



THE EFFECTS OF DIFFERENT OVERLAYS ON THE SURFACE PROPERTIES OF MDF PANELS

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ABSTRACT

In order to determine the surface properties of MDF panels, three types overlays were used; including lacquer paint (LP), melamine impregnated decorative paper (MIDP) and polyvinyl chloride (PVC). The effects of overlays on MDF panel's surface properties were determined and compared to each other. According to the results, PVC coated MDF panels showed higher abrasion resistance compared to MIDP and LP panel surfaces. Cigarette burn test show that LP panels have performed better than others. Water steam test and staining test results revealed that all overlays better performed at standard quality values. PVC overlaid panels presented higher impact resistance than the others. LP panels were found poor in terms of cracking performance compared to PVC and MIDP panels.

Key Words: Decorative paper, surface properties, lacquer paint, PVC, coated panels

FARKLI KAPLAMALARIN MDF PANELLERİN YÜZEY ÖZELLİKLERİ ÜZERİNE ETKİLERİ

ÖZET

Bu çalışmada, yüzeyleri melamin emdirilmiş dekor kağıdı (MIDP), polivinil klorür (PVC) ve lake boya (LP) ile kaplanmış MDF levhaları kullanılmıştır. Kaplama malzemelerin MDF levhaların yüzey özellikleri üzerine etkileri belirlenerek karşılaştırılmıştır. Elde edilen sonuçlara göre, yüzeyi PVC ile kaplanmış MDF levhaların aşınma direnci, MIDP ve LP uygulanmış levhalardan daha yüksek olduğu görülmüştür. Sigara ateşine dayanım özelliği lake boyalı levhalarda diğerlerine göre daha yüksek bulunmuştur. Su buharı dayanım ve lekelenmeye karşı mukavemet dirençleri yönüyle her üç yüzey kaplama malzemesi standart kalite değerlerinden daha iyi bulunmuştur. PVC kaplı levhaların çarpmaya karşı direnç özellikleri, lamine ve lake boyalı levhalardan daha yüksek bulunmuştur. LP uygulanmış levhaların çatlamaya karşı direncinin, PVC ve lamine kaplı levhalara göre daha düşük olduğu görülmüştür.

Anahtar Sözcükler: Dekor kağıdı, yüzey özellikleri, lake boya, PVC, yüzeyi kaplanmış levha

1. INTRODUCTION

Wood based panels are typically made with a heat-curing adhesive that holds the wood particle components or wood fibers together. Wood-based fiber or wood-particle panel composite manufacturers use different wood materials and resins having different physical and mechanical properties and surface characteristics. Thus, their manufacturing processes and intended uses accordingly vary (Winandy and Kamke, 2004). MDF is one of the most commonly used panel products in furniture, home construction, laminated flooring, floor underlayment, cabinet manufacturing, shelving, and other industrial product applications etc. (İstek et al., 2009).

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Basic requirement for durable coating performance on the surface of wood-based panels is a good adhesion between the panel surface and the overlay material. Manufacturing parameters such as the mixture of wood species, storage and conditioning of the boards appeared to be closely linked with the surface properties, the using ratio of adhesives, sanding, and their performance during coating (Barbu et al., 2000).

The main surface characteristics obtained by the lamination process are resistance to scratching, abrasion, moisture, heat, and to some household chemicals. The purposes of these applications are to increase physical, mechanical, and surface properties, to suppress the absorption of water and humidity, and to eliminate the release of formaldehyde emission (Nemli and Colakoglu, 2005; Nemli and Hiziroglu, 2009; Ozdemir et al., 2009; Nemli et al., 2004, 2007). Surface improvement by the lamination depends on the materials used in laminating and the system used for lamination (Ahonen, 1977; Ozdemir et al. 2009). Besides, resin type used in the production of substrate and coating materials affects final product properties. As a rule, urea and melamine formaldehyde resins are extensively used as binder adhesives in the production of panel and overlay materials (Seller, 1996). The type of resin used for impregnation of melamine paper influences the quality of décor papers (Nemli and Usta, 2004; Nemli and Hiziroglu, 2009). Polyurethane-based varnish is more resistant to the scratching, abrasion, and cigarette burns compared to cellulosic varnish (Nemli 2008). In the other study, it was reported that phenolic-impregnated paper overlays resist weathering better than overlays impregnated with urea or melamine (Fahey and Pierce, 1971). It was reported in another study that paper pattern and resin type in impregnated décor papers effect surface properties (İstek et al. 2010, 2012).

The objective of this study was to determine the influence of different coating material on surface properties of MDF panel overlaid with melamine impregnated decor paper (MIDP), polyvinyl chloride (PVC) and lacquer paint (LP) and to compare with each other.

