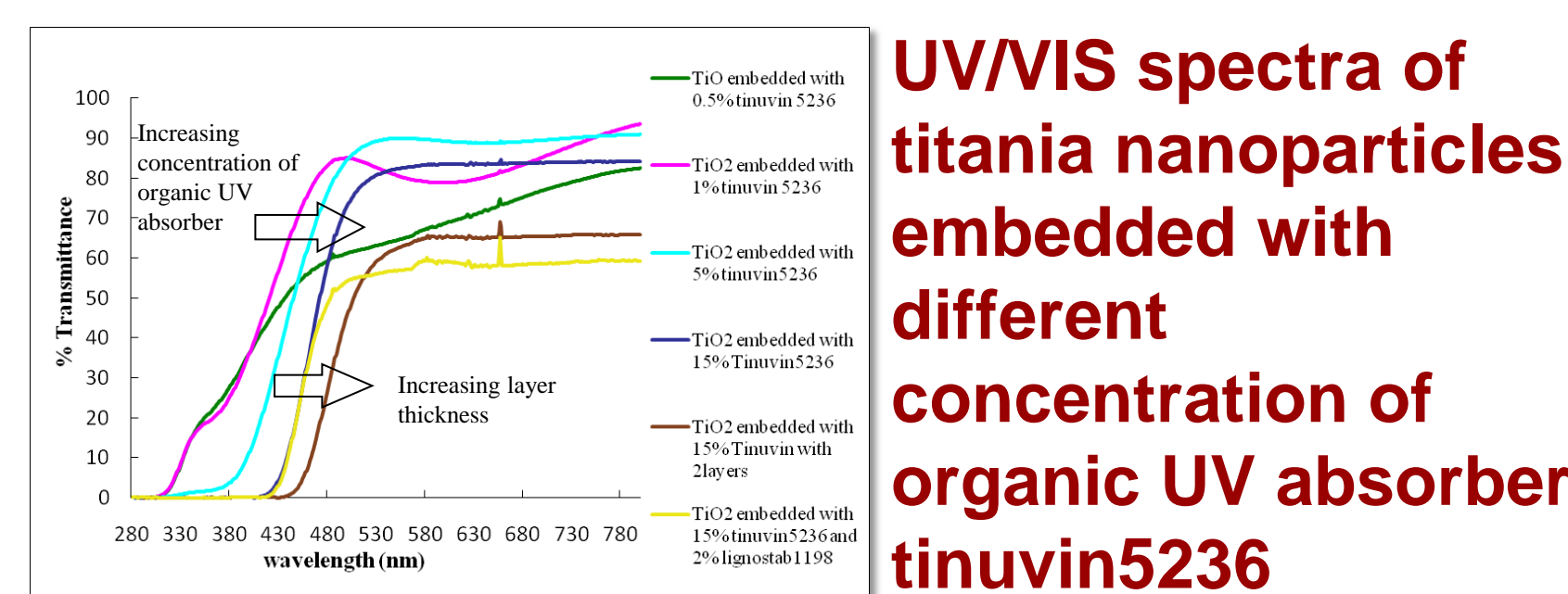
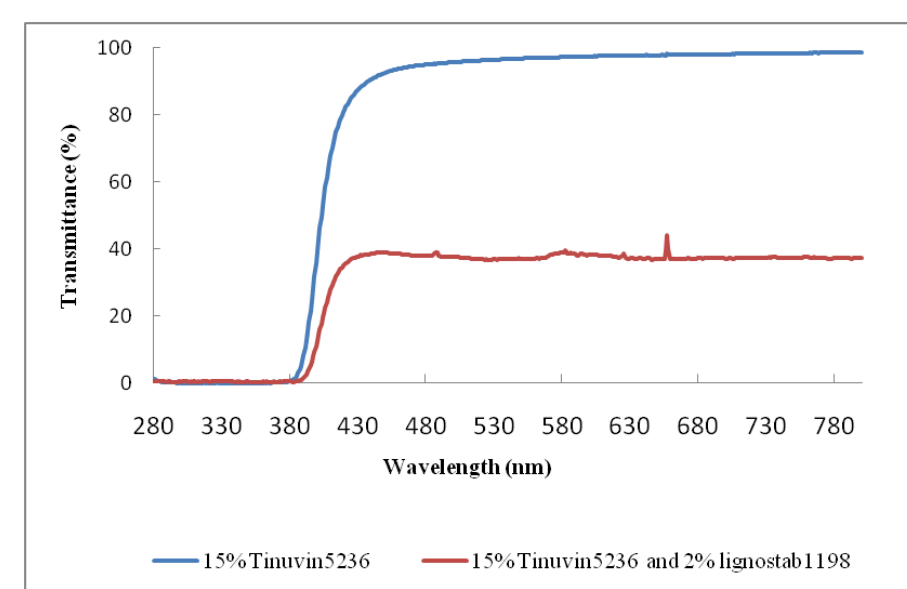
Apply UV protective coating - screen the harmful UV light before reaching to the wood surface

