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Influence of Wood Surface Preparation on Roughness, Wettability and Coating Adhesion of Unmodified and Thermally Modified Wood

Utjecaj pripreme površine na hrapavost, kvašenje i adheziju premaza na nemodificiranome i toplinski modificiranom drvu

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ABSTRACT • *In this research, the influence of face milling, sanding and UV irradiation of the hornbeam and ash wood sample on the wetting and adhesion strength of solvent-based and water-borne coating was studied. The adhesion of coatings to substrates is one of the most important parameters for finishing quality and service life of wood coatings, while wetting properties are usually used to assess the quality of surfacing process and could also provide important information on the adhesion ability of coatings. Surface roughness, contact angle of coatings and water as well as adhesion strength of coatings were tested on differently prepared (face milled, sanded and UV irradiated) samples of unmodified and thermally modified ash and hornbeam wood. Surface roughness was measured with stylus-type profilometer over the traverse of 12.5 mm and with a cut-off value of 2.5. Contact angle was measured using the sessile drop method 2 s, 10 s and 30 s after the application of the liquid drop on the sample surface, and adhesion strength was measured according to ASTM D4541. Results showed that sanding of hornbeam and ash wood resulted in the least rough surface compared to the face milled and UV irradiated surface. Contact angles of the water-borne coating were on average three times higher than the contact angles of the solvent-based coating. Sanding the surface of hornbeam and ash samples increased the adhesive strength in relation to the face milled surface, while UV irradiation of the sanded surface decreased the adhesive strength of most samples coated with solvent-based coating.*

KEYWORDS: *face milling; sanding; UV irradiation; wetting; adhesion*

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SAŽETAK • *U radu je istraživan utjecaj čeonog blanjanja, brušenja i UV zračenja grabovine i jasenovine na kvašenje i adhezivnu čvrstoću premaza na bazi organskih otapala i vodenog premaza. Adhezija premaza jedan je od najvažnijih parametara za kvalitetu površinske obrade i trajnost premaza za drvo, dok svojstva kvašenja obično služe za ocjenu kvalitete nanošenja i adhezije premaza. Na različito pripremljenim uzorcima (obrađenim čeonim blanjanjem, brušenjem ili UV zračenjem) nemodificirane i toplinski modificirane grabovine i jasenovine ispitivana je hrapavost, kontaktni kut premaza i vode te adhezivna čvrstoća premaza. Hrapavost površine mjerena je profilometrom na duljini vrednovanja 12,5 mm, uz referentnu duljinu od 2,5 mm. Kontaktni kut mjeren je metodom s kapljicom, i to 2 s, 10 s i 30 s nakon nanošenja kapljice na površinu uzorka, a adhezivna čvrstoća određivana je prema normi ASTM D4541. Rezultati su pokazali da je brušenje grabovine i jasenovine rezultiralo najmanje hrapavom površinom u usporedbi s čeono blanjanom i UV zračenom površinom. Kontaktni kutovi vodenog premaza bili su u prosjeku tri puta veći od kontaktnih kutova premaza na bazi organskih otapala. Brušenjem površine uzoraka grabovine i jasenovine adhezivna je čvrstoća postala veća od čvrstoće čeono blanjanih površina, dok je UV zračenjem na brušenim površinama većine uzoraka smanjena adhezivna čvrstoća premaza na bazi organskih otapala.*

