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RESISTANCE OF WOODEN LACQUERED SURFACE TO SCRATCHING

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ABSTRACT

In this study the resistance of lacquered wood surfaces to scratching was analyzed. The samples for varnishing were previously prepared by second level and third level of grinding. Further, the samples were surface treated with unadventurous 2K polyurethane coating and modified 2K alkyd urethane coating. The aim of this study is to determine which of the used coatings will give a better resistance to scratching. The test results indicate that surfaces treated with modified 2K alkyd urethane coating give greater resistance to scratching compared to the surfaces treated with unadventurous 2K polyurethane coating.

Key words: surface, resistance, scratching, grinding, 2K polyurethane coating, 2K alkyd urethane coating

1. INTRODUCTION

The basic functions of the corresponding surface treatment are: protection of surfaces against mechanical and chemical influences, decorative surface processing and increasing of the utility of the products (material and conceptual values).

Depending on the place of application, coatings are divided into those for internal use (interior), for example household furniture, flooring, paneling, etc. and those for external use (exterior) in wooden windows, wooden walls, wooden fences, etc. Different requirements need to be met by coatings for internal and external use, which requires different procedures for application. The focus lies in the industrial procedures for wood processing and wooden materials.

Unlike metal, a tree is a "living" material. Therefore there must the various technologies that are available to carefully choose the most appropriate surface treatment, in order to achieve perfect varnishing. The following parameters play a significant role::

- Type of wood species
- Presence of extractive substances in the wood
- Type of binder - glue (PVAc, UF resin or FF)
- Deviation in moisture content of wood, especially in solid wood
- Grinding of wood: kind of material for grinding, distribution of the size of grains, as well as longitudinal and/or transverse grinding
- Conditions of temperature and humidity of the air in the cabin for varnishing or in the process of drying,
- Parameters of the coating, such as viscosity, temperature, amount of alluvium, conditions of application and drying, Jaić, M., Palija, T., (2010).

For surface treatment of wood appropriate systems varnishing must be applied which can ensure important insulation properties of the substrate side by the extractive materials, good wetting ability of the pores of the wood and spillage of the applied coating, a slight increase in roughness of the wood, good elasticity of the film, thus preventing the occurrence of cracks and good mechanical properties, especially resistance to abrasion (wear) in parquets and wood paneling.

It's important for all coatings to underscore the structure, texture and color of the wood after surface processing. Further, there are opportunities to achieve different effects as natural (nature) processing in transparent coatings, color processing / lazur surface and fully covered (painted) laquered surface.

The aim of the research presented in the paper is to determine the quality of oak and spruce solid wood surface treatment depending on the different grinding modes and different types of coatings that will be used in this research.

By determining the parameters of scratch resistance of the coatings, the quality of the wood surface treatment will be determined. By comparing the quality of the wood with different types of PU coatings, as well as different treatment modes, the best solution for surface treatment of solid oak and spruce wood will be determined.

2. MATERIAL AND METHODS

2.1. Material Pad

As a foundation for the examination, lumber from spruce (Picea abies Karst.) and from oak (Quercus robur L.). is taken

Spruce as material can be easily processed, painted, colored, lacquered and polished; it dries quickly, and as such has a wide use. This indicates that spruce is one of the many highly distinguished wood species. The white color of the wood, small knots, proper anatomy, evenly broad rings, low mass, high elasticity and easy processing, contribute to widespread usage of this kind of wood Георгиевски, Ж., (2003).

Spruce has the following chemical composition: 19-29% lignin, carbohydrate 67.90 to 75.70%, which cost 41.0 to 57.80% cellulose, 8.09 to 13.30% pentozan and 1.10 to 1.40% acetyl group. The acidity of the water extract was 4.0-5.3 pH, Jevtić, P, (2005).

This wood belongs to the oak tree ring-porous species with broad and well visible rings in all three sections. Trachea of the early wood zone forms a closed ring porous. Zones of late wood are more compact and darker colored. Glare is the larger radial surface, Ugrenović, A., (1950).

Oak is from heavy hard to medium hard, stable to pressure and blow and with medium elasticity. This type of oak is used as a first-class technical wood for construction, joinery, carpentry, furniture, veneers, parquet, floors, etc.

Oak has the following chemical composition: 41% cellulose, pentozan 19%, 29% lignin, ash 0.22%. Tannin substances found in the tree are 13% in the wood and 9% in the bark, Пејоски, Б. (1966).

Planed timber is dried and conditioned. The average moisture content was 7.76% for spruce and 9.24% for oak. Planed timber is first flattened to have lower based side. Then thickness of 15 mm. is formed

The dimensions of the samples of spruce and oak are 200 x 100 x 15 mm.

2.2 Preparation of surfaces by grinding

Achieving quality surface treatment of objects and elements of wood is related to good surface preparation and application of quality systems and appropriate protection coatings. Key operation for each surface preparation before applying the coating is grinding the surface of the wood. Grinding is especially important even after applying of all the layers of coatings up to applying the latest-finishing layer of coating.

Grinding was done with wide-band grinding machine with paper number $N^0$80. Then followed partial grinding, for each system for preparation of the surface by grinding (systems I and II), which were processed as follows:

• I system: second level of grinding - numbering $N^0$120 + $N^0$150.

• II system: third level of grinding - numbering $N^0120 + N^0150 + N^0200$.

Technical features of wide-band grinding machine:

- Manufactured: CASOLIN, Italian
- Type of element of pressure: crunches beam
- Speed of grinding: 17 m/s
- Speed of movement accessory: 20 m/min.

2.3 Preparation and application of the coatings

Systems protection coating that is applied to wood surfaces, in accordance with its purpose, must meet a series of requirements related to the good mechanical, thermal and chemical resistance, as well as resistance to endure the effects of weathering, UV radiation and so on, and also to meet a wide range of decorative and aesthetic requirements depending on their application.

In technology of surface treatment there are many types of coatings with different chemical and physical characteristics. When applying the protection coatings system, 2K polyurethane and 2K alkyd-urethane coatings were used.

The work was carried out by tests on resistance of scratching of coatings depending on the system of care. The survey refers to the exploitation of wood elements in the interior.

2.3.1. Preparation and application of 2K polyurethane coating

For processing of the samples' surface, basic and final (gloss) 2K polyurethane coating is used. Basic and final coatings are prepared by mixing the components "A" and "B" immediately before application, with mixing ratio 2:1. Application of the coating is done by air spraying. For all samples the same amount of coating - 180 g/m^2, with deviation ± 5% - is used. Conditions of application of the coating are given in Table 2.3.1.

After drying the underlying layers, and before application of the final coating, manually intermediate grinding with paper numbering N^0 240 is performed.

Table 1. *Conditions of applying 2K polyurethane coating*

Parameters	Value
Mode of spraying	Air spraying
Pressure of spraying	3,0 bar
Diameter of nozzle	1,2 mm
Distance of nozzle from the sample	250 mm
Temperature of coating	20 ^{o}C
Viscosity of coating	20 s (F4/20 ^{o}C)
Temperature of the air in the room	21 ^{o}C
Relative humidity of the air	60%
Amount of alluvium	180 g/m^2 ± 5%

2.3.2. Preparation and application of 2K alkyd - urethane coating

Processing of the surface of the samples is performed with basic 2K polyurethane and final 2K alkyd-urethane coating.

Basic and final coatings are prepared by mixing the components "A" and "B", just before use, with mixing ratio 2:1 and 1:1 respectively.

Applying the coating is done by air