Optical investigation



UV/VIS spectra of titania coatings on glass as function of concentration and layer thickness

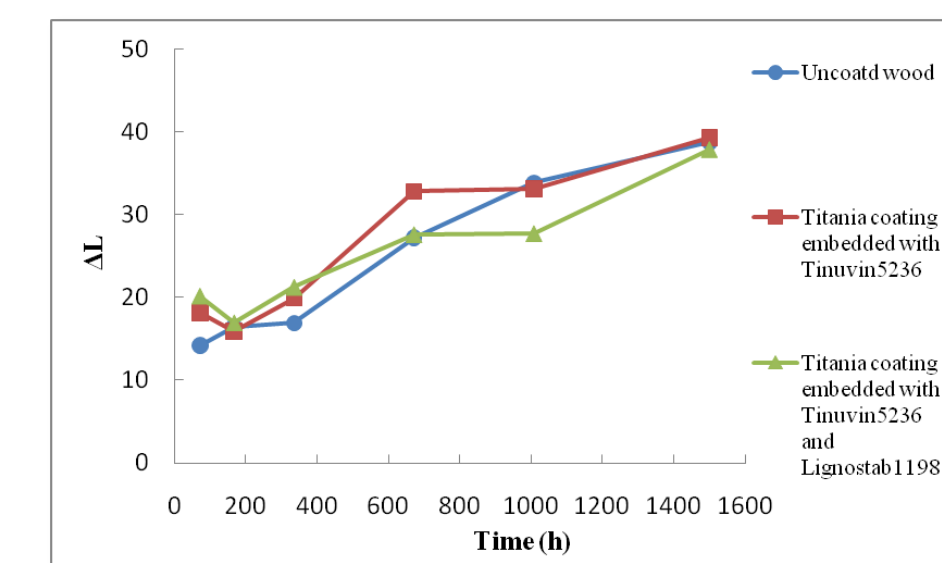
Effect of lignin stabilizer (lignostab 1198) on transmission spectra of Tinuvin5236



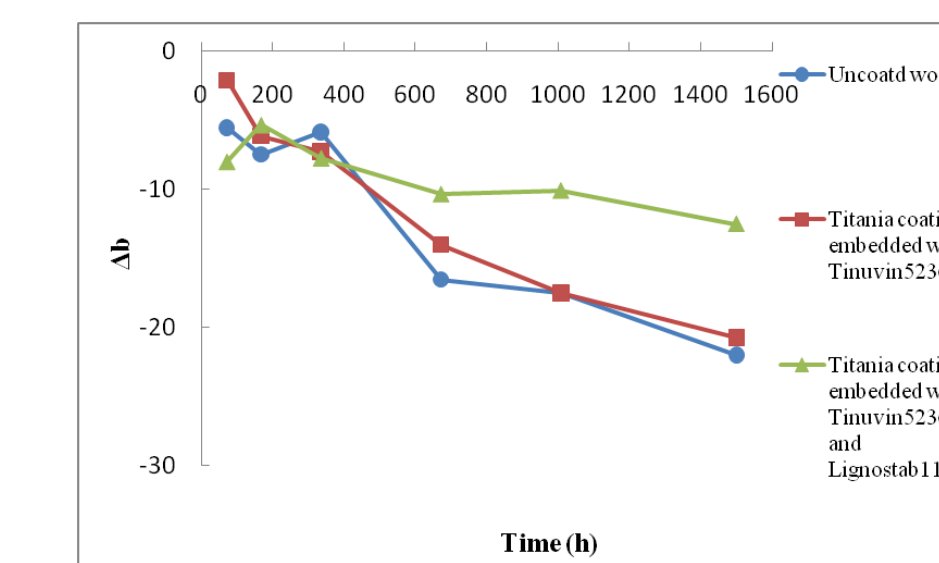
UV/VIS spectra of titania nanoparticles embedded with different concentration of organic UV absorber tinuvin5236

