Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology No 75, 2011: 74-77
(Ann. WULS-SGGW, Forestry and Wood Technology 75, 2011)

Penetration dynamics of lime wood surface (*Tilia* sp.) wetting with Paraloid B-72 solution

PIOTR MAŃKOWSKI[1)], PIOTR BORUSZEWSKI[2)]
[1)] Katedra Nauki o Drewnie i Ochrony Drewna SGGW w Warszawie
[2)] Katedra Technologii Organizacji i Zarządzania w Przemyśle Drzewnym SGGW w Warszawie

Abstract: Substantial parameter of saturation is wettability of protected surface by solution being spread. Wettability depends on wood species and its anatomical structure, as well as section of wood being exposed to saturation. Properties of polymer applied, solvent used, solution viscosity and its temperature influence polymer retention and penetration depth. Lower wettability informs about possible problems with treatment, gluing or surface finishing.

Keywords: lime wood, Paraloid B-72, penetration, goniometer, wetting angle

INTRODUCTION

Saturation of wood with polymer's solutions by brushing and submerging is commonly used procedure in wood (Wieczorek 2006).

Substantial parameter of saturation is wettability of protected surface by solution being spread. Wettability depends on wood species and its anatomical structure (Collmann 1968), as well as section of wood being exposed to saturation. Properties of polymer applied, solvent used, solution viscosity and its temperature influence polymer retention and penetration depth. (Unger 2001). Viscosity of polymers' solutions depends on their strength (Ciabach 1998). Thinner solutions show better penetration (Paciorek 1993)

Wetting angle is a measure of interaction between wetting solution and the base. Lower value of this parameter show better base wettability. Other than wetting angle itself, it is important to analyze its change characteristics in assumed time. Lower wettability informs about possible problems with treatment, gluing or surface finishing (Wolkenhauer et al. 2009, Gindl et al. 2001).

TEST MATERIAL AND METHODIC

Lime wood samples were used during the tests, cut in a manner that every sample showed clear radial land tangential face. Samples were conditioned 20^0C with 60% relative air humidity. Samples were sanded with No 120 paper and dusted off before tests.

Preliminary tests consisted of drop penetration along the grain (transverse section). Because of too quick penetration analysis in this section was abandoned, only radial and tangential sections were tested.

Paraloid B72 20% solution strength was also tested, but because of too slow soaking only 15% solution was used.

Wetting angle was determined with Phoenix 300 goniometer (Surface Electro Optics, Korea) equipped with CCD camera. Apparatus was also used in conjunction with specialized software, enabling wider analysis of surface properties. Because wetting angle testifies about other surface properties, Phoenix 300 goniometer enables analysis of advancing and receding contact angles, wetting energy, surface energy, adhesion work.

Mentioned parameters determine usable and technological properties of the material, such as gluability, finishing ability or impregnation ability. Wider application of tested materials become possible because of extended tests made with described apparatus.

For radial section 5 s and for tangential section 2s measurement time were selected. Times were shortened because of quick absorption, sampling of 0.1 s was used. Measurement was started after 1s lag and stopped after complete drop absorption by wood. Wetting angle determination was stopped when creation lines tangential to tested drop was not possible.

RESULTS AND ANALYSIS.

Wetting angle of wood depends on wetting liquid and species and tested section.

Test results for lime wood wetted with 15% Paraloid B-72 solution are shown on fig. 1.

Dynamics of wetting angle is dependent on the wood section used for test. For tangential section, higher initial wetting angle is measured. Simultaneously, quicker decrease of wetting angle for this section is observed. This phenomena is caused by quicker penetration of solution thru pith rays.

For radial section initial wetting angle and wetting dynamic are both lower

Wettability of wood surface is dependent on the species and its chemical composition. Presence of non-structural substances, such as waxes, gums and fats highly increases wetting angle and slow drop absorption (Unger 2001).

