Chemical wood pretreatment for OHT process –analysis of the selected application properties.

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ABSTRACT

The aim of the research was to determine the wood resistance against destroying fungi and its water absorption and hygroscopicity. The tests were performed with the use of scots pine (*Pinus sylvestris* L.), poplar (*Populus sp.*), and black alder wood (*Alnus glutinosa*). The samples were pretreated with sodium silicate or organosilicon compounds, with addition of aqueous dispersion of hydrophilic fumed silica and next they were subjected to oil heat treatment process (OHT). The influence of OHT process on stability of the used chemicals in the treated wood has been determined. The OHT process was carried out at the temperature of 200°C, with the use of palm oil as a heating medium. The results show pretreatment beneficial effect to the fungal resistance against *Poria placenta* even after aging procedure. The reduced water absorption and hygroscopicity of the treated wood was also observed.

INTRODUCTION

Thermal treatment of wood is known to improve wood properties by reducing hygroscopicity, improving dimensional stability and enhancing the resistance against biological attack (Stamm and Hansen 1937, Stamm 1964, Burmester 1973, Giebeler 1983). The boiling point of the most natural oils enables to use these oils in the heat treatment technology of wood. Former investigations (Rapp and Sailer 2001) proved that better wood properties can be achieved by using hot natural oils compared to the gaseous atmosphere. Thermal treatment of wood to enhance its resistance to decay and moisture related defects in service is not attractive for low-density and permeable wood species. They shows more negative aspects of the treatment, e.g. insufficient biological durability, decreased mechanical stability, UV-unstability of the surface (Bak et al. 2009 and 2013). The challenging issue was to use low-density and permeable wood species for OHT, preceded by the treatment with silicon-based chemicals. **The main aim of our research work was to improve the biological durability of low-quality wood species against wood destroying fungi and reduce its water absorption and hygroscopicity.**

METHODOLOGY

Spices of wood: pine (*Pinus sylvestris* L.) [P], poplar (*Populus* sp.)[Po] black alder (*Alnus glutinosa*)[Al]

Chemicals for pretreated process: A - 10% sodium silicate, B – 10% emulsion based on 2-9034 (Dow Corning), C - 10% emulsion based on 2-9034 (Dow Corning) + 5% Aerodisp W 1714 (Evonik).

Chemical pretreated
Vacuum 0.85 bar/30 minutes
Wood dimensions 25 x 40 x 250 mm

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OHT process
Preheated T = 100°C; Heated T = 200°C, t = 18 h
Heating medium – palm oil

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Cutting wood; dimensions 15 x15x5 mm

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Analysis:
Mycological examination; *Poria placenta* acc. to EN 113
Aging test acc. to EN 84
Hygroscopicity
Water absorption

Hygroscopicity - mass changing of the wood samples incubated above over saturated aqueous solution of ammonium phosphate.

Water absorption - mass changing of the wood samples immersed in water.

Time measuring 0, 1, 2, 4, 8, 24, 48, 72, 120 and 192h.

CONCLUSION

The performed tests proved a fungal resistance of wood treated with sodium silicate. OHT process of the pretreated wood contributed to a fixation of the silicone compounds in wood and limited leaching effect. The desired effect of sodium silicate were reproducible, regardless to the species of wood. The sodium silicate increased the hygroscopicity of scots pine and black alder by about 30% and of poplar by about 70%. This parameter decreased after the aging process and remained higher than the control samples. Organosilicon compounds (2-9034 and 2-9034+Aerodisp) didn't show any significant increase of the tested wood properties.

RESULTS

The following code system for samples were used: P - pine; Po - poplar, Al - Alder, A - sodium silicate , B - 2-9034, C - 2-9034 + Aerodisp, M/NM – OHT modified/non-modified, L/NL – leached/unleached.

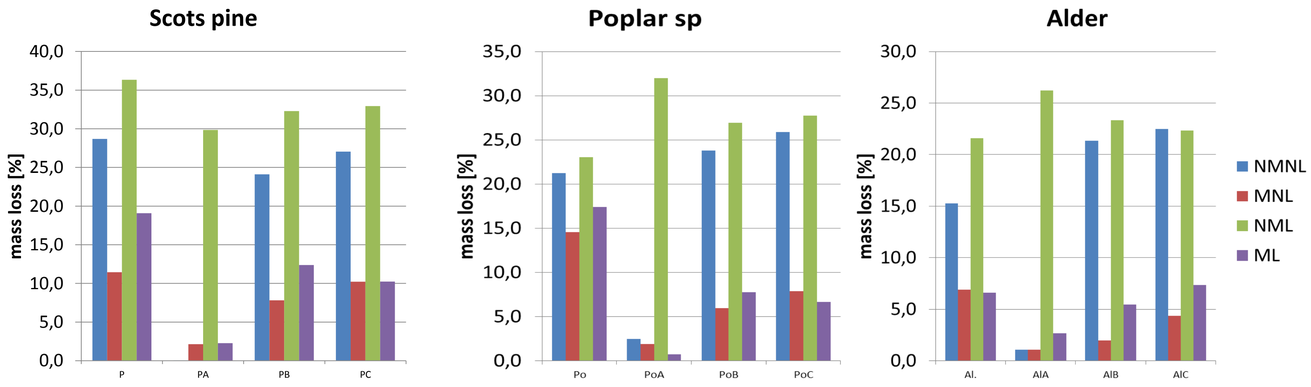

Fig. 1. The mass loss of scots pine (P), poplar(Po) and Alder (Al) exposed to Poria placenta. P- not pretreated, PA - pretreated with sodium silicate, PB - pretreated with 2-9034, PC – pretreated with 2-9034+Aerodisp.