KLJUČNE RIJEČI: *čeono blanjanje; brušenje; UV zračenje; kvašenje; adhezija*

1 INTRODUCTION
1. UVOD

Wood surface preparation is of great importance for the good appearance and functional properties of wood coatings. It has been reported that surfacing of wood causes changes in both morphology and chemistry of the wood surface (Liptáková and Kudela 1994). Different wood species will show different physical and chemical changes under the same processing and environmental conditions, which could affect wood-coating interaction and coating performance (Liptáková *et al.*, 1995). It is known that thermally modified wood has altered characteristics compared to unmodified wood. Thermally modified wood is shown to have lower hygroscopicity, liquid water uptake, changed acidity, and anatomical structure (Jirouš-Rajković and Miklečić, 2019). It has also been shown that thermal modification has influence on the surface roughness and wettability of wood and wood-based materials (Candan *et al.*, 2010; Unsal *et al.*, 2011; Candan *et al.*, 2012; Candan *et al.*, 2021a). Thermal modification was shown to reduce the wettability and surface roughness of rowan (*Sorbus aucuparia* L.) wood (Candan *et al.*, 2021b). Changed surface properties of thermally modified wood can be determinative for the quality of many processes, such as coating, machining, etc. (Candan *et al.*, 2021b). Surface roughness and wetting properties are usually used to assess the quality of surfacing process and could also provide important information on the adhesion ability of coatings on wood surfaces (de Moura and Hernández 2005; Hernández and Cool 2008b, Vitosytė *et al.*, 2012). The adhesion of coatings to substrates is one of the most important parameters for finishing quality and service life of wood coatings. Sanding is one of the most common methods of wood surfacing before finishing with the aim of achieving a surface without visible defects that will allow uniform absorption of the coating. Sanding is an abrasive cutting process characterized by a negative rake angle of the cutting edge and by the random position of grit embedded in the holding tissue (Csanády and Magoss, 2020). The abrasive grain induces superficial cell crushing and fibrillation in wood (Stewart and Crist 1982; de Meijer *et al.*, 1998; de Moura and Hernández 2005; de Moura and Hernández 2006a). Sanded surfaces are also characterized by lumens clogged by fine dust, scratches and packets of microfibrils torn out from cell walls (de Meijer *et al.*, 1998; Murmanis *et al.*, 1983; Murmanis *et al.*, 1986; de Moura and Hernández, 2006b). Crushing and clogging of cells could hinder penetration (Richter *et al.*, 1995; de Meijer *et al.*, 1998; de Moura and Hernández 2005) of coating material in wood, while slight fibrillation and scratches accelerate spreading of liquid coatings on sanded surfaces. However, it has been established that sanding homogenizes the wood surface and reduces the influence of the anatomical structure on the coating behaviour (Richter *et al.*, 1995**;** de Moura and Hernández 2005; Hernández and Cool 2008a). Face milling is a surfacing method in which the milling cutter is positioned perpendicular to the workpiece. It is reported to generate lower cutting forces and consequently lower sub-surface damage of the wood surface structure compared to conventional planing (de Moura *et al.*, 2010; Kläusler *et al.*, 2014). The surface milling also generates cell wall fibrillation on the surface (Hernández and Cool, 2008b; de Moura *et al.*, 2010; Cool and Hernández, 2011a; Cool and Hernández, 2011b), which could affect wood-coating interactions. To avoid the formation of mechanical weak boundary layers, the wood surface cells should be the least deformed during surface preparation (de Moura *et al.*, 2010). This weak boundary level can prevent penetration and anchoring of adhesives and coatings to intact wood material (Stehr and Johansson, 2000). It has been reported that a freshly cut wood surface soon undergoes a natural transformation process known as surface inactivation (Nussbaum, 1995). This inactivation of wood surface contributes to the change of wood surface free energy due to migration of low molecular extractives to the wood surface, and oxidation (Nussbaum, 1999; Gindl *et al*., 2004). The wettability of wood surfaces has been shown to decrease with surface ageing (Nussbaum, 1999; Wålinder and Ström, 2001; Jirouš-Rajković *et al*., 2007), and freshly prepared surface has been identified as one of the most critical factors for good adhesion of coating (Nussbaum, 1995). Gindl *et al*. (2006) reported that short term ultraviolet light irradiation used as a pre-treatment to activate spruce and teak wood surfaces caused a significant increase in wettability and free surface energy of wood surfaces indicating good coating and adhesion properties of the activated material. UV irradiation provided cleaning of the wood surface and changes in surface morphology and in surface chemical composition. Patachia *et al*. (2012) also established increase of the surface energy of wood and lower initial contact angle for water after 24 h of exposure to UV light (254 nm), probably due to the formation of more hydrophilic compounds resulting from lignin and/or wood extractives degradation. It has also been shown that the plywood surfaces pre-treated with UV irradiation showed improved adhesion strength of coating compared to untreated or gamma irradiation pre-treated plywood samples (Khan *et al*., 2006). The aim of this paper is to evaluate the effects of two machining processes (face milling and sanding) and UV irradiation of unmodified and commercially thermally modified hornbeam (*Carpinus betulus* L.) wood and ash (*Fraxinus excelsior* L.) wood on wood surface roughness, wettability and adhesion of solvent-based and water-borne wood coatings.

