UNIVERSITY of SOPRON

11th Hardwood Conference

30-31 May 2024
Sopron

11TH HARDWOOD CONFERENCE PROCEEDINGS

Róbert Németh, Christian Hansmann, Holger Militz, Miklós Bak, Mátyás Báder

11TH HARDWOOD CONFERENCE PROCEEDINGS

Sopron, Hungary, 30-31 May 2024

Editors: Róbert Németh, Christian Hansmann, Holger Militz, Miklós Bak, Mátyás Báder

UNIVERSITY OF SOPRON PRESS

SOPRON, 2024

11TH HARDWOOD CONFERENCE PROCEEDINGS

Sopron, Hungary, 30-31 May 2024

ISBN 978-963-334-518-4 (pdf)
DOI https://doi.org/10.35511/978-963-334-518-4
ISSN 2631-004X (Hardwood Conference Proceedings)

Constant Serial Editors: Prof. Dr. Róbert Németh, Dr. Miklós Bak
Cover image based on the photograph of Dr. Miklós Bak, 2024
The manuscripts have been peer-reviewed by the editors and have not been subjected to linguistic revision.
In the articles, corresponding authors are marked with an asterisk (*) sign.

University of Sopron Press, 2024 (Bajcsy-Zsilinszky 4, 9400 Sopron, Hungary)
Responsible for publication: Prof. Dr. Attila Fábián, rector of the University of Sopron

Sponsors: University of Sopron, Hungary; Wood K Plus, Austria; Georg-August University of Göttingen, Germany; Scientific Association for Wood Industry, Hungary

Content

Session II - Hardwood resources, product approaches, and timber trade

Session III - Surface coating and bonding characteristics of hardwoods

Session IV - Hardwood structure and properties

Session V - Hardwoods in composites and engineered materials

Session VI - Modification & functionalization

The effect of wood and solution temperatures on the preservative uptake of Pannonia poplar and common spruce – preliminary research

Luca Buga-Kovács[1], Norbert Horváth[2]

[1,2] University of Sopron, Institute of Basic Sciences, Bajcsy-Zs. Str. 4, Sopron, Hungary, 9400

E-mail: kovacs.luca@phd.uni-sopron.hu; norbert.horvath@uni-sopron.hu

Keywords: prolonged immersion, Pannonia poplar, common spruce, temperature differences, copper-sulphate

ABSTRACT

Our research aimed to compare the effect of wood and solution temperatures on the preservative uptake of Pannonia poplar and common spruce. The choice of the wood species was motivated by the followings. Poplar trees are less used wood species in the Hungarian construction industry. Some hybrids have similar characteristics to the commonly used spruce. Among them, the properties of the hybrid Hungarian Pannonia poplar are the focus of much research nowadays, because a significant amount of Hungarian Pannonia poplar trees are maturing to cutting age. Imported spruce is a common structural timber used in the Hungarian construction industry. According to CEN EN 14734, a copper sulphate solution was used to evaluate the prolonged immersion treatment. The temperature of the wood samples was 20 °C for both tests. The temperature of the copper sulphate solution in the control test was the same as that of the wood materials at 20 °C, while in the other test the materials were soaked in a solution at 12 °C. The preservative uptake graph, the mass of the copper sulphate solution taken up and the calculated mass of copper-sulphate after 3 hours of prolonged immersion were determined. We found that Pannonia poplar can take up more solution than spruce. For both species, the uptake of preservative at the initial stage was higher for the 12 °C solution than for the room temperature solution.

INTRODUCTION

The present study focuses on Pannonia poplar, an abundant poplar hybrid in Hungary and common spruce, for several reasons. Spruce is frequently utilized as structural timber in the Hungarian construction industry. As it is found in small quantities (1%) in Hungarian forests, it is the most important imported timber (Molnár 2004). Poplar hybrids are the subject of much research nowadays among other things because of their structural potential. Additionally, the two species exhibit nearly identical physical-mechanical properties (Molnár, 2004).

Resistance to insects and decay fungi is also a major determinant of the performance of structural timber, which can be based on treatment with preservatives. According to the Hungarian building regulations, both the low-durability Pannonia poplar and the pine species used in the construction industry until now have to undergo additional chemical wood preservative treatment before installation. In Hungary, prolonged immersion treatment is the most common method of wood protection. The question arises to what extent the differences in temperature during the soaking of the two species of wood promote the absorption of the preservative. According to CEN EN 14734, a copper sulphate solution was used to evaluate the prolonged immersion.

The prolonged immersion is when the wood is immersed for a longer period of time in the liquid preservative or its solution. The liquid penetrates into the wood by means of capillary action and possibly further seepage. The effectiveness of the prolonged immersion and the depth of penetration, depends on the anatomical structure of the wood, its moisture status, the material of the preservative, the concentration of the preservative solution and the duration of the soaking (Gyarmati et al. 1964). The amount and extent of penetration of the preservative solution is influenced more by temperature than by duration (Bálint 1967).

The water in the wood freezes well below 0 ºC. In the soaking tub the protective agent can freeze, although this can and should be avoided by using a heating rod or heating blanket in modern equipment to make the technology work. The movement of the bonded water in the wood is faster the higher the temperature.