Table 1. The mass loss of scots pine (P), poplar (Po) and Alder (Al) exposed to Poria placenta.

symbol	Mass loss [%]	Wood moisture content after test [%]	symbol	Mass loss [%]	Wood moisture content after test [%]	symbol	Mass loss [%]	Wood moisture content after test [%]
Unleached samples								
P	28,7	63,1	**Po**	21,2	58,3	**Al**	15,3	43,1
PM	11,5	29,0	**PoM**	14,5	36,3	**AlM**	6,9	38,9
PA	0,5	127,5	**PoA**	2,5	123,1	**AlA**	1,1	104,8
PAM	2,1	104,4	**PoMA**	1,9	120,7	**AlMA**	1,1	78,1
PB	24,1	58,0	**PoB**	23,8	60,7	**AlB**	21,4	55,9
PBM	7,8	27,0	**PoMB**	5,9	24,1	**AlMB**	1,9	32,8
PC	27,0	52,6	**PoC**	25,9	52,2	**AlC**	22,5	54,2
PCM	10,2	28,8	**PoMC**	7,9	33,3	**AlMC**	4,4	21,4
Leached samples								
P	36,3	67,0	**Po**	23,0	64,2	**Al**	21,6	62,2
PM	19,1	38,7	**PoM**	17,4	53,3	**AlM**	6,6	46,5
PA	29,9	71,5	**PoA**	32,0	72,8	**AlA**	26,2	69,8
PAM	2,3	58,8	**PoMA**	0,8	70,2	**AlMA**	2,7	49,2
PB	32,3	69,1	**PoB**	26,9	61,6	**AlB**	23,3	58,7
PBM	12,4	30,1	**PoMB**	7,8	27,1	**AlMB**	5,5	24,7
PC	32,9	65,5	**PoC**	27,7	61,4	**AlC**	22,3	53,3
PCM	10,2	32,5	**PoC**	6,6	40,3	**AlC**	7,4	41,4

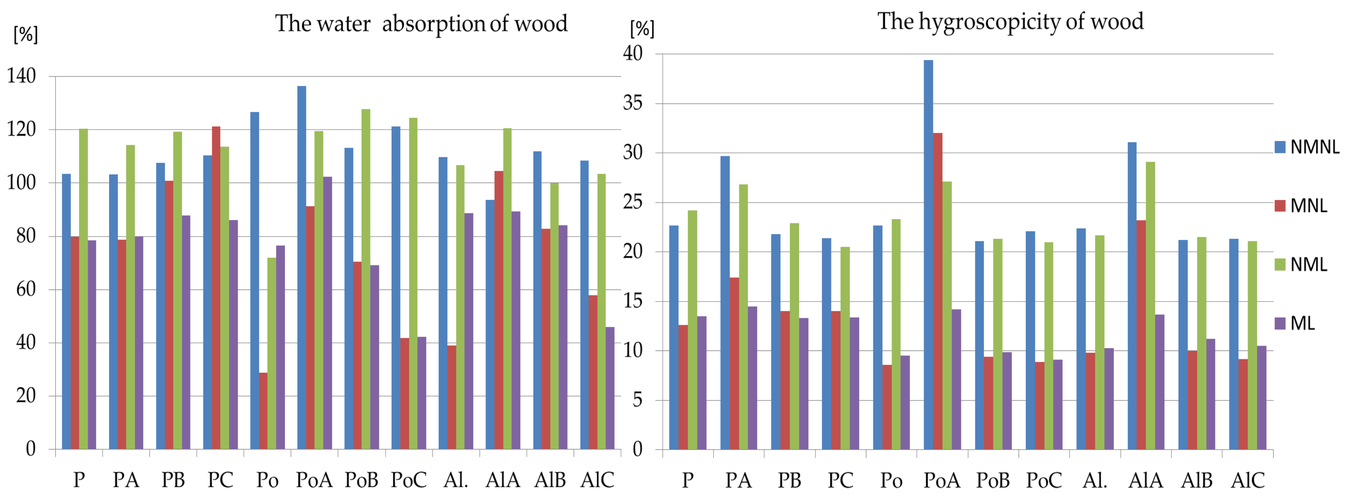

Fig 2. The water absorption and hygroscopicity of wood after 192 h of the test: wood: NMNL - not subjected to OHT process, MNL - subjected to OHT process, NML not subjected to OHT process, weathered according to EN 84, ML - subjected to OHT process, weathered according to EN 84.

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