Results

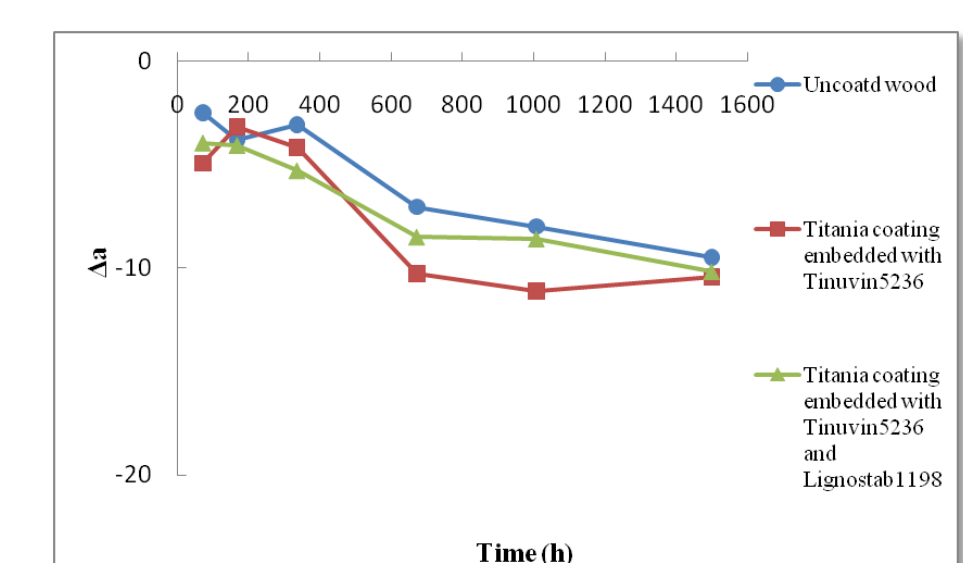
The color measurement done according to CIELab and along the grain of the wood surface



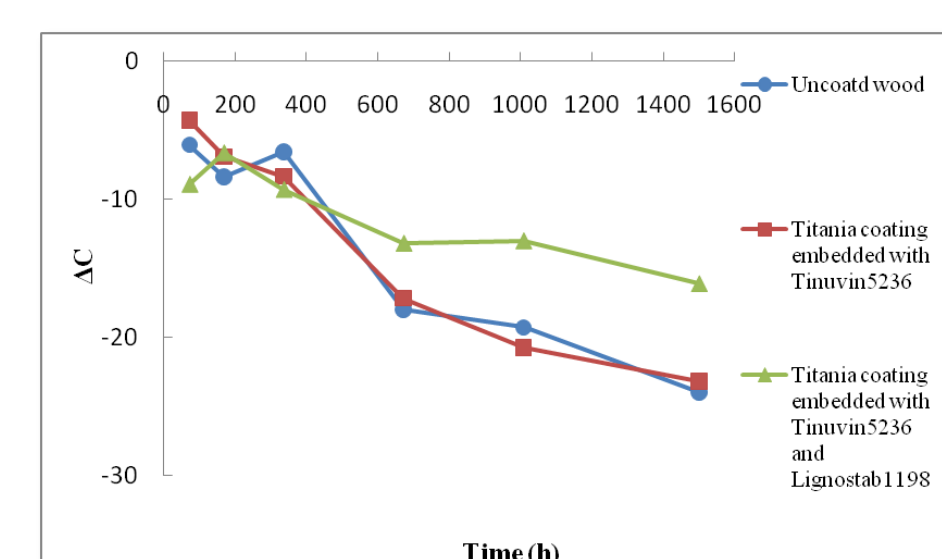
Lightness variation of uncoated and coated heat-treated wood as a function of time