2 MATERIALS AND METHODS
2. MATERIJALI I METODE

2.1 Wood and coating materials
2.1. Uzorci drva i premaza

Radial-textured samples of unmodified and thermally modified ash (*Fraxinus excelsior* L.) and hornbeam (*Carpinus betulus* L.) wood without any visible defects were used in this study. Wood samples were commercially thermally modified using ThermoWood® process with a peak temperature of 190 °C for ash wood and 212 °C for hornbeam wood. Before preparing the surface, wood samples were machined and planed to the dimensions of 300 mm × 100 mm × 18 mm (L×R×T) and conditioned at (23±2) °C and (50±5) % relative humidity (RH) to the constant mass. Conditioned samples were divided into three groups. The surface of the first group of samples was hand-sanded with paper grit size P80, P120 and P150 along the grain. After sanding, the surface of samples was cleaned with compressed air. The surface of the second group of samples was face milled on a CNC machine with an 80 mm diameter three-blade cutter, 20,000 rpm rotation speed and 5 m/min feed speed. The surface of the third group of samples was hand-sanded like in the first group and additionally exposed to UV light in a QUV weathering tester equipped with UVA-340 fluorescent lamps for 2 hours at a distance of 50 mm with (60±3) °C black panel temperature (BPT) and 0.77 W/m^2nm irradiation.

The prepared wood samples were finished with two commercial clear coatings. Two-component solvent-based polyurethane coating Chromos CHROMODEN (density 1.02 g/cm^2, solid content 50 %) and one-component water-borne coating based on polyurethane and acrylate dispersion JORDAN 1K ECO-FINISH (density 1.02 g/cm^2, solid content 34 %). In this experiment, coatings were applied in two coats on previously prepared wood samples with a film applicator with adjustable gap heights in a wet film thickness of 100 mm. The first coat of each coating was sanded with paper grit size 240 after 24 h drying time at (23±2) °C and (50±5) % RH and then the second coat was applied. The finished wood samples were conditioned for seven days at (23±2) °C and (50±5) % RH before testing the coated wood surface.

2.2 Surface roughness
2.2. Hrapavost površine

For each wood species and type of surface preparation, surface roughness was measured at five locations with Surtronic S-126 stylus-type profilometer manufactured by Taylor-Hobson equipped with a 5 mm stylus tip radius and 90° tip angle at a speed of 0.5 mm/s. The profiles were spaced by a minimum of 30 mm. Roughness measurement was performed in the direction perpendicular to the wood grain over the traverse of 12.5 mm, and roughness profiles were filtered with a cut-off value of 2.5 using a Gaussian filter. For the evaluation of surface roughness, parameters *Ra* and *Rz* were used. *Ra* represents arithmetic mean deviation of the assessed profile and *Rz* is the average maximum peak to valley of five consecutive sampling lengths within the measuring length.

2.3 Contact angle
2.3. Kontaktni kut

The contact angle of distilled water and tested coatings was measured using the sessile drop method and video measuring system with Dino-Lite Microscope. Immediately after preparation of the surface, in total five liquid drops of 0.01 ml volume were applied on each type of wood sample with dimensions of 100 mm × 100 mm × 18 mm (L×R×T) for each liquid. The contact angles were measured 2 s, 10 s and 30 s after the application of the liquid drop, and the average contact angle was calculated from five measurements for each type of sample and measuring time.

2.4 Adhesion strength
2.4. Adhezivna čvrstoća

For adhesion strength, pull-off test was performed according to ASTM D4541 at eight locations per wood species and prepared wood surface. On the coated surface, 10 mm diameter aluminum dollies were glued with two-component UHU plus 300 adhesive and allowed to cure for 24 hours. The dollies were pulled-off perpendicular to the substrate using a PATTI instrument where adhesion strength was measured, and adhesion and cohesion fracture were estimated.

2.5 Statistical analysis
2.5. Statistička analiza

Statistical analysis was performed with the Kruskal-Wallis test using TIBCO® Data Science/Statistica™ 14 software.

