

# COLOUR CHANGES OF WOOD BY TWO METHODS OF AGING

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# INTRODUCTION

## Wood

Is a natural, versatile, and renewable resource used worldwide for different uses.



Figure 1.- The uses of wood.

# INTRODUCTION

## Wood

✿ The durability of wood is affected by the contact with water or high humidity environment, UV rays and microorganism.

### Wood Decay

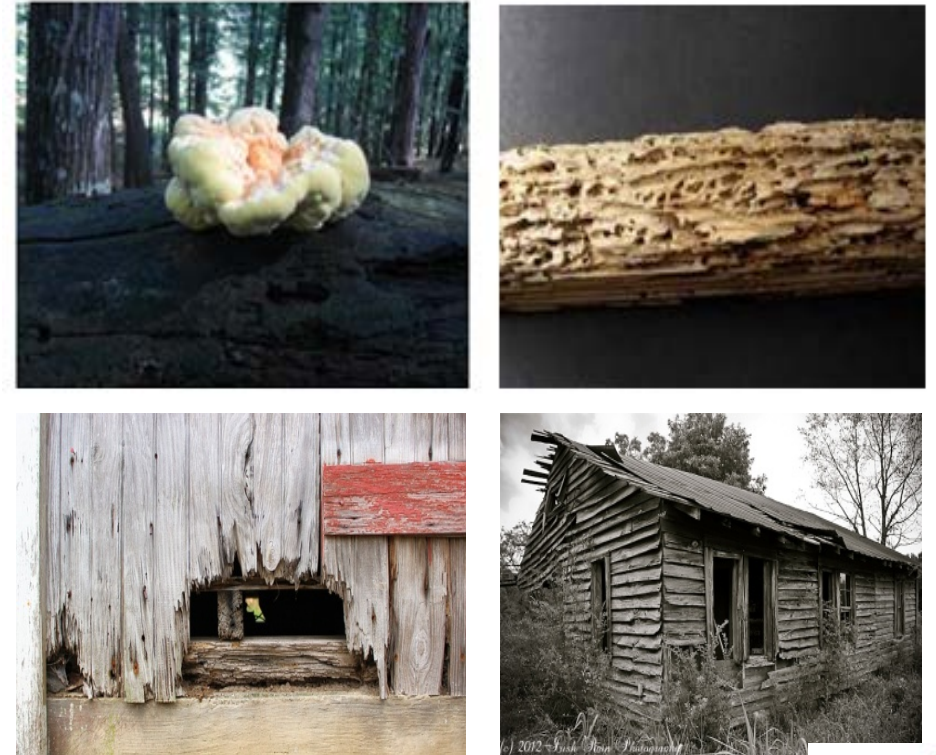


Figure 2- Degradation of wood by Uv rays, fungi and insects.



# OBJECTIVES

✿ This study sought to compare outdoor weathering and accelerated weathering methods, in order to verify the change of color and roughness of the wood, through the different methods of exposure.

# OBJECTIVES

- ✿ Natural weathering exposure is often used to observe the photo degradation of wood, but is very time consuming, requiring months of exposure.
- ✿ However, using an accelerated weathering method allows one to control the environment with simulated rain, dew, temperature, and irradiation allowing one to obtain results in shorter exposure times.

# MATERIALS AND METHODS

✿ The *Pinus elliotti* wood (Figure 3), were overthrow from homogeneous plantations of Rio Grande do Sul state, in southern Brazil.



Figure 3- Homogeneous plantations of *Pinnus elliotii*.

# MATERIALS AND METHODS

✿ For the action of natural weathering, colorimetric measurements were performed every 90 days during the period of 9 months, for the accelerated aging test. The wood was exposed in the first summer day so that exposure to UV light was the best possible in the first months of exposure.



Figure 4- Test of natural weathering.



# MATERIALS AND METHODS

✿ The accelerated aging test was conducted in a Model Bass chamber, according to ASTM G 154. The standard called for a 12 hour cycle consisting of 8 hours of light exposure at 60 °C , 0.25 hours of water spry (no light), and 3.75 hours condensation at 50 °C, were performed every 30 hours for a period of 240 h.



Figure 5- Test of accelerated aging.



# MATERIALS AND METHODS

✿ The parameters CIE  $L^*$ ,  $a^*$ ,  $b^*$  (Figure 6), and the variation of colour between the initial and final time ( $\Delta E$ ) was determined measuring the sample (ends and in the middle), according to the CIE Lab standard.