2. MATERIALS AND METHODS

In this study, MDF panels coated with melamine impregnated decor paper (MIDP), polyvinyl chloride (PVC) and solvent based acrylic lacquer paint (LP) commonly used in furniture production were used as materials. LP was applied with spray gun. Test samples were taken from market in Bartın-Turkey. The surface properties of coated MDF panels such as scratch, abrasion, impact, cracking, cigarette burn resistance, water stream, stain resistance and resistance to hot pots tests were determined.

Eighteen samples were prepared for each test. All the tests were carried out in Kastamonu Entegre A.Ş., Forest Product Laboratory. Each tests sample was conditioned at $20\pm 2^{\circ}\text{C}$ and 65 percent relative humidity for 2 weeks before they were tested according to the TS EN 14323 Turkish standard. Abrasion resistance tests were carried out using model 5135 Taber abraser. Initial and final abrasion levels were determined visually based on the initial indication of surface fading and extremely worn out on the surface. Scratch resistance was measured with universal scratch tester (413 ERICHSEN Model).

3. RESULTS AND DISCUSSION

Surface properties of MDF panels coated with MIDP, PVC and LP were determined and obtained results were given in Table 1.

Table 1. Surface properties of MDF panels coated with MIDP, PVC and LP

Surface Properties	Standard values	Overlay MDF panels		
		LP	PVC	MIDP
Abrasion resistance (rpm)	Fourth class (rpm:50-150) Third Class (rpm:151-350)	Ip:119 Fp:154	Ip:183 Fp:215	Ip:127 Fp:163
Scratch resistance (N)	First Class (4<) Second Class (1.6-4.0)	3	4.5	4
Impact test (mm)	Scar diameter Max:10	12.5	9.6	10
Cracking resistance (observation)	4. grade	3	5	5
Cigarette burn resistance (observation)	4. grade	4	2	3
Water steam test (observation)	4. grade	4	4	4
Stain resistance test (observation)	4. grade	5	5	5
Resistance to hot pots (observation)	4. grade	3	2	3

Lacquer paint (LP), melamine impregnated decorative paper (MIDP), polyvinyl chloride (PVC), average values (X), Ip (initial point), Fp (final point)

As shown in Table 1, abrasion resistance values of the MIDP, PVC and LP coated surfaces were found to be different. It has been identified that abrasion resistance of PVC surface is as third grade and LP, MIDP surfaces are as fourth grade (TS 10610). Moreover, the best abrasion resistance was determined on PVC surface, followed by MIDP surfaces, and the lowest abrasion resistance was on panels with LP surface. Nemli and Kalaycıoğlu found resistance of abrasion with LP and MIDP surfaced boards as 366rpm and 541rpm (Nemli and Kalaycıoğlu 2006). Changes of the abrasion resistance of the surfaces depending on coating material are shown in Figure 1.

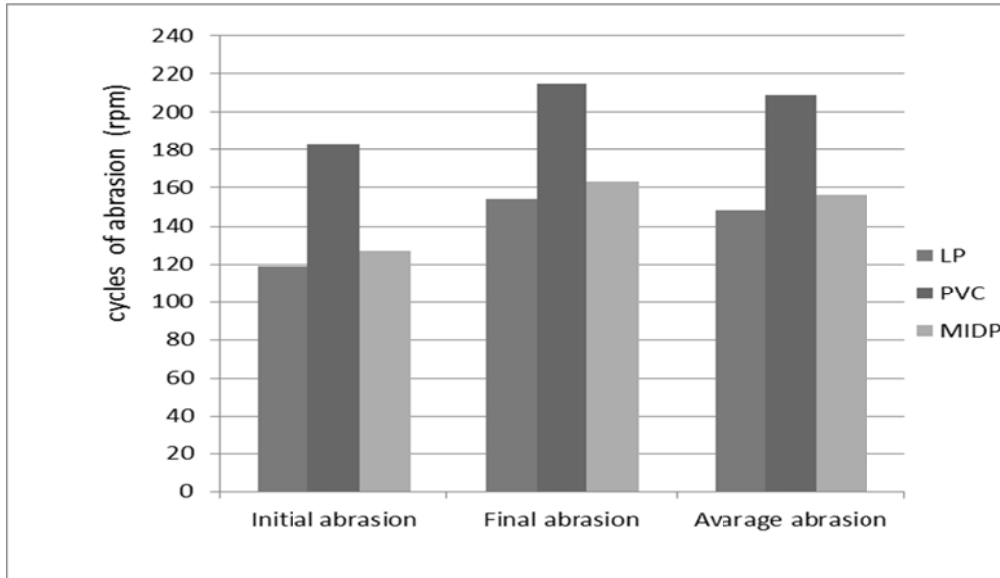


Figure 1 Abrasion resistance depending on to the types of overlay materials

As can be seen in Figure 1, abrasion resistance of MDF panel surfaces coated with PVC demonstrated higher performance than MIDP and LP coated surfaces. However, MIDP coated surfaces was found as slightly better than LP coated surfaces.