A distinction has to be made between the temperature of the wood and the outside environment, as it is often the case (in spring, after snow melt) that the daily peak temperature is already around 20 ºC, but the inside of the beam to be soaked or saturated is still frozen. In summary, the higher is the temperature of the wood, the faster is the movement of the water inside. The speed of water movement is also related to its density. Water is most dense at + 4 ºC. The higher the temperature, the lower the density and surface tension of the water. The properties of water affect the properties of the solution also. In summer, the soaking wood preservation technology can be used without any particular constraints, as both the soaking liquid and the wood are at the right temperature. If the wood or the preservative solution is cooled below +5 °C, the effectiveness of the soaking process is severely impaired, and so the use of soaking technology is often a problem in winter. However, heating the preservative and/or the wood should be strongly considered as it is a very energy intensive operation and rarely economical (Király and Csupor 2013).

MATERIALS AND METHODS

The tested bulk samples originated from Hungarian growing areas. All the specimens had a lying annual ring position. A total of 8 spruce and 8 Pannonia poplar samples were tested. The specimens were cut from a board along the grain. Half of the test specimens served as control samples for both species. A 5% copper sulphate solution and frozen ice cubes prepared from it were used for the test to evaluate the prolonged immersion, as prescribed in CEN EN 14734. The frozen solution provided cooling and ensured that the solution did not dilute.

For the control samples, the temperature of the solution and the specimens was maintained at 20 °C (Figure 1, left). The initial temperature of the other group of samples was the same as the control samples, but in this case the copper sulphate solution was continuously cooled with frozen copper sulphate solution "ice cubes". The solution temperature was 12 °C during the test (Figure 1, right). The temperatures of the solutions and samples were determined for the reasons described above.

Figure 1: Prolonged immersion in room temperature solution (left) and with copper-sulphate "ice-cubes" cooled solution (right)

Weights were measured before adding to the solution (m_b). As the freshly immersed wood absorbs the liquid more quickly at first, the masses were measured more frequently in the initial stage. The masses were measured 7 times in both cases. The preservative uptake curves were determined from these mass measurements per sample groups.

The times of the mass measurements are summarised in the following table (Table 1).

Table 1: Times of the mass measurements

Measurement	**1**	**2**	**4**	**4**	**5**	**6**	**7**	**8**
Time (min.)	5	10	15	35	55	75	95	180

The last 8th measurement was taken 3 hours after immersion in the solution, from which the mass of the copper sulphate solution taken up was determined. The mass of the specimens was measured before (m_b) and after (m_a) the prolonged immersion. The mass of the copper sulphate solution taken up (Δm) was calculated from the difference between their weights (Eq. 1).

$$\Delta m = m_a - m_b \; [g] \tag{1}$$

Δm – the mass of the copper sulphate solution taken up
m_a– the measured mass after the treatment
m_b – the measured mass before the treatment

$$m_{CuSO_4} = \Delta m \cdot 0{,}05\ [g] \quad (2)$$

m_{CuSO_4} – the calculated mass of copper-sulphate

RESULTS AND DISCUSSION

The curves illustrates the average preservative uptakes of the sample groups are depicted in Figure 2. The first three measurements were taken every 5 minutes. The highest uptake of preservative is observed within the first 5 minutes at the beginning of the soak for all sample groups, as indicated by the slope of the curves. During this time the Pannonia poplar samples soaked in a 12 °C solution absorbed the most protective agent on average. Spruce specimens soaked in 12 °C and 20 °C solutions did not exhibit significant differences in average preservative uptake, but more preservative was absorbed by the room temperature solution on average. Weights were measured every 20 minutes subsequently. The uptake of Pannonia poplar samples immersed in room temperature preservative surpassed that of spruce samples by the 6th measurement. After 95 minutes of prolonged immersion, the Pannonia poplar samples absorbed more preservative than the spruce samples in both cases.