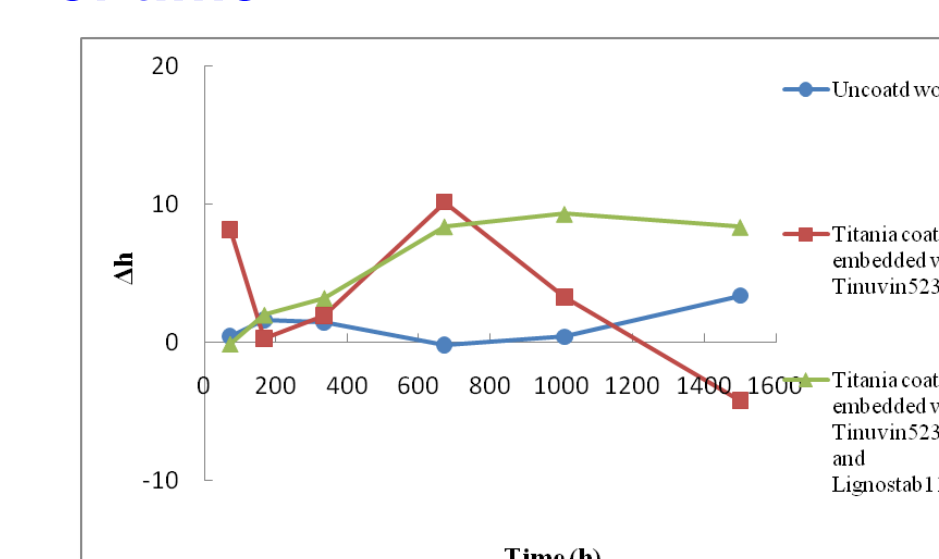
Yellow-blue index variation of uncoated and coated heat-treated wood after accelerated weathering test as a function of time



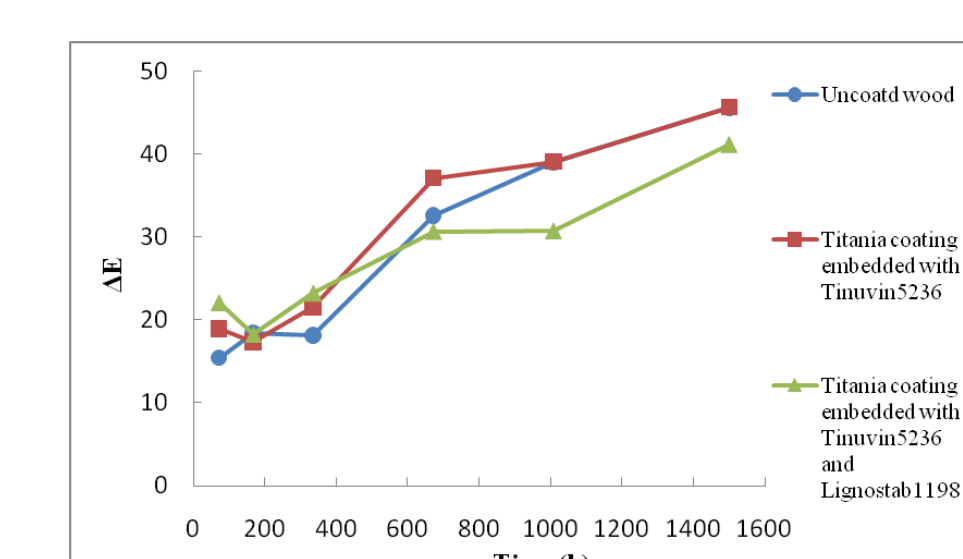
Red-green index variation of uncoated and coated heat-treated wood as a function of time