3 RESULTS AND DISCUSSION
3. REZULTATI I RASPRAVA

The results of surface roughness presented in Table 1 show that surface roughness after machining of thermally modified hornbeam wood is lower than that of unmodified wood. Sandak *et al*. (2017) also found lower roughness of thermally modified specimens than unmodified specimens of deodar cedar wood, black pine wood and black poplar wood after machining. For ash wood, only face milled thermally modified samples exhibited lower roughness values compared to unmodified samples. Zdravković *et al*. (2020) also reported that thermal modification of ash wood at 160 °C improved surface quality after CNC face milling. It has been shown that exposing the surface of hornbeam and ash wood to UV irradiation increased the surface roughness compared to the sanded surface. However, this increase is statistically significant only for thermally modified hornbeam samples for both roughness parameters. Jankowska *et al*. (2020) also established increased surface roughness values after 24 hours of UV irradiation for garapa (*Apuleia leiocarpa* (Vogel) J.F. Macbr.), tatajuba (*Bagassa guianensis* Aubl.), courbaril (*Hymenea courbaril* L.) and massaranduba (*Manilkara bidendata* (A. DC.) A. Chev.) wood species. Also, it can be seen that parameters Ra and Rz are higher for the UV irradiated surface compared to the face milled surface for all samples except for unmodified hornbeam samples, and statistically significant only for thermally modified ash samples for both roughness parameters. For hornbeam wood, as a representative of the diffusely porous wood species, sanding with paper grit size P80, P120 and P150 resulted in the least rough surface compared to the face milled and UV irradiated surface. Furthermore, thermal modification of the hornbeam wood reduced the difference in roughness between the face milled and sanded surface, which was not the case on ash wood. Also, for ash wood as a representative of the ring-porous wood species, sanding resulted in a finer surface for the parameter *Rz* and in most cases for the parameter *Ra*. Differences in roughness between hornbeam and ash wood are due to differences in wood surface structure.

The results of contact angles of water-borne coating, of solvent-based coating and of distilled water measured after 2, 10 and 30 s are presented in Figures 1. It can be seen that the lowest values of contact angles were measured on the solvent-based coating (Fig-

Table 1 Results of roughness parameters *Ra* and *Rz* (values in parentheses are standard deviations)
Tablica 1. Rezultati parametara hrapavosti *Ra* i *Rz* (u zagradama su standardne devijacije)

Type of wood / *Vrsta drva*	Modification / *Modifikacija*	Type of surface / *Vrsta površine*	*Ra*, mm*	*Rz*, mm*
Hornbeam *grabovina*	Unmodified *nemodificirano*	Face milled / *čeono glodana*	4.28 (0.858)a	30.8 (3.915)a
		Sanded / *brušena*	2.68 (0.396)a	23.3 (3.650)b
		UV irradiated / *UV zračena*	3.16 (0.789)a	26.3 (4.804)ab
	Thermally modified *toplinski modificirano*	Face milled / *čeono glodana*	2.48 (0.471)ab	20.6 (3.190)ab
		Sanded / *brušena*	2.48 (0.277)a	18.4 (2.770)a
		UV irradiated / *UV zračena*	3.62 (0.614)b	29.0 (3.335)b
Ash *jasenovina*	Unmodified *nemodificirano*	Face milled / *čeono glodana*	3.60 (0.938)a	27.9 (5.493)a
		Sanded / *brušena*	3.28 (1.372)a	30.4 (11.437)a
		UV irradiated / *UV zračena*	4.12 (0.876)a	33.7 (9.916)a
	Thermally modified *toplinski modificirano*	Face milled / *čeono glodana*	3.22 (1.152)a	23.3 (11.128)a
		Sanded / *brušena*	5.40 (1.910)ab	47.2 (13.604)ab
		UV irradiated / *UV zračena*	6.24 (1.616)b	54.8 (8.258)b

*Means within the unmodified and thermally modified wood samples followed by the same letter are not significantly different at 5 % level of significance using the Kruskal-Wallis test.
**Srednje vrijednosti za pojedine nemodificirane i modificirane uzorke drva s istim slovima ne razlikuju se značajno pri stupnju značajnosti od 5 % (utvrđeno Kruskal-Wallisovim testom).*

ure 1a), and a significant difference in contact angles of solvent-based coating was found between the face milled and sanded surface only for contact angles measured after 2 s. Furthermore, contact angles of the solvent-based coating were reduced by 40 % between 2 and 30 s on all samples. Surface preparation did not affect the contact angles of the solvent-based coating measured after 10 and 30 seconds. Figure 1b shows the difference in contact angles of the water-borne coating with respect to surface preparation and wood species. A statistically significant difference was found between sanded and UV irradiated surface. Sanding of the surface of hornbeam samples increased contact angles of the water-borne coating compared to the face milling