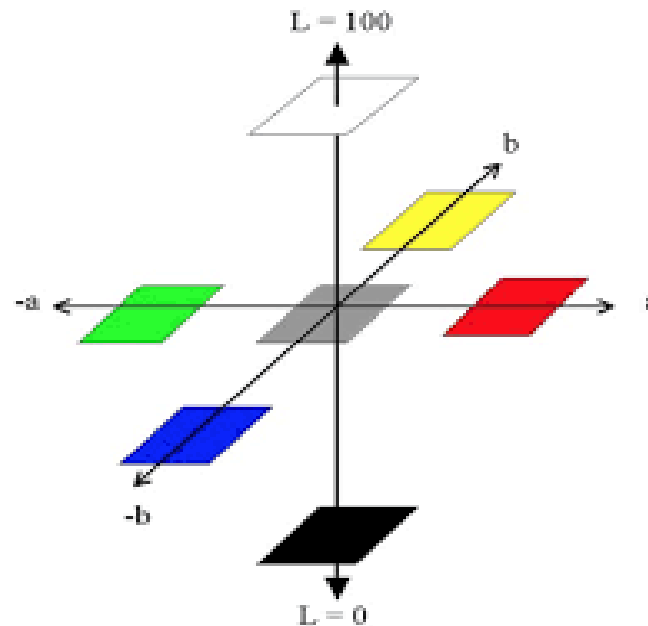


Figure 6- Test of colour by CIE  $L^*$ ,  $a^*$ ,  $b^*$  system.

# MATERIALS AND METHODS

- ✿ The equipment of roughness used was digital Homis, model 899 with diamond tip, which analyzed the Ra parameter (microns).

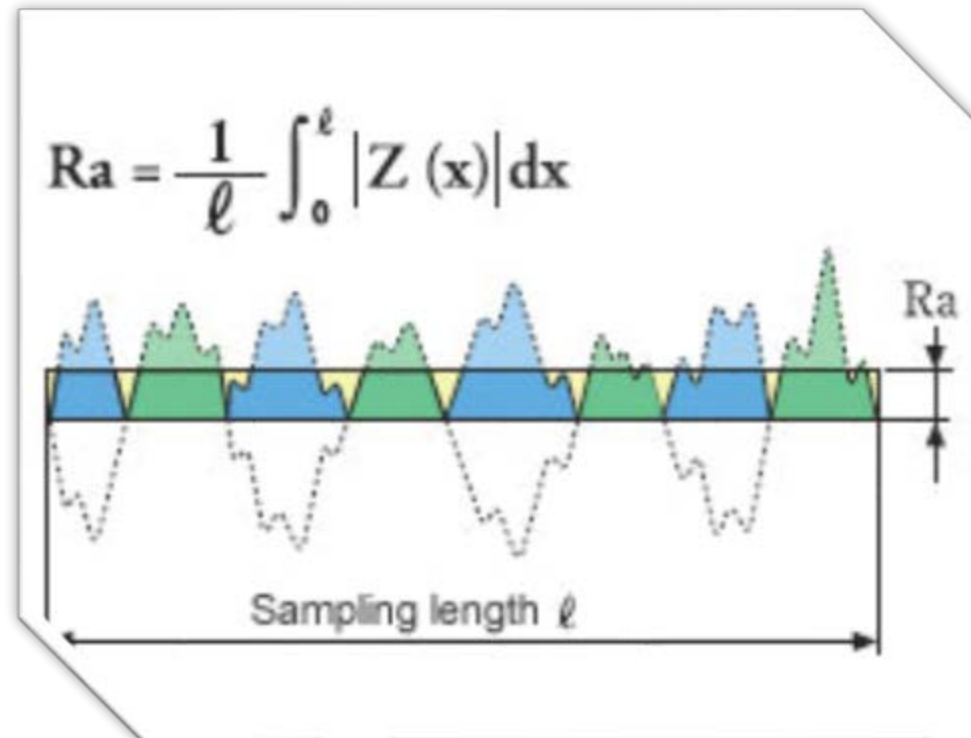


Figure 7- Test of roughness by Ra parameter .

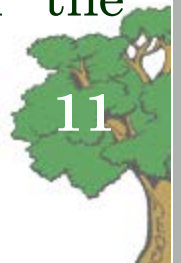
# RESULTS AND DISCUSSION

Table 1 - Weather conditions (monthly averages) site.

