Mould and blue stain on heat treated wood

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Abstract

Heat treatment improves biological durability and dimensional stability of wood. The degree of improved properties depends significantly on heat treatment process parameters.

Pine and spruce boards were heat treated at 225 °C for 6 hours under steam. The panels were painted with coatings, which are used on exterior cladding, joinery and fences in Finland. Performance of the coated heat treated and untreated panels was monitored during five years exposure.

Moisture content of heat treated wood has been found to be in a lower level compared to not heat treated wood substrate. However, no decrease in surface growth of coated wood was detected.

1. Introduction

About 10 manufacturers in Finland produce heat treated wood in 2002. The production of heat treated wood was 20 000 m^3 last year. The current capacity is 130 000 m^3. The fast growth in production of heat treated wood is based on good properties achieved. The treatment decreases shrinking and swelling of wood and increases biological durability. Heat treated wood is at present used in exterior cladding and fencing, window and door joinery, garden and park furniture and interior flooring and furniture. Therefore two classes of for the heat treated wood have been suggested in Finland.

An industrial heat treatment process, under trade name of ThermoWood®, has been developed at VTT together with Finnish industry (Pat. 1997and Pat 1999 and Pat 2001). The process is based on heating wood for several hours at high temperatures between 180 and 250 °C in water vapour atmosphere. The process can be tailored for a certain application by means of optimising process temperature and duration (Viitaniemi and Jämsä 1996,Viitaniemi, 1997a, Viitaniemi 1997b, Viitaniemi et al. 2002).

It was expected to have a decrease in surface growth based on two results: the moisture content of heat treated wood was lower compared to not heat treated substrates and also mould growth of heat treated wood was slighter in some laboratory tests.

1.1. Moisture content

Relative humidity and precipitation affected moisture content of the heat treated panels, but moisture content was still lower than in the reference panels during the whole measuring time (Jämsä et al 2000). In Figure 1, moisture content of the panels painted with the water-borne acrylic paint is shown as an example. In October 1994, moisture content of the heat treated panels painted with this joinery paint was about 7 % and that of the reference panels 15 %.

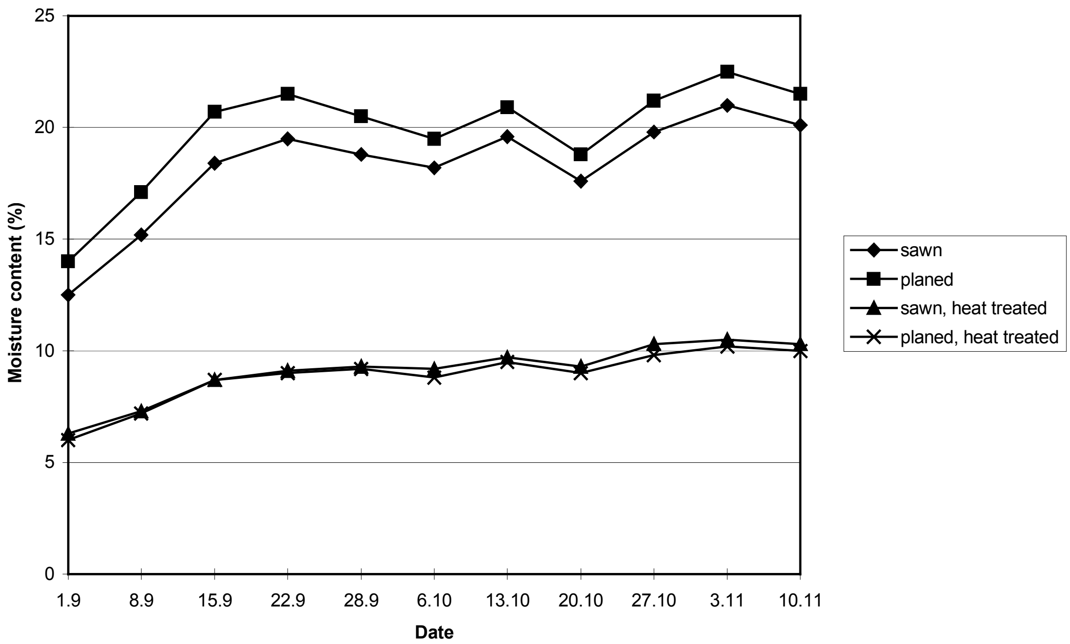

Figure 1. M*oisture content of the spruce panels painted with the water-borne acrylic paint 1994.*

Moisture content of the coated panels in autumn 1999 is presented in Table 1. The heat-treated wood had still lower moisture content than the untreated wood.

