Colour change of Scots pine and spruce wood by steaming for renovation of wooden cultural heritages

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Introduction

The colour of solid wood is sensitive to light and heat. Indoor wooden applications change their colour during decades, getting more brown and darker. The maintenance and replacement of damaged parts of old wooden constructions is difficult because of the unique aged colour. Proper coloration of the surface is usually produced using chemicals for surface modification. This method only changes the colour of the surface. If the surface is damaged the thin coloured layer disappears. Steaming can be the proper solution creating the colour matching between the old and the new wooden parts.

Approach

Scots pine (*Pinus sylvestris* L.) and spruce (*Picea abies* Mill.) were selected for analyses and represented by a series of 10 samples for each steaming temperatures. The sample dimensions were 100x30x10 mm^3. Steam treatment was carried out in a steaming vat in 100% relative humidity at pre-set temperatures of 70; 80; 90; 95 and 100^oC for 1; 2; 4; 6; 9; 12; 15; 18 and 22 days followed by colour measurement at 10 points on each sample with a colorimeter (Konica-Minolta 2600d). Colour co-ordinates were then evaluated in CIELab system.

Steaming time (days)	L*	a*	b*
1	81.85	4.75	20.67
2	79.44	5.36	21.19
4	74.24	6.49	22.30
6	71.80	7.09	22.72
9	69.02	7.63	22.65
12	66.46	7.81	22.36
15	63.91	7.90	22.29
18	62.37	7.76	22.03
22	60.48	7.80	21.36

Figure 1 Steam induced discolouration of spruce samples treated at 90^oC

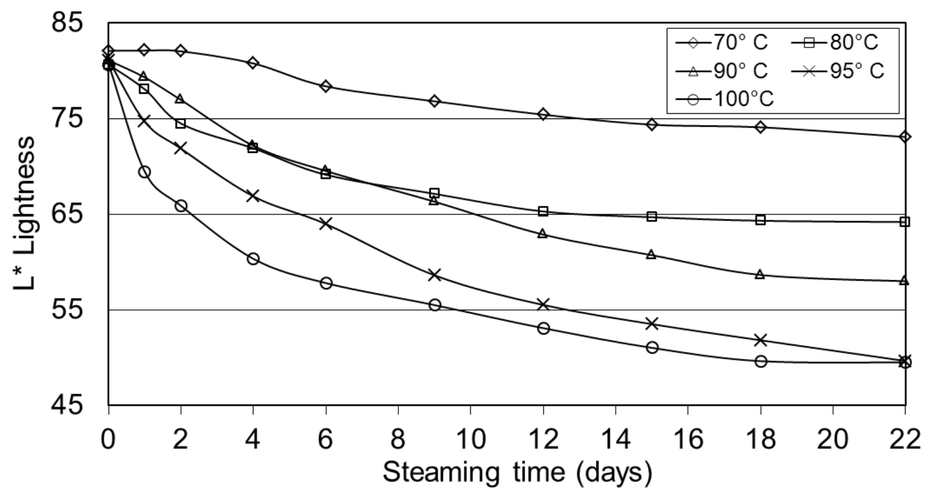

Figure 2 Lightness change of Scots pine treated with different steaming parameters

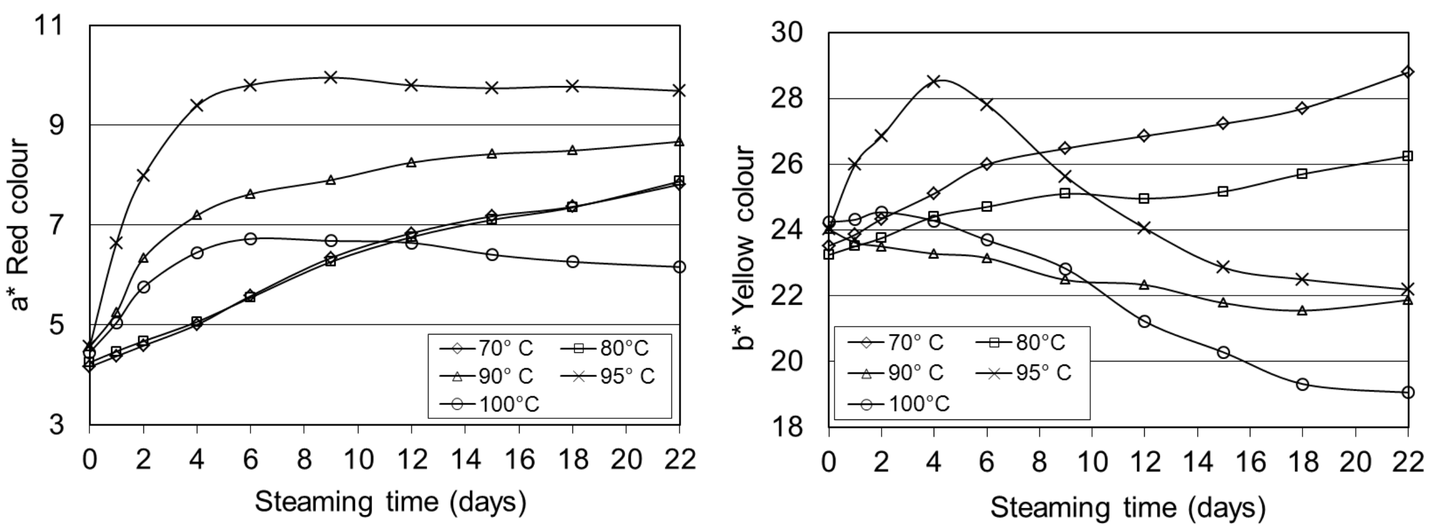

Figure 3 Red and yellow hue shift of Scots pine treated with different steaming parameters

Findings

The different exposures initiated a variety of colour changes of the examined softwoods, mostly similar to the colours of naturally aged indoor objects (Fig. 1). The lightness of softwoods (L*) decreases rapidly in the initial phase of exposures (Fig. 2), except when exposed to low temperature steaming (70^oC). Red hue (a*) increases during the initial phase and after 10-15 days of treatment it tends to be stabilised (Fig. 3). The changes of yellow coordinates (b*) demonstrate the wash away effect of steam above 90^oC treatment temperature (Fig. 3). The developed data base and the graphical representations can be used to identify optimum steaming parameters. By selecting them, the current expensive trial and error practices may be avoided or at least reduced. Furthermore, steam treated softwoods may be used to manufacture replicated historical furniture and joinery constructions.

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