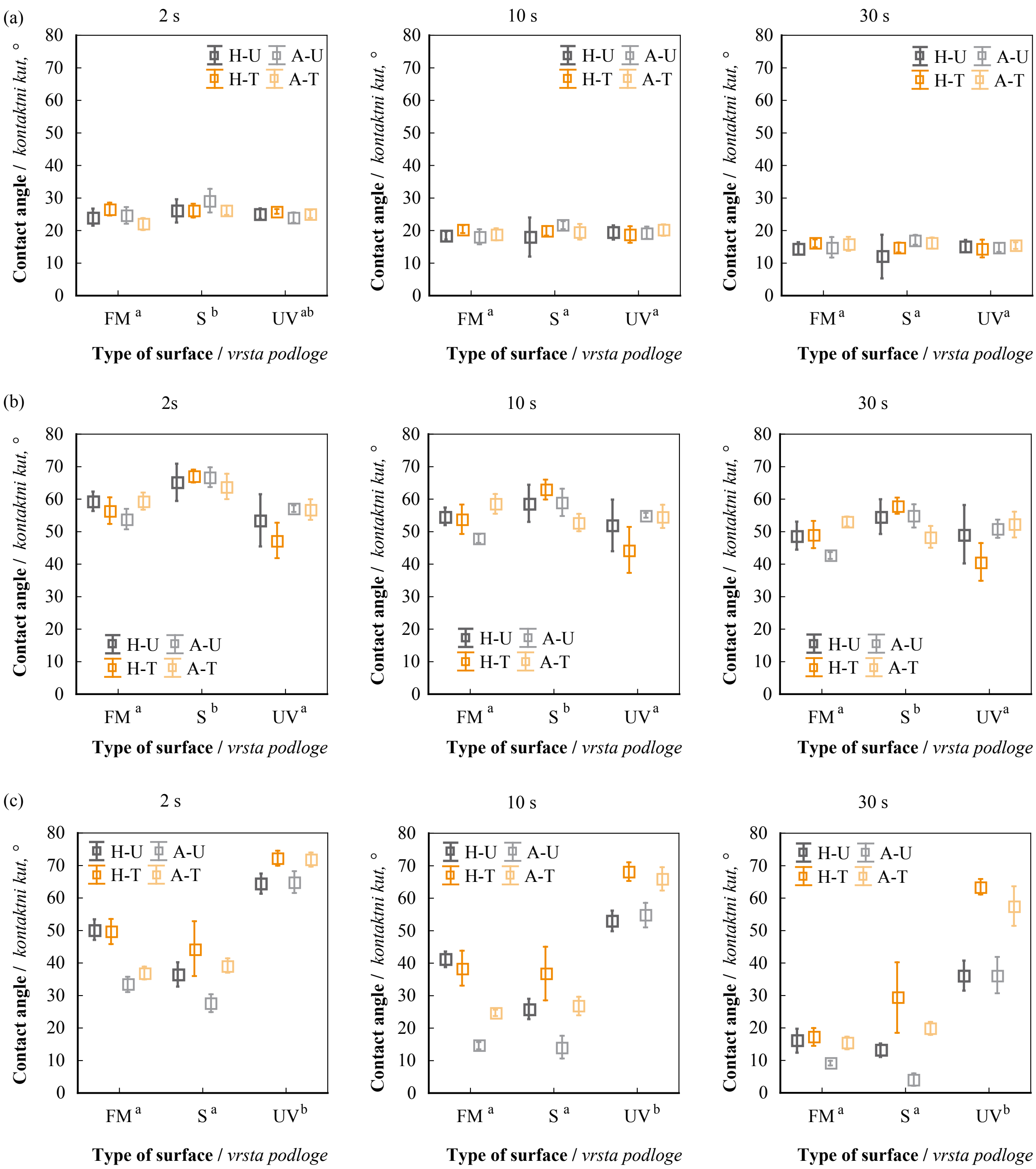

Figure 1 Mean value and standard deviation of contact angles of solvent-based coating (a), water-borne coating (b) and water (c) 2 s, 10 s and 30 s after liquid drop application on wood samples; H-U - unmodified hornbeam, H-T - thermally modified hornbeam, A-U - unmodified ash, A-T - thermally modified ash, FM - face milled, S - sanded, UV - UV irradiated (Means within the measuring interval followed by the same letter are not significantly different at 5% level of significance using the Kruskal-Wallis test)