Table 1. M*oisture content of the panels in October 1999 after 5 years exposure to natural weathering*

Surface	moisture content (%)	
	heat treated	no heat treatment
Uncoated spruce	6	8
Uncoated pine	7	10
House paints on spruce	8	13
Joinery coatings on pine	10	15
Fence coatings on pine	8	9

1.2. Mould growth on uncoated wood

The susceptibility of heat treated wood to mould fungi was tested in a chamber at 100 % RH and 20^{o} C for 8 weeks. The heat treatment of the samples was carried out at 230^{o} C for 2 and 4 hours. The scale used in mould assessment was from 0 to 4 (0 no, 1 starting, 2 mild, 3 moderate and 4 heavy growth).

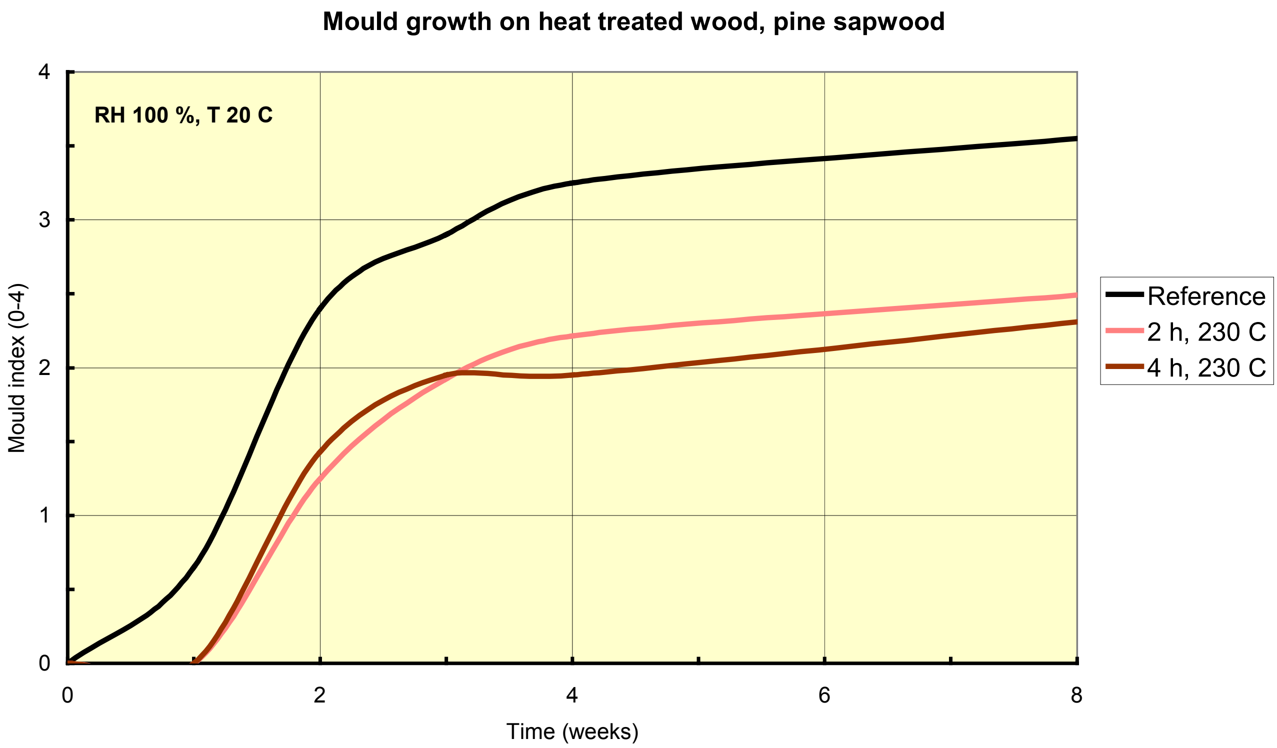

Figure 2. *Mould growth at 100% RH and 20 ^oC during 8 weeks.*

Experimental

Wood was planed and sawn spruce (*Picea abies*) and pine (*Pinus sylvestris*). The size of the specimens was 22 - 25 mm (thickness) x 100 mm (width) x 750 mm (length). The panels were cut tangentially. There were three replica panels. Heat treatment temperature was 225 ^oC and duration 6 hours. Weight loss for spruce was 11 - 12.9 % and that for pine 10 - 11.8 % due to heat treatment

The panels were coated with commercial coatings for exterior cladding, window joinery or fences. The coatings were applied by brush or spray gun in Tikkurila Paints Ltd. The coating types are shown in Table 2**.** Both sides and edges of the panels were coated with the joinery coatings, but only the exposed side and the edges were painted with the other coatings.

The panels were weathered vertically on the racks like a fence. The exposure racks were facing south. The heartwood sides of the panels were exposed to weather. The exposure was started in August 1994. The panels were assessed after 1, 3 and 5 year's exposure.

Surface growth results

The visual assessment according to ISO 4628 after 1, 3 and five years are published in Jämsä et al. 1998 and 2000. The surface growth results after 3 and 5 years weathering are shown in Table 2.