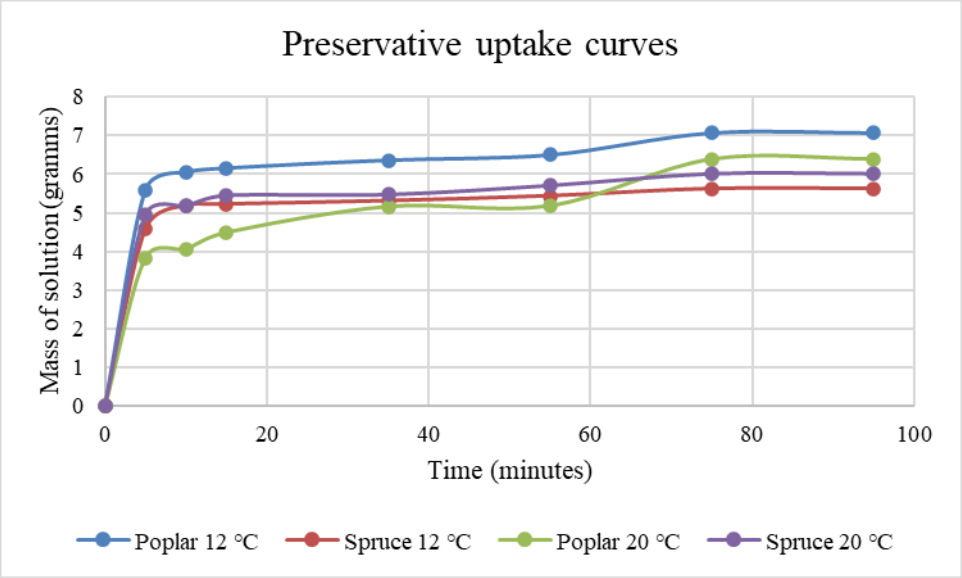

Figure 2: Preservative uptake curves during 95 minutes of prolonged immersion

Figure 3 illustrates the average preservative uptake of the sample groups after 3 hours of prolonged immersion. The Pannonia poplar specimens soaked in a cold solution at 12 °C absorbed an average of 7.11 grams of preservative, while the spruce specimens absorbed an average of 6.65 grams after three hours of prolonged immersion. The Pannonia poplar samples soaked in room temperature preservative were able to take up an average of 6.98 grams of preservative in the same time frame, while the spruce specimens absorbed an average of 6.89 grams. While in the case of Pannonia poplar, the samples soaked in the 12 °C solution exhibited a higher average uptake of preservative, in the case of spruce samples, those soaked in the 20 °C solution displayed a higher average mass of preservative. However, significant differences in preservative uptake were observed at the initial stage rather than after 3 hours of soaking.

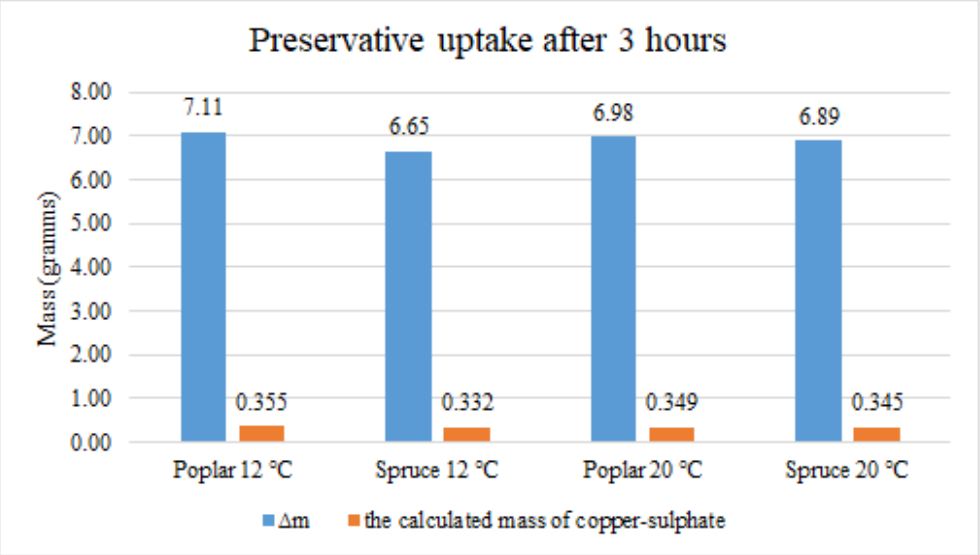

Figure 3: Preservative uptake after 3 hours of prolonged immersion

CONCLUSIONS

The prolonged immersion of Pannonia poplar has been demonstrated to be superior to that of spruce. The poplar hybrid species absorbed more of the solution at both liquid temperatures than spruce after 95 minutes of soaking. The uptake efficiency of Pannonia poplar samples is better in the 12 °C solution at the initial stage than in specimens soaked in preservative at room temperature. The Pannonia poplar samples absorbed more copper sulphate solution from both the cold and room temperature solutions after 3 hours. The differences between the groups of samples were much smaller than at the initial stage of soaking.

Overall, Pannonia poplar proved to be easier to treat with prolonged immersion than spruce, which is an important consideration for industrial protective treatment practices. Easier handling results in a higher durability class for treated wood. Pannonia Poplar can be classified in a higher durability class due to its easier prolonged immersion.

REFERENCES

Bálint, Gyula (1967): Protection of buildings. (Épületek védelme) Műszaki Könyvkiadó Budapest. (in Hungarian) p. 180

CEN EN 14734:2022 (MAIN): Durability of wood and wood-based products - Determination of treatability of timber species to be impregnated with wood preservatives - Laboratory method

Gyarmati, Béla; Igmándy, Zoltán; Pagony, Hubert (1964): Wood protection. (Faanyagvédelem) Mezőgazdasági Kiadó Budapest (in Hungarian) p. 235

Király, Béla; Csupor, Károly (2013): Materials and mixtures for chemical wood and fire protection. (A kémiai faanyag- és tűzvédelem anyagai és keverékei) Textbook. PALATIA Nyomda és Kiadó Kft. (in Hungarian) pp. 131-132

Molnár, Sándor (2004): Wood material knowledge (Faanyagismeret). Szaktudás Kiadó Ház Zrt (in Hungarian) pp. 330, 390-391