Slika 1. Srednja vrijednost i standardna devijacija kontaktnih kutova premaza na bazi organskih otapala (a), vodenog premaza (b) i vode (c) 2 s, 10 s i 30 s nakon nanošenja kapljice tekućine na uzorke drva; H-U – nemodificirana grabovina, H-T – toplinski modificirana grabovina, A-U – nemodificirana jasenovina, A-T – toplinski modificirana jasenovina, FM – čeono glodana površina, S – brušena površina, UV – UV ozračena površina (srednje vrijednosti unutar mjernog intervala s istim slovom ne razlikuju se značajno pri stupnju značajnosti od 5%; utvrđeno Kruskal-Wallisovim testom) of the surface, while UV irradiation reduced contact angles of the water-borne coating compared to the sanded surface. This result is obtained after 2, 10, and 30 s, but these differences diminish with prolonged standing of the water-borne coating drop on the sample surface. For the ash wood samples, this relationship between differently prepared samples is visible only for a measurement interval of 2 s. In addition, contact angles of the water-borne coating are on average three times higher than contact angles of the solvent-based coating. The higher contact angle of water-borne coating compared to the solvent-based coting was also obtained by Gibbons *et al*. (2020) in researching 23 commercial coatings on southern yellow pine wood. Accordingly, it can be assumed that solvent-based coating will form more effective contact with hornbeam and ash wood surface than water-borne coating due to better wettability. Unlike the water-borne coating, UV irradiation of the sanded wood surface significantly increased contact angles of water (Figure 1c) and they are higher than those of the water-borne coating (Figure 1b). Furthermore, contact angles of the water on the face milled and sanded surface are lower than contact angles of the water-borne coating (Figure 1c). These results support the statement from the study by Gindl *et al*. (2004) that the wettability of wood with water does not sufficiently explain the interaction between wood and coating. In general, contact angles of water are higher on face milled than on sanded surfaces. These results correspond to the results of de Moura and Hernandez (2005) on sugar maple wood and Hernandez and Cool (2008a) on paper birch wood. Based on the results of contact angles with water, it can be concluded that ash wood surfaces machined with face milling and sanding are more wettable than hornbeam wood surfaces. Moreover, contact angles of the water for ash wood samples are affected by the modification for all three measurement intervals and this is in line with the findings of other authors that wettability of wood by water is lower for thermally modified wood than for unmodified wood (Pétrissans *et al*., 2003; Petrič *et al*., 2007; Kocaefe *et al*., 2008). Pétrissans *et al*. (2003) state that the higher level of cellulose crystallinity in thermally modified wood compared to unmodified wood is the reason for lower wettability of thermally modified wood with water compared to unmodified wood. Moreover, Hakkou *at al*. (2005) attributed the wettability increase of thermally modified wood to the reorganization of the lignocellulosic polymeric components of wood due to lignin plasticization.

Figure 2 presents the results of the adhesive strength of solvent-based and water-borne coatings. It can be seen that on most samples the adhesive strength is lower on thermally modified samples compared to unmodified samples. Altgen and Militz (2017) also reported reduction in adhesion strength of some water-borne coatings on thermally modified wood, which was related to the mechanical interaction of the specific substrate/coating system. De Moura *et al*. (2013) also established reduced pull-off adhesion strength of polyurethane coating applied to thermally modified *Eucalyptus grandis* and *Pinus caribaea* wood samples compared to unmodified samples. They assumed that the reduction in adhesive strength is related to the decrease in the mechanical properties of wood during thermal modification. The same results were also obtained by