Table 2. *Surface growth after 3 and 5 years exposure. The latter is put in brackets. The scale is (ISO 4628) is from 0 to 5 (the lower the ranking score, the less mould growth)*

Substrate	Coating		Untreated	Heat treated
	Undercoat	**Topcoat**		
Pine	uncoated	uncoated	4 (5)	4 (5)
Spruce	uncoated	uncoated	4 (4)	4 (5)
Joinery coatings				
Pine	acid curable paint	acid curable paint	0.3 (3)	0.7 (2.3)
Pine	WB acrylic paint	WB acrylic paint	3.3 (3.3)	4 (1)
Pine	SB stain	SB stain	1 (1)	0 (1)
House paints				
Spruce	priming oil	SB alkyd paint	1.3 (0)	0 (0)
Spruce	priming oil	WB acrylic paint	0 (0)	1 (1)
Spruce	SB alkyd undercoat	WB acrylic paint	0 (0)	1.7 (2)
Spruce	WB oil stain	WB acrylic paint	0 (1.3)	1.3 (2)
Spruce	priming oil + SB alkyd undercoat	WB acrylic paint	1 (0)	1.3 (1)
Coatings for fences				
Pine		oil	2 (2)	1 (3)
Pine	priming oil	WB oil stain	2 (2)	0 (2)

The colour of the uncoated panels became grey due to sunlight, mould and blue stain. After the exposure, most of the coated panels showed only slight mould growth. Much mould and bluestain growth was detected on the panels coated with the opaque acrylic joinery paint, except on the heat treated panels after 5 years weathering. Also on the other opaque joinery paint (ac curable), there was quite much staining after 5 years weather trial. There was a difference between the joinery panels and the other panels; the joinery panels were coated all around, but the back of the other panels was uncoated. The moisture content of the joinery panels was slightly higher than the panels coated with the house paints and fairly higher that the panels coated with paints suitable for fencing. However, considerable much mould was found on the panels coated with the fence coatings. On some of the substrate-coating system, more mould was detected on the heat treated wood and vice versa.

Conclusions

Coating performance on the heat treated wood was studied during five years weathering and compared to untreated wood.

Heat treated wood should be coated against weather and fungi in order to prevent cracking, fading and surface growth. The end users prefer transparent or semitransparent coatings through which the dark colour and texture are still possible to be seen. Unfortunately, those coatings often have a poorer performance than opaque coatings.

The heat treatment used did not have an influence on mould and bluestain growth on coated wood in service. The heat treatment process should be developed in order to have better performed exterior cladding and joinery applications. By combining a good coating and an optimised heat treatment process a high-performance exterior joinery of cladding can be generated.

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Blue-Stain Wood, Compressed Wood, Property Analysis, Thermal Treated Wood. Export: RIS, BibTeX.Â Effect of wood stain disease on wood industry. Shandong Forestry Science and Technology, Vol. 161-6(2005) , pp.84-86. [3] B. Mazala, R. Zakrzewski, G.W. Kowias, G. Cofta, M. Bartkowiak. Resistance of thermally modified wood to basidiomycetes. Wood Technol., Vol. 7-1(2004), pp.253-262. [4] S. Yildiz, E.D. Gezer, U.C. Yildiz. Mechanical and chemical behavior of spruce wood modified by heat. Build. Environ., Vol. 41-121(2006), pp.762-1766. DOI: 10.1016/j.buildenv.2005.07.017.Â The effects of heat treatment on physical and technological properties and surface roughness of Camiyani Black Pine (Pinus nigra Arn. subsp. Pallasiana var. pallasiana) wood. Bioresour. Typical sap stain or blue stain penetrates into the sap-wood and cannot be removed by surfacing. Also, the discol-oration as seen on a cross section of the wood often appears as pie-shaped wedges oriented radially, corresponding to the direction of the wood rays (Fig. 14â€“2). The discoloration may completely cover the sapwood or may occur as specks, spots, streaks, or patches of various intensities of color. The so-called blue stains, which vary from bluish to bluish black and gray to brown, are the most common, although various shades of yellow, orange, purple, and red are sometimes encountere... Discover The Best Exterior WOOD STAINS of 2021 for your decks and outdoor projects! Our TOP LIST will help you choose the right one!Â Kilz Semi-transparent Waterproofing Exterior Wood Stain is designed to treat and protect outdoor wood products. The formula is 100% acrylic and provides protection from rain, snow and sun damage for decks, railings, siding, shingles, patio furniture, shakes and fences. This stain is offered in 9 colors.Â Thereâ€™s something about when you put an exterior stain on natural wood and you get to see that woodgrain pop, it just gives you goosebumps. When it comes to stains you can honestly have the best qualities of both worlds. You can have a durable product that also looks professional with enough care taken during the application.