Chroma variation of coated and uncoated heat-treated wood after weathering as a function of time



Hue variation of coated and uncoated heat-treated wood after weathering test as a function of time



Total color variation of uncoated and coated heat-treated wood as a function of time

Materials and methods

Substrate

Heat-treated jack pine wood

Coating materials and preparation

The organic UV absorber (Tinuvin5236, CIBA) and lignin stabilizer (lignostab1198, CIBA).

The inorganic TiO₂ sol prepared by hydrolysis of titanium butoxide (Ti(OC₂H₅)₄ obtained from Sigma Aldrich) and pure ethanol at room temperature.

The final coatings prepared by dissolving Tinuvin5236 and lignostab1198 in diluted TiO₂ sols

ATLAS weatherometer



Condition of the test

Irradiance- 0.55W/m² @ 340nm, BPT= 63°C±3
Cycle- 102min light and 18 min spray, Humidity- 50%
Filter- Inner CIRA/ outer soda lime
Light Source-6500W water cooled xenon arc lamp

Datacolor colorimeter



Axis ULTRA XPS instrument

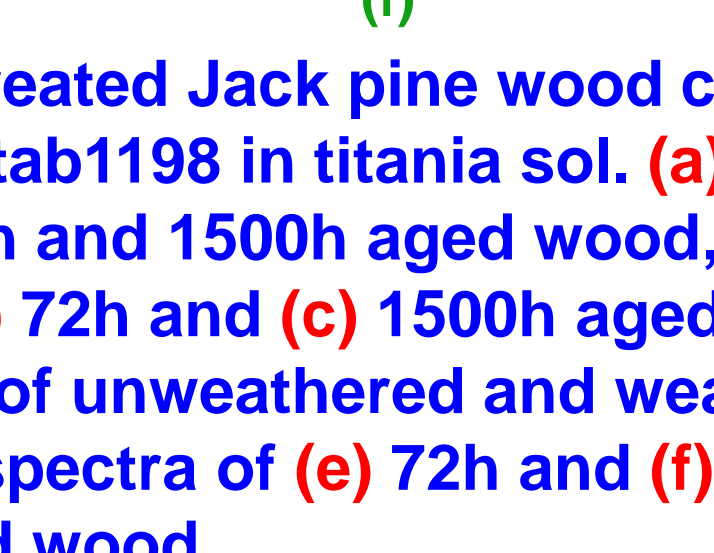
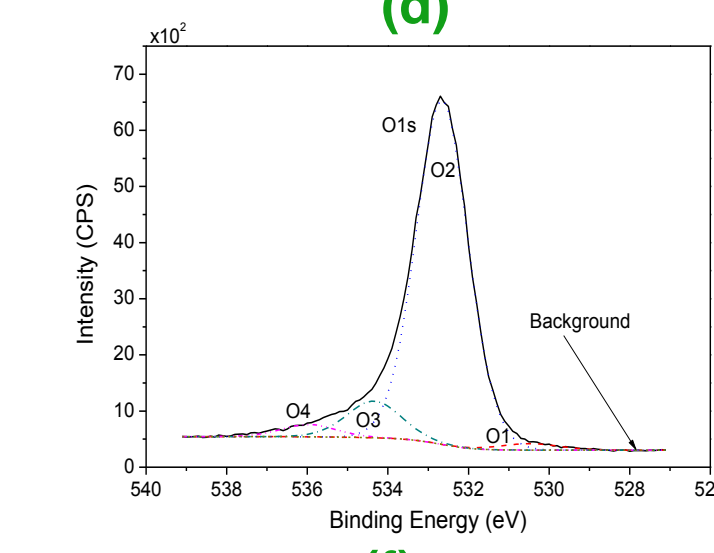
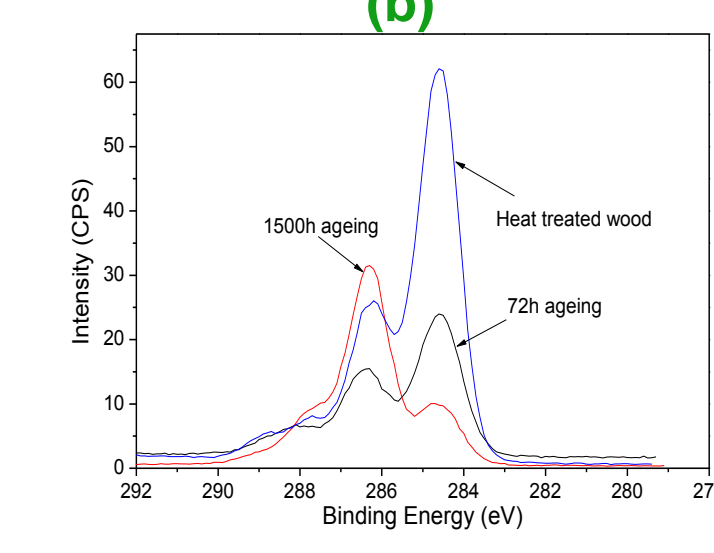
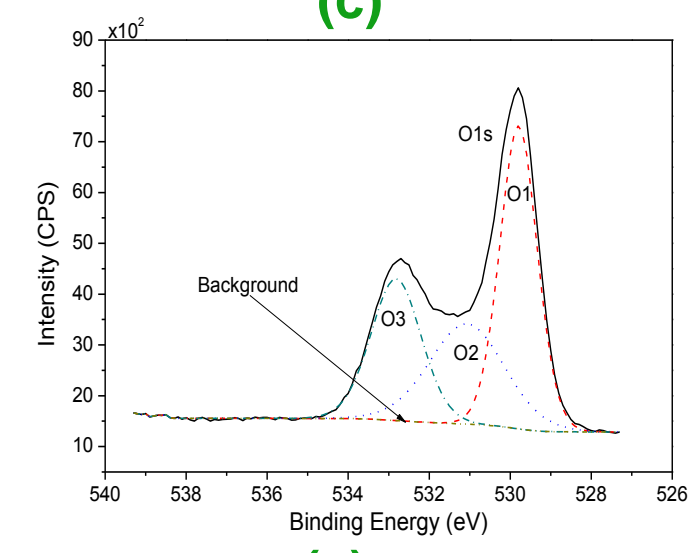
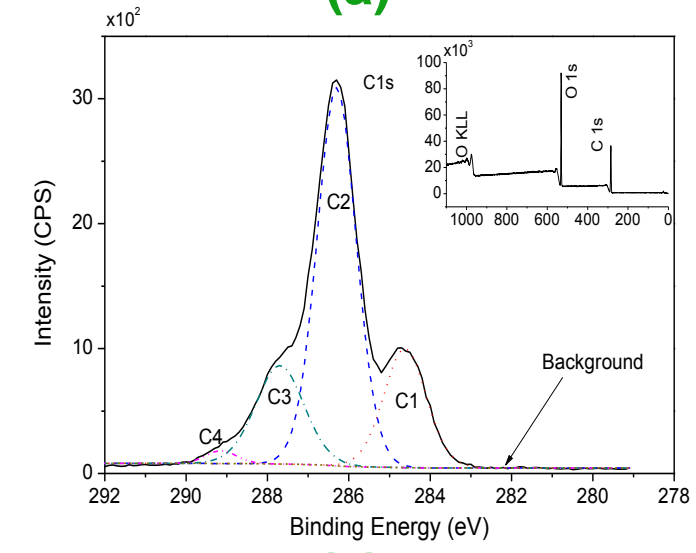
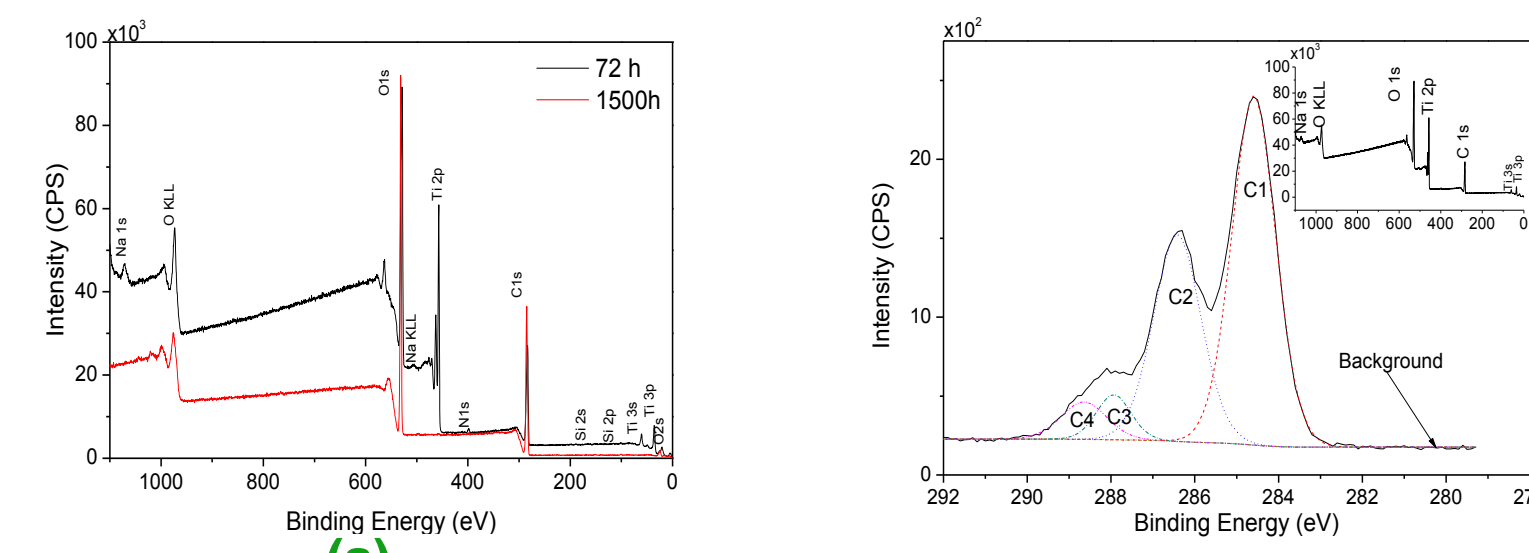