Scratch resistance performance of Lacquer painted samples was observed as the lowest compared to other coated surfaces. It was seen that on Samples with LP surface, scratch resistance value is determined as 3N and they have second grade. Despite this, the number of samples that covered with PVC and MIDP is calculated as 4.5N

and 4N respectively, and it has been determined that they have first-grade surfaces. In a similar study, the values were reported as 1.0N on LP surfaces and 3.83N on MIDP surfaces (Nemli and Kalaycıoğlu, 2006).

Impact resistance of overlaid surfaces was carried out using a large ball. This standard value is required to be no more than 10 mm. Impact resistance of LP surfaces has been found higher than the desired degree as 12.5 mm. However, it was found as 9.6 mm on PVC surfaces and 10 mm on MIDP surfaces that they were in the standard values.

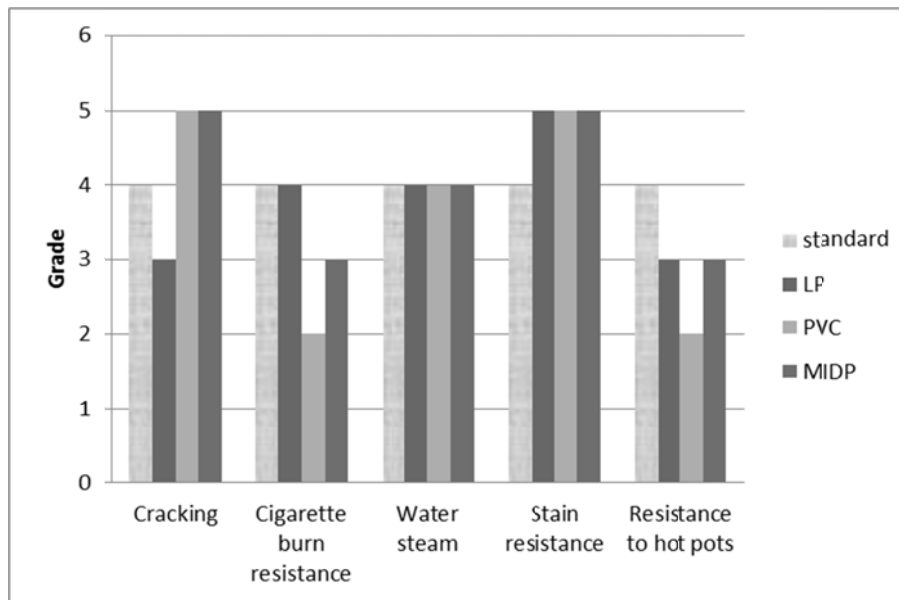


Figure 2 Some surface properties depending on to the types of overlay materials

As can be seen in Figure 2, cracking is lower than the standards on LP surfaces. In contrast, the amount of cracking during trimming is found as that was required on PVC and MIDP surfaces. It was seen that cigarette fire resistance values are sufficient only with LP surfaced panels; on other two surfaces the amount is lower than the standard degree. It was found that properties of water steam and stain resistance were sufficient for all the three surface coating materials. A small difference in surface gloss and color were observed on boards when exposed to water steam. However, these changes were found to be in the standard range. An observable change to staining was identified on the surface of the overlaid MDF panels. It was identified that resistance to hot pots was lower than the desired value for the three coating materials. Resistance to hot pots of PVC surfaces was found to be lower than the other two surface materials. When viewed from different angles on LP and MIDP surfaces, brightness decreases and brown stains were observed. However, it was found that there wasn't any deterioration in the surface structure. Nevertheless, the lowest degree of hot pots resistance was observed on PVC surfaces. Traces of burns and blisters and cracks in the metal block were found on these surfaces.

4. CONCLUSION

This study showed that the success of the coating and finished product depended on the surface coating material types and its properties. Coating and finishing materials such as LP, PVC and MIDP affected the surface properties such as abrasion, scratch, impact, cracking, cigarette burn resistance and resistance to hot pots except water steam and stain resistance properties. According to the results of this study PVC coated surface properties is found better than MIDP and LP coated samples. Moreover, MIDP coated surface presented better properties than LP. In conclusion, the results obtained from this study are as follows;

- It was found that scratch and abrasion resistance of PVC and MIDP coated boards are better than LP coated boards. Thus, PVC or MIDP coated MDF boards should be used when scratch or abrasion resistance is important.

- LP coated boards presented better performance on cigarette burn and hot pots resistance than PVC and MIDP coated boards.
- All of the three coating methods are found suitable for water steam and stain resistance according to the standard values.
- PVC coated boards presented better performance regarding impact resistance than MIDP and LP coated boards. When impact resistance is the primary factor, PVC coated boards should be chosen.

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