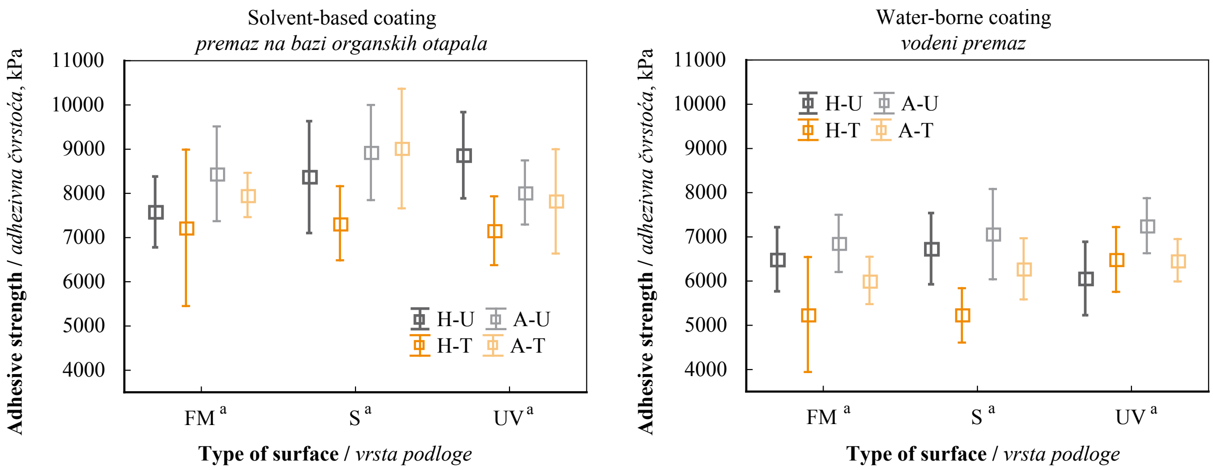

Figure 2 Mean value and standard deviation of adhesion strength of water-borne and solvent-based coating: ; H-U - unmodified hornbeam, H-T - thermally modified hornbeam, A-U - unmodified ash, A-T - thermally modified ash, FM - face milled, S - sanded, UV - UV irradiated (Means within the measuring interval followed by the same letter are not significantly different at 5 % level of significance using the Kruskal-Wallis test)

Slika 2. Srednja vrijednost i standardna devijacija adhezivne čvrstoće vodenog premaza i premaza na bazi organskih otapala; H-U – nemodificirana grabovina, H-T – toplinski modificirana grabovina, A-U – nemodificirana jasenovina, A-T – toplinski modificirana jasenovina, FM – čeono glodan uzorak, S – brušeni uzorak, UV – UV ozračeni uzorak (srednje vrijednosti unutar mjernog intervala s istim slovom ne razlikuju se značajno pri stupnju značajnosti od 5%; utvrđeno Kruskal-Wallisovim testom)

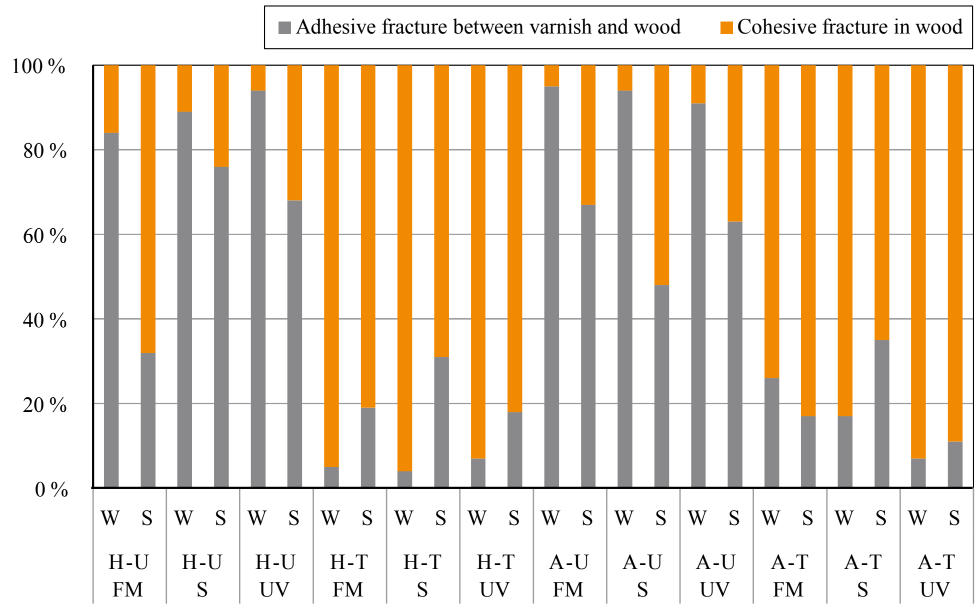

Figure 3 Mean proportion of adhesive fracture between coating and wood and cohesive fracture in wood (W - water-borne coating, S - solvent-based coating, H-U - unmodified hornbeam, H-T - thermally modified hornbeam, A-U - unmodified ash, A-T - thermally modified ash, FM - face milled, S - sanded, UV - UV irradiated)
Slika 3. Srednji udio kohezijskog loma između premaza i drva te kohezijskog loma po drvu (W – vodeni premaz, S – premaz na bazi organskih otapala, H-U – nemodificirana grabovina, H-T – toplinski modificirana grabovina, A-U – nemodificirana jasenovina, A-T – toplinski modificirana jasenovina, FM – čeono glodano drvo, S – brušeno drvo, UV – UV zračeno drvo)