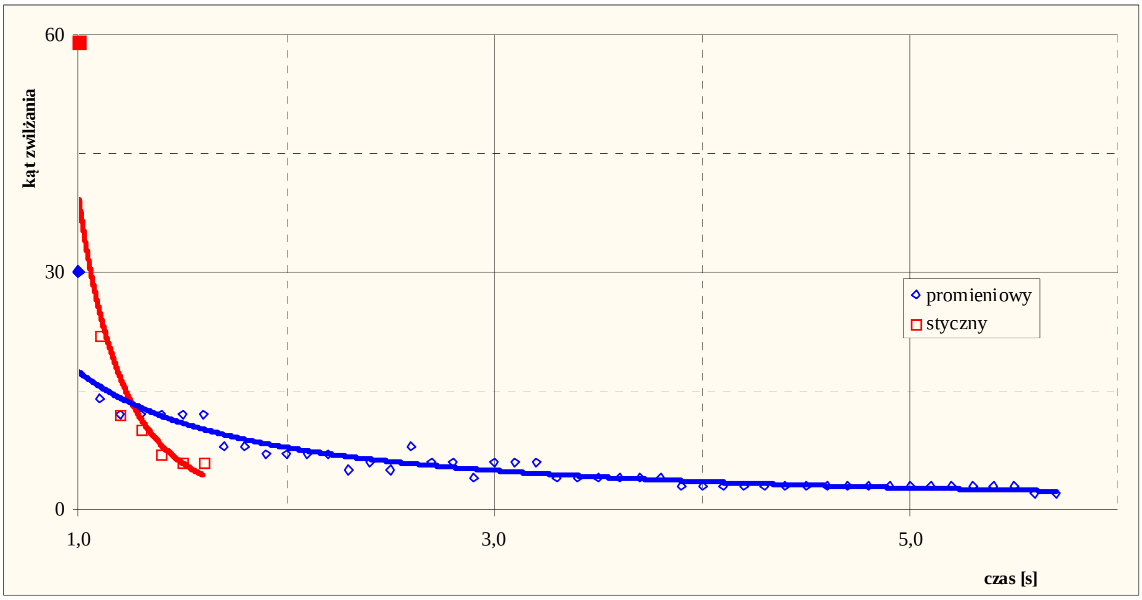

Diagram 1. Wetting angle on tangential and radial section of lime wood in dependence on the wetting time.

Figures 1 and 2 show sample pictures of percolating Paraloid B72 drop. Wetting angle and additional parameters were determined.

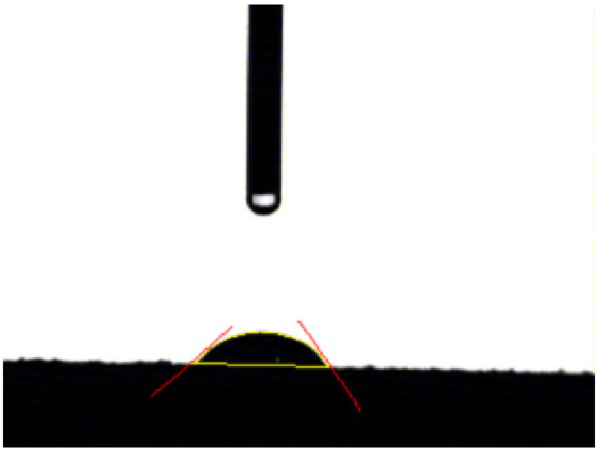

Fig 1. Photograph of percolating Paraloid B-72, analyzed drop with determined wetting angles.

CONCLUSION

1. For lime wood wetted with Paraloid B-72 solution higher wetting angles were noticed on tangential section.
2. Dynamics of wetting angle changes is higher on tangential section.
3. For 15% Paraloid B-72 toluene solution wetting angle in on transverse section can not be measured, because of too fast percolation.

REFERENCES:

1. CIABACH J., 1997: Właściwości żywic sztucznych stosowanych w konserwacji zabytków. Wyd UMK Toruń
2. CIABACH J., 1998: Żywice i tworzywa sztuczne stosowane w konserwacji zabytków. Wyd UMK Toruń
3. GERARDIN P., PETRI M., PETRISSANS M., LAMBERT J., EHRHRARDT J., 2007: Evolution of wood surface free energy after heat treatment. Polymer Degradation and Stability 92, 653-657.
4. KOLLMANN F., CÖTE W.A., 1968: Principles of wood science and wood technology. Solid wood. Berlin-Heidelberg N.York.
5. PACIOREK M., 1993: Badania wybranych tworzyw termoplastycznych stosowanych do impregnacji drewna. Studia i materiały Wydziału Konserwacji i Restauracji Dzieł Sztuki ASPw Krakowie. Wyd. Literackie.
6. UNGER A., i in. 2001: Conservation of wood artifacts. Springer Werlag Berlin-Heidelberg.
7. WIECZOREK K., 2006: Zastosowanie tworzyw sztucznych do wzmacniania struktury drewna w konstrukcjach. M-pis

Streszczenie: *Wnikanie Paraloidu B-72 do drewna lipowego.*
Badano wnikanie roztworu Paraloidu B-72 w toluenie w drewno lipy. Pojęto próbę analizy wnikania 20% roztworu, jednak ze względu na zbyt długi czas wnikania zmniejszono stężenie i badania prowadzono dla stężenia 15%. Podjęto próbę wyznaczenia kątów wnikania dla przekroju poprzecznego, jednakże ze względu na zbyt dużą dynamikę zmian nie uzyskano zadowalających wyników. Stwierdzono różnicę kątów zwilżania dla poszczególnych przekrojów drewna. Większy kąt zwilżania uzyskano dla przekroju stycznego (59 st). Dla tego przekroju zaobserwowano także większą dynamikę zmian kąta zwilżania.

Corresponding authors:

dr inż. Piotr Mańkowski
Katedra Nauki o Drewnie i Ochrony Drewna
Wydział Technologii Drewna, Szkoła Główna Gospodarstwa Wiejskiego
ul. Nowoursynowska 159
02-787 Warszawa
e-mail: piotr_mankowski@sggw.pl

dr inż. Piotr Boruszewski
Katedra Technologii Organizacji i Zarządzania w Przemyśle Drzewnym SGGW w Warszawie
Wydział Technologii Drewna, Szkoła Główna Gospodarstwa Wiejskiego
ul. Nowoursynowska 159
02-787 Warszawa
e-mail: piotr_boruszewski@sggw.pl