Agilent UV-VIS spectrophotometer



Surface characterization

XPS analyses



The XPS spectra of Heat-treated Jack pine wood coated with Tinuvin5236 and Lignostab1198 in titania sol. (a) survey spectra comparison of 72h and 1500h aged wood, High resolution C1s spectra of (b) 72h and (c) 1500h aged wood, (d) C1s spectra comparison of unweathered and weathered wood, O1s high resolution spectra of (e) 72h and (f) 1500h aged wood

Conclusions

The UV absorbing titania coating and also organic UV absorbers themselves do not produce sufficient UV protection. The UV/VIS spectroscopy results for titania embedded with UV absorbers show very promising UV protective characteristics. But the accelerated aging test results do not agree with these results. The color change diagrams demonstrate that the titania embedded with UV absorber coating does not have significant influence on wood color change but lignin stabilizer play an important role in wood protection. Ineffectiveness of the coatings may be due to the thickness of the coatings. If the coating layer is very thin, protection on the surface is inefficient due to porous character of wood. This point can be further proved by the fact that there is not much coating retained on the surface after weathering. It is also possible that a coating which is not suitable for wood can have application in other fields such as polymer foils, textile fabrics etc. Further study is needed to investigate the performance of UV protective coating incorporated in to clear wood coatings.

Acknowledgements

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