Miklečić *et al*. (2017) for thermally modified beech (*Fagus sylvatica* L.) wood samples. Only sanded ash wood samples coated with solvent-based coating and UV irradiated hornbeam samples coated with water-borne coating exhibited higher adhesive strength on thermally modified samples. In addition, higher values of adhesive strength were measured on the solvent-based coating compared to the water-borne coating, which is partly related to the lower contact angles of the solvent-based coating compared to the water-borne coating (Figures 1a and 1b). Jaić *et al*. (2014) reported higher values of adhesion for solvent-based than for water-borne coatings on sanded beech wood surface. Sönmez *et al*. (2011) also reported higher values of adhesion for two-component polyurethane coating than for water-borne coating on Scots pine (*Pinus sylvestris* L.), Eastern beech (*Fagus oriantails* L.) and oak (*Quercus petraea* L.) wood surfaces. Adhesion between a water-borne coating and the substrate is primarily based on a mechanical bonding, while the adhesion of a two-component polyurethane coating could be based on both chemical and mechanical bonding mechanisms (Jaić *et al*., 2014). Furthermore, lower adhesive strength of solvent-based coating was measured on all hornbeam samples than on ash samples except for UV irradiated hornbeam samples. Higher adhesive strength of coating applied to ash wood is probably caused by the difference in texture and structure between ash wood and hornbeam wood. Sanding the surface of hornbeam and ash samples increased the adhesive strength in relation to the face milled surface, while UV irradiation of the sanded surface decreased the adhesive strength of most samples coated with solvent-based coating. However, statistical analysis did not determine a significant impact of surface preparation on the adhesive strength of solvent-based and water-borne coating. De Moura and Hernández (2005) reported that adhesion of the polyurethane coating was better on sanded than on planed sugar maple (*Acer saccharum* Marsh) wood surfaces.

From the results of the fracture mode under the pulled-off dolly, it can be seen that for unmodified samples the adhesive fracture between wood and coating predominates, while for thermally modified samples cohesive fracture in wood predominates (Figure 3). Furthermore, when testing the adhesion of coating on unmodified samples, a higher proportion of adhesive fracture was recorded for water-borne coating than for solvent-based coating, while on thermally modified samples a higher proportion of adhesive fracture was recorded for solvent-based coating than for water-borne coating. It can be concluded from the obtained results that the surface preparation does not affect the type and proportion of the fracture mode after adhesion test.

4 CONCLUSIONS
4. ZAKLJUČAK

In this research, it was found out that UV irradiation increased the surface roughness of hornbeam and ash wood sanded surface. Moreover, sanding of hornbeam and ash wood resulted in the least rough surface compared to the face milled and UV irradiated surface, while machining of thermally modified hornbeam wood decreased surface roughness compared to unmodified wood. It can be concluded that sanding is more favourable for surface preparation than face milling before applying the coating (regardless of the type of coating material). In addition, the contact angles of the water-borne coating were on average three times higher than contact angles of the solvent-based coating. Furthermore, the ash wood surfaces machined with face milling and sanding were more wettable than hornbeam wood surfaces. UV radiation of the sanded wood surface significantly increased the contact angles of water on hornbeam and ash wood, and they were higher than those of the water-borne coating. The influence of pre-treatment with UV radiation on the wetting of the wood surface with coatings needs to be further investigated. Moreover, wetting of the wood surface with water should not be taken as an indicator of the quality of wetting the wood surface with water-borne coatings. The higher adhesive strength was measured on the solvent-based coating compared to the water-borne coating. Moreover, adhesive strength was lower on thermally modified samples compared to unmodified samples. It was also found out that the investigated surface preparation does not significantly affect the adhesion strength and the type and proportion of the fracture mode after adhesion test.

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