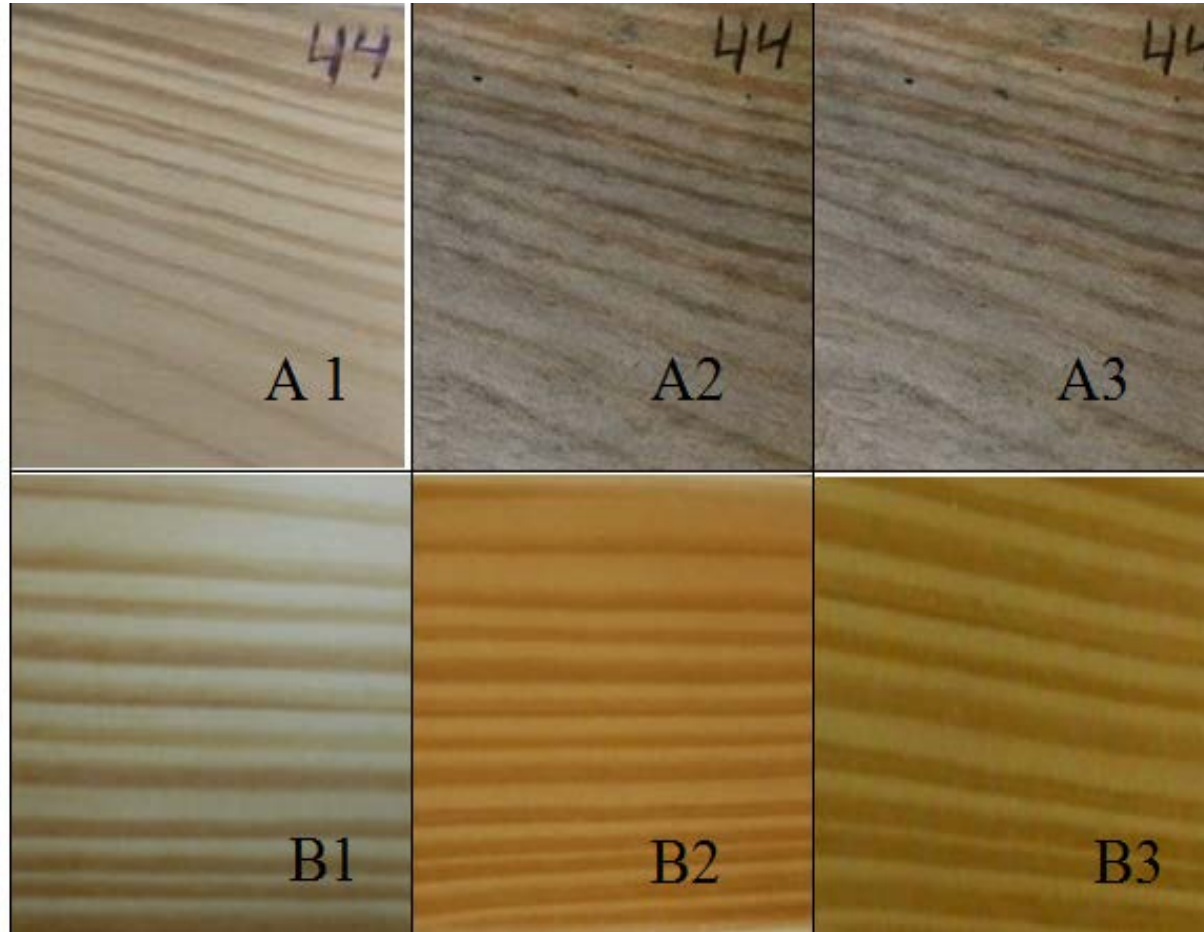
Months	Average temperature (°C)	Rain precipitation (mm)	Solar radiation (cal.cm-2.dia-1)
06/2013	13.8(1.9)	2.2(7.7)	212.0(74.2)
07/2013	12.9(4.2)	1.7(4.3)	227.0(90.0)
08/2013	12.6(3.5)	2.7(5.6)	242(141.4)
09 /2013	16.5(4.2)	4.7(14.5)	310.5(143.8)
10/2013	17.9(2.1)	6.0(14.4)	451.7(183.4)
11/2013	20.9(2.1)	3.8 (7.5)	514.3(220.7)
12/2013	24.2(2.8)	2.32(8.8)	608.5(138.4)
01/2014	25.2(2.6)	7.0(10.8)	492.0(203.6)
02/2014	24.4(3.0)	8.0(10.6)	430.9(167.8)
03/2014	21.3(2.1)	5.6(13.2)	393.5(154.9)

The data in parentheses are the standard deviation

Weather conditions during the study period. Table 1 shows the average temperature, relative humidity and precipitation for the southern region of Brazil, where the study was conducted by EMBRAPA-CPTAC. The data show that December was the largest solar energy emitted with about  $609 \text{ cal} \cdot \text{cm}^{-2} \cdot \text{day}^{-1}$  and higher soil temperature of  $30 \text{ }^\circ\text{C}$ , but it was not the month that had the highest average temperature.



# RESULTS AND DISCUSSION



The total colour change ( $\Delta E^*$ ) observed in accelerated aging was 17.5, while the natural weathering colour change was greater than 31.8. A greater  $\Delta E^*$  value means a larger amount of colour change during the test. Both methods exhibit noticeable colour variations and are noticeable by eye when compared with non-exposed specimens.

Figure 8: Effect of color changes of *Pinus* wood exposed to (A) natural weathering with 0, 90, and 270 days respective and (B) accelerated aging with 0, 120, and 240 hours respectively.

