

Quality of surface finish on furniture doors of MDF board

GABRIELA SLABEJOVÁ, MÁRIA ŠMIDRIAKOVÁ, IVAN VOZAF

Department of Furniture and Wood Products, Faculty of Wood Sciences and Technology, Technical University in Zvolen, Slovakia

Abstract: *Quality of Surface Finish on Furniture Doors of MDF Board.* The paper deals with the assessment of the quality of furniture door surface. The properties were tested on the following types of the surface finish on MDF doors: PVC foil (glossy and matt), acrylic foil, and PUR pigmented coating material. The following physical and mechanical properties of the surfaces were assessed: the film hardness, the impact resistance, and the resistance against scuffing. The polyurethane surface finish and the glossy PVC foil achieved the same film hardness. The impact resistance of the polyurethane finish was significantly lower than the impact resistance of the PVC foils and the acrylic foil. The resistance against scuffing was lower for the polyurethane finish if compared to the foiled surfaces.

Key words: polyurethane pigmented surface finish, PVC foil, acrylic foil, film hardness, impact resistance, resistance against scuffing

INTRODUCTION

To produce cabinet furniture, particleboards (PB) and MDF boards are used. The surface of MDF is usually finished by laminating, veneering or varnishing. All types of surface finish must fulfil the required quality. The quality is assessed according to the properties of the surface finish. The surface finishes created by coating materials or foils are evaluated according to the appearance, physical-mechanical properties and chemical-resistance properties (Tesařová et al. 2010; Scrinzi, et al. 2011; Modrák and Mandulák, 2013; Bekhta et al. 2014; Salca et al. 2017; Yong et al. 2017).

The quality of surface finish is affected by the quality of the base material (Joščák and Langová, 2015; Fekiač, et al. 2016; Fekiač and Gáborík, 2016), and especially by the quality of coatings and foils. Pavlič et al. (2004) pointed out a basic approach for evaluation of the quality of surface finishing.

Currently, there is a trend to improve the properties of already known types of coating materials and foils. Modification of PTFE foil was researched by Wang et al. (2000). The adhesion of PES foil after plasma treatment was reported by Novák et al. (2016). Modification of coatings with nano-technological products was evaluated and reported by Kumar et al. (2015), Weththimuni et al. (2016), Cataldi et al. (2017), and Miklečić et al. (2017).

The paper deals with the quality of the surface finish of furniture doors based on the evaluation of the surface hardness, the impact resistance, and the resistance against scuffing.

MATERIALS AND METHODS

The test pieces were made from MDF furniture doors supplied by the firm “Svet dvierok” (a division of NIVA Expo s.r.o.). MDF with a thickness of 18 mm was used as the base material – covered with the following surface finishes:

- Glossy PVC foil (PVC Gloss) – the thickness of 0.4 mm – white,
- Matt PVC foil (PVC Matte) – the thickness of 0.4 mm – nut,
- Acrylic foil (ACRYLIC) – the thickness of 0.7 mm – white,
- Polyurethane pigmented surface finish (PUR) – the thickness of 0.1 mm – white.

From the furniture doors, the following test specimens were cut out:

- 300 × 300 × 18 mm (for evaluation of film hardness and impact resistance),
- 100 × 100 × 18 mm (for evaluation for resistance against scuffing).

The film hardness was determined by the pencil test according to the standard STN EN ISO 15184 (2012). The results of the test were evaluated according the pencil that scratched the surface (Table 1). The test started with the softest pencil – number 1.

Table 1. Film hardness of the surface finishes.

Pencil hardness	3B	2B	B	HB	F	H	3H	4H	5H	6H	7H	8H	9H
Pencil number	1	2	3	4	5	6	7	8	9	10	11	12	13

The impact resistance of the surface finishes was determined according to the standard STN EN ISO 6272-2 (2011). The intrusion (diameter of the intrusion) was measured and the surface finish was evaluated subjectively according to Table 2.

Table 2. Impact resistance: degree of change and evaluation.

Degree	Visual evaluation
1	No visible changes
2	No cracks on the surface and the intrusion was only slightly visible
3	Visible light cracks on the surface, typically one to two circular cracks around the intrusion
4	Visible large cracks at the intrusion
5	Visible cracks were also off-site of intrusion, peeling of the coating

Evaluation of the surface finish resistance against scuffing was determined according to the standard STN EN ISO 7784-3 (2006). The coefficient of the resistance against scuffing K_T was calculated according to the formula:

$$K_T = (m_1 - m_2)/F \quad (1)$$

Where: m_1 – specimen weight before sanding (g),
 m_2 – specimen weight after sanding (g),
 F – correction coefficient of the used pair of abrasive papers (F = 1.052).

RESULTS AND DISCUSSION

Table 3 lists the results of the film hardness, the impact resistance, and the resistance against scuffing for all the tested surfaces. The polyurethane surface finish (PUR) reached the same film hardness (9) as the glossy PVC foil. PVC Matte and ACRYLIC foils reached higher film hardness.

