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ASSESSING THE ABRASIVE RESISTANCE OF WOOD-BASED MATERIALS WITH FIBREGLASS

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Abstract

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The aim of this paper is to examine the abrasive resistance of the plywood formatted by fiberglass. Our methodology for the evaluation of the newly designed material was developed so that it corresponds to the related European standards. It is complemented with the sampling method and the preparation of the samples for examination including their climatization. According to our design, we carried out the measurements of the selected structures of fire-proof multi-layered veneer materials with coats of different surface weight in combination with the fiberglass. The gained data about the abrasive resistance can be considered as reliable. The rates of abrasive resistance were examined in reference to the EU current standards which set their area of application. This research is part of the MSMT project No. MSM 6215648902 „Les a dřevo" (Forest and Wood).

abrasive resistance, fibreglass, wood-based panels, plywood

Sheathed veneered materials are used where a direct contact with other materials or environment occur, eg bookshelves, worktables, transport platforms, floors, decks, floors and walls of railroad cars, lorries and trailers. A subject of this paper was to assess the surface resistance of a new composite material the basis of which was made particularly of veneers of determined construction. Phenol-formaldehyde foils with the low content of resins were used, which were combined with unwoven and woven fibreglass highly resistant to mechanical wear. Paper for phenol-formaldehyde foils manufactured of sulphate pulp (area weight 60 g·m^{-2}) was impregnated by low-molecular resin with the resin deposit amounting to 140–160% dry matter (DM) to the paper DM. Abrasive resistance is affected by several factors: kind, composition and the amount of the resin deposit, the quality and area weight of the supporting paper, special admixtures, the shape of the moulding plate surface. The manufacture of sheathed panels is a specialized branch. For sheathing, single-layer or multi-layer foils of a weight of up to 900 g·m^{-2} are used either with smooth plain surface or with a number of forced on patterns increasing utility properties of panels and the range of their use. In materials with glued-on casing high requirements are posed on the surface quality. Sanding papers of the grain of paper 100 to 120 carried out sanding the surface. Papers impregnated by phenol-formaldehyde resins were pressed at a temperature of 125–140 °C using a pressure of 1.2–1.5 MPa. To prevent sticking the panel on surface metal plates a separator was used, namely 1% solution of aluminium stearate or a separative paper. Several standards deal with testing the abrasion resistance of wood-based materials. As for Czech standards it refers to: ČSN EN 438 – 1, ČSN EN 438 – 2 Decorative high-pressure laminates (HPL) – Panels based on thermoset resins, ČSN 64 4218 Panels of hardened paper with decorative surface – Melamine decorative laminated material, EN 13 329 Laminated floors, ČSN 67 3073 Determination of the resistance of coatings to abrasion by abrasive paper in the Taber abraser apparatus, ČSN 91 0270 – ST SEV 5092 – 85 Furniture – Methods of determining the surface resistance to abrasion and ČSN 49 2628 Wood-based laminated panels. As for foreign standards, DIN 53 799 standard deals with the abrasive resistance of wood-based materials.

MATERIAL AND METHODS

Abrasive resistance was tested in multilayer 15 mm panels manufactured of 1.8 mm beech veneers.

The surface of the boards was treated by single-layer phenol-formaldehyde foils (weight 150, 167 and 220 g·m⁻²) in combination with fibreglass and application on sanded or unsanded surface. The antiskid surface structure was also used, viz. hexagonal design (pattern). Samples were modified and prepared according to our procedure. Sanding papers "S – 33 Taber Industries" were used as a sanding element. Tests of abrasive resistance were carried out using the Taber abraser device. Their principle consists in determining the resistance of surface layers of tested boards to resist excessive sanding. Rotating test specimen fixed on a carrier is abraded due to loaded cylindrical abrasive disks with sticked slips of sanding paper. The disks are placed in such a way their cylindrical surfaces to be in the same distance from the axis of rotation of the test specimen. However, they are not oriented tangentially to it. Through the rotation of a test specimen sanding disks rotate creating an annulus on the test specimen surface.

RESULTS AND DISCUSSION

Abrasive resistance was tested on boards defined thickness and construction. Single-layer phenol-formaldehyde foils in combination with fibreglass treated the surface of the boards with application on sanded or unsanded surface. Ten test specimens were measured from each of the boards. The boards were distinguished according to the surface treatment to sanded and unsanded, according to the surface structure to a sheath with smooth or antiskid (antislip) design (the outside diameter of particular hexagonal projections was 5 mm, their spacing 2.5 mm). Results of measurements are given in Tabs. I–IV. Figs. 1 and 2 depict values of abrasive resistance for particular types of tested materials.

I: *Smooth sheath with sanded surface*

Sheath weight ($g \cdot m^{-2}$)		Initial point of abrasion (rpm)	Final point of abrasion (rpm)	Value of abrasion (rpm)
150	$\bar{x}$	**415**	**640**	**528**
	S	13.693	13.693	10.458
	V (%)	3.300	2.140	1.983
167	$\bar{x}$	**440**	**720**	**580**
	S	13.693	20.917	14.252
	V (%)	3.112	2.905	2.457
220	$\bar{x}$	**905**	**1430**	**1168**
	S	11.180	20.917	11.180
	V (%)	1.235	1.463	0.958

II: *Smooth sheath with unsanded surface*

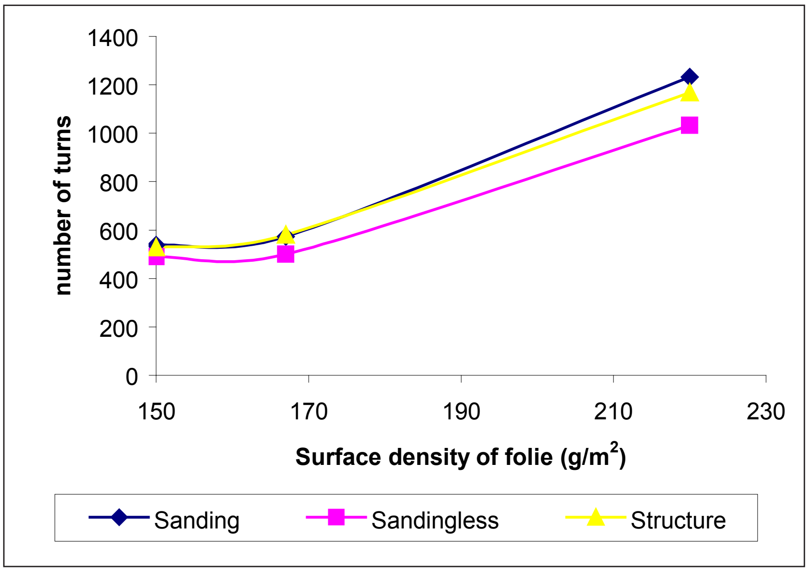
Sheath weight ($g \cdot m^{-2}$)		Initial point of abrasion (rpm)	Final point of abrasion (rpm)	Value of abrasion (rpm)
150	$\bar{x}$	**355**	**625**	**490**
	S	20.917	17.678	18.540
	V (%)	5.892	2.828	3.784
167	$\bar{x}$	**340**	**660**	**500**
	S	13.693	13.693	8.839
	V (%)	4.027	2.075	1.768
220	$\bar{x}$	**730**	**1335**	**1033**
	S	20.917	13.693	14.252
	V (%)	2.865	1.026	1.380

III: *Antiskid sheath with sanded surface*

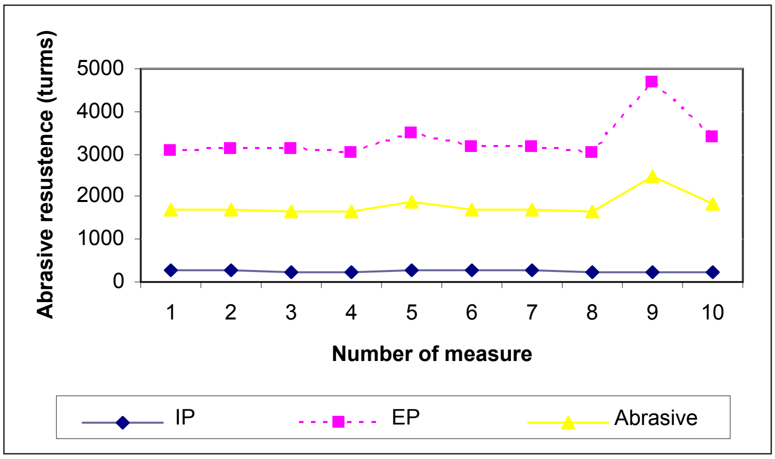
Sheath weight ($g \cdot m^{-2}$)		Initial point of abrasion (rpm)	Final point of abrasion (rpm)	Value of abrasion (rpm)
150	x̄	**305**	**770**	**538**
	S	11.180	11.180	8.839
	V (%)	3.666	1.452	1.644
167	x̄	**360**	**785**	**573**
	S	13.693	13.693	10.458
	V (%)	3.804	1.744	1.827
220	x̄	**940**	**1525**	**1233**
	S	13.693	25.000	14.252
	V (%)	1.457	1.639	1.156

IV: *Antiskid sheath with unsanded surface*

Sheath weight ($g \cdot m^{-2}$)		Initial point of abrasion (rpm)	Final point of abrasion (rpm)	Value of abrasion (rpm)
150	x̄	**205**	**835**	**520**
	S	11.180	22.361	6.847
	V (%)	5.454	2.678	1.317
167	x̄	**205**	**900**	**553**
	S	11.180	17.678	10.458
	V (%)	5.454	1.964	1.893
220	x̄	**715**	**1510**	**1113**
	S	13.693	28.504	8.839
	V (%)	1.915	1.888	0.795



1: *Abrasive resistance of foiled surfaces*



2: *Abrasive resistance of surface with fibreglass*

It follows that with the increasing area weight of a foil its abrasive resistance also increases. The cause of the fact is the increasing thickness of the pressed-in foil (Tabs. I–IV). At the abrasion of surfaces with antiskid design the initial point of abrasion occurs in all cases on the area of the hexagonal design projecting above the surrounding sheath. Only after its removal the abrasion of the pressed-in foil occurs. On the other hand, smooth surface is worn off evenly and thus, the start of abrasion can occur anywhere on the sanded surface. The antiskid design of the board surface with a sanded plywood sheet shows better results than a smooth foil.

The quality of the last layer surface of veneers is a marked factor affecting abrasion. Unsanded plywood sheet shows unambiguously negative effects. Due to gluing a foil wood fibres, which were not ground away were pressed-in to the sheath. During testing this roughness appears as the first participating in the low point of the initial abrasion thus lowering the resulting value of abrasion. Although the final point of abrasion is roughly the same in both variants the sanded plywood sheet gives a little better results of the final point of abrasion. The tree species density under the foil also affects abrasive resistance. The plywood sheet is ground off after achieving the initial point of abrasion. Surfaces where phenol-formaldehyde foil is combined with fibreglass (both woven and unwoven) are a special case. This surface and material can be recommended in exterior because of high resistance to weather factors. The abrasive resistance of these surfaces is markedly higher being on average fourfold. The comparison of values measured at our workplace with data given by manufacturers (WISA, FINNFOREST and RIGATEST) is rather problematic because the preparation of the board surface is not comparable – different underlay tree species, another surface design and methods differ from our methods in many aspects. For particular types of surface, indicators of the abrasive resistance of sheathed boards have been determined.

CONCLUSION

The aim of this paper is to examine the abrasive resistance of the plywood formatted by fiberglass. Our methodology for the evaluation of the newly designed material was developed so that it corresponds to the related European standards. It is complemented with the sampling method and the preparation of the samples for examination including their climatization. According to our design, we carried out the measurements of the selected structures of fire-proof multi-layered veneer materials with coats of different surface weight in combination with the fiberglass. The gained data about the abrasive resistance can be considered as reliable. The rates of abrasive resistance were examined in reference to the EU current standards which set their area of application. This research is part of the MSMT project No. MSM 6215648902 "Les a dřevo" (Forest and Wood).

SOUHRN

Posouzení odolnosti materiálů na bázi dřeva se skelným vláknem vůči oděru

Opláštované materiály fólií odolné proti vzdušné vlhkosti a vodě se používají tam, kde dochází k přímému kontaktu s vnějším okolím. V konkrétním případě tohoto příspěvku například na podlahy a stěny železničních vagónů, nákladních automobilů a přívěsů. Použití fólií je ještě markantnější, když je odolnost vůči pronikání vlhkosti spojena se zvýšenou odolností proti opotřebení oděrem.

Toho lze dosáhnout, jsou-li např. konstrukční dýhy aplikovány do nového kompositního materiálu využívajícího pro zvýšení mechanických vlastností odolnější nedřevěné materiály, jako např. skelné vlákno. Odolnost vůči oděru ovlivňuje více faktorů, jako např. plošná hmotnost nosného papíru, druh, složení a velikost nánosu pryskyřice, speciální příměsi, vlastnosti a způsob aplikace dalších nedřevěných materiálů, tvar povrchu lisovací desky apod.
Předmětem článku je posouzení odolnosti překližek upravených skelným vláknem proti oděru. Pro hodnocení nově navrženého materiálu byla naše zkušební metodika vypracována tak, aby odpovídala souvisejícím evropským standardům. Je doplněna o metodu odběru vzorků, přípravu vzorků ke zkouškám včetně jejich klimatizace. Podle našeho návrhu byla provedena měření vybraných konstrukcí vodovzdorných vrstvených dýhových materiálů s plášti o různých plošných hmotnostech, kombinovaných se skelným vláknem. Byly získány údaje o odolnosti vůči oděru, které můžeme považovat za spolehlivé. Hodnoty oděruvzdornosti byly posuzovány vzhledem ke standardům platným v Evropské unii, které stanovují jejich oblasti použití.

odolnost vůči oděru, skelné vlákno, materiály na bázi dřeva, překližka

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