# RESULTS AND DISCUSSION

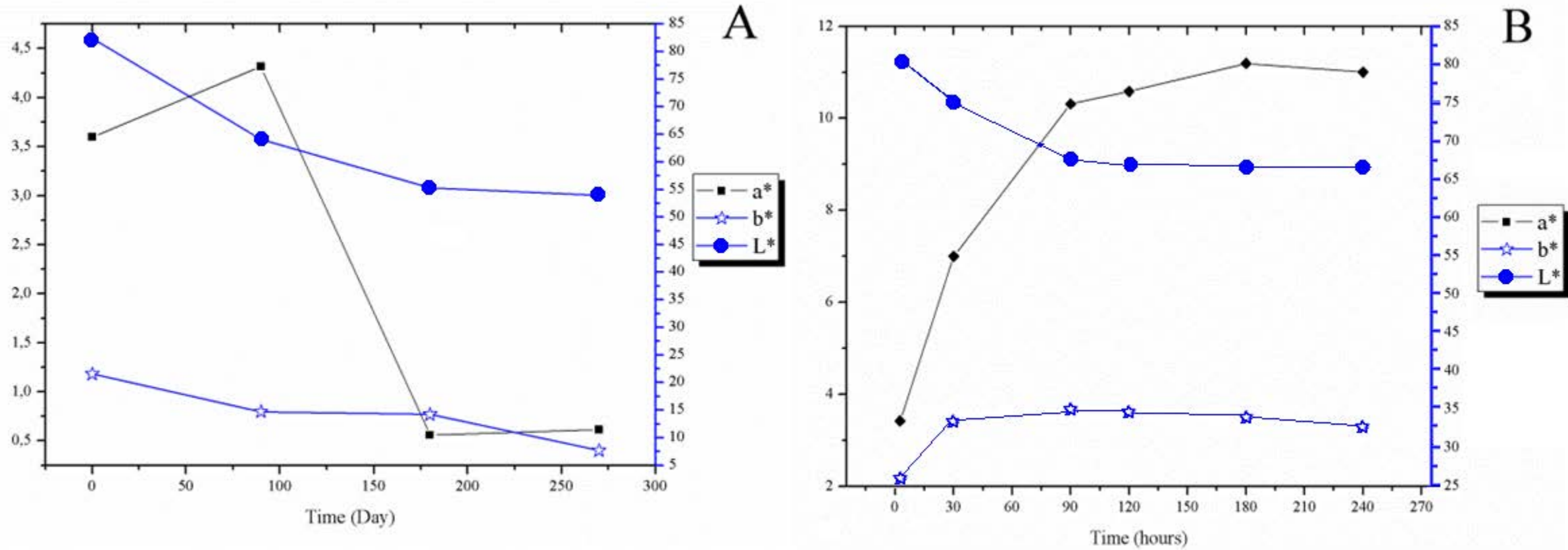


Figure 9: Changes in colour change parameters in Brazilian *Pinus* wood exposed to natural weathering (A) and accelerated aging (B).

# RESULTS AND DISCUSSION

✿ The surface roughness was changed with degradation. For both methods the aging of the samples showed variation in surface roughness (Table 2).

Table 2 - Effect of roughness changes of *Pinus elliotti* wood exposed to natural weathering and accelerated aging

	Average Roughness Ra ( $\mu\text{m}$ )			
	Weathering in the natural (days)		Climatic chamber (hours)	
	0	180	0	240
Control wood	4.99	13.92	4.92	9.98

# RESULTS AND DISCUSSION

✿ The study data show that for variation in surface roughness with the accelerated test in a period of 240 hours, it is possible to achieve similar results to external weathering for a period of 180 days, it is noted that this result is valid for weathering climatologically region of southern Brazil to other regions is necessary similar studies\* comparing the methods.

\* Martins, S. A., Santos, C. M. T. D., Gonzalez, J. C., & Camargos, J. A. A. (2011). Envelhecimento artificial acelerado por radiação ultravioleta de madeiras de *Eucalyptus benthamii* e *Pinus caribaea* var. *hondurensis*. *Revista\_Floresta\_v41\_n1\_p87-96\_2011*.

# CONCLUSIONS

- ✿ Colour variations were observed during the time of exposure of wood for the two tests (natural aging and accelerated aging);
- ✿ Both methods caused significant discoloration of the wood, which showed a greyish colour as a function of exposure;
- ✿ The accelerated test shows very similar results to the natural test, with the application of reduced times.



# REFERENCE

✿ Feist, W.C., Hon, D.N.S. (1984). Chemistry of Weathering and Protection. In: Rowell RM, editor. The Chemistry of Solid Wood, Advances in Chemistry Washington: American Chemical Society, 401-451

THANKS FOR YOUR ATTENTION !

ACKNOWLEDGEMENT