The polyurethane finish (PUR) showed lower impact resistance if compared to the foils (Table 3). At a drop height of 400 mm, the foils reached the impact resistance of 2 (No cracks on the surface and the intrusion was only slightly visible), but the PUR showed the grade of 4 (Visible large cracks at the intrusion). The polyurethane finish, if compared to the foils, is fragile. At larger drop heights (i.e. 400 mm), the cracks visible to the naked eye arise in it.

Table 3. Film hardness, impact resistance and resistance against scuffing of the surface finishes.

	Film Hardness	Impact Resistance - Visual Evaluation						Resistance Against Scuffing
		Drop height (mm)						Coefficient of Resistance Against Scuffing K_T
		10	25	50	100	200	400	
PVC Gloss	9	1	2	2	2	2	2	0
PVC Matte	> 13	1	1	1	1	2	2	0.032
ACRYLIC	13	1	2	2	2	2	2	0.014
PUR	9	1	2	2	2	3	4	0.073

Slabejová et al. (2018) reported an occurrence of cracks, at higher drop heights, in the silicone coatings. Lower impact resistance of polyurethane surface finish on beech wood compared to wax-oil surface finish was reported by Slabejová (2012).

The PUR surface finish showed the smallest resistance against scuffing. The best resistance against scuffing was reached by the PVC glossy foil.

Fig. 1 shows that the surface damage after abrasion was visible on all the tested surface finishes. From the view point of the weight loss, the PVC Gloss achieved $K_T = 0$, but from the visual evaluation, the surface was damaged equally the other surface finishes.

The resistance against scuffing, the impact resistance, and the surface film hardness are ensured by the individual components of the coating material as well as by the adhesion between layers (Kalendová and Kalenda, 2004). On the laminated furniture doors, these physical and mechanical properties of the surface finish are provided by the foil.

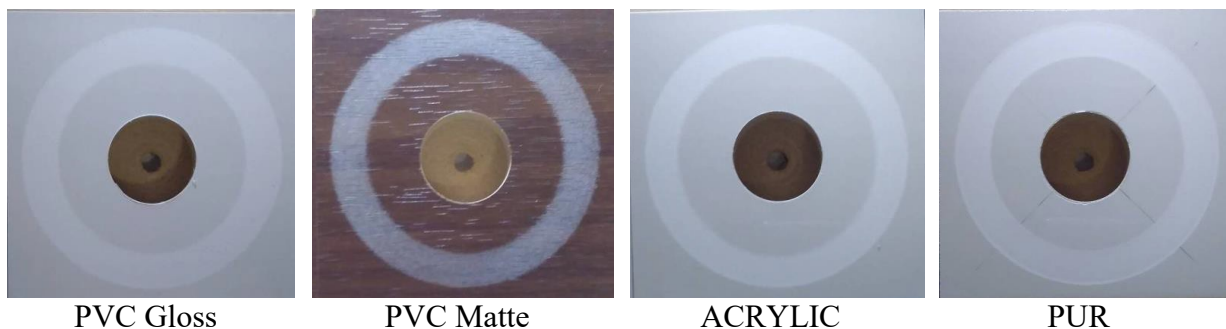


Figure 1. The surface finishes after abrasion.

CONCLUSIONS

Based on the analysis of the results, one can draw the following conclusions:

- The film hardness of the polyurethane pigmented surface finish on MDF furniture doors was the same as the film hardness of the surface with the glossy PVC foil. The film hardness on furniture doors with the PVC matt foil and the acrylic foil was higher.
- The impact resistance of the polyurethane surface finish, at the drop heights of 200 mm and 400 mm, was lower than the impact resistance of the surfaces with the PVC foils and the acrylic foil.
- The resistance against scuffing of the polyurethane surface finish was lower than the resistance of the surfaces with the PVC foils and the acrylic foil.

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Streszczenie: *Jakość wykończenia powierzchni drzwi meblowych z płyty MDF.* W ramach artykułu zbadano właściwości powierzchni drzwi z płyty MDF o trzech rodzajach wykończenia: folia PVC (błyszcząca i matowa), folia akrylowa i pigmentowany materiał PUR. Określono następujące właściwości fizyczne i mechaniczne powierzchni: twardość folii, odporność na uderzenia i odporność na ścieranie. Powierzchnie wykończone PUR i błyszcząca folią PCV charakteryzowały się zbliżoną twardością. Odporność na uderzenia powierzchni wykończonej poliuretanem była znacznie niższa niż odporność powierzchni wykończonych folią PVC i folią akrylową. Powierzchnia wykończona PUR charakteryzowała się niższą odpornością na ścieranie w porównaniu z pozostałymi badanymi wykończeniami.

Corresponding author:

Ing. Gabriela Slabejová, PhD.

Ing. Mária Šmidriaková, PhD.

Bc. Ivan Vozaf

Department of Furniture and Wood Products, Faculty of Wood Sciences and Technology

Technical University in Zvolen,

T.G. Masaryka 24

960 53 Zvolen, Slovakia

slabejova@tuzvo.sk

smidriakova@tuzvo.sk

ORCID ID:

Slabejová Gabriela

0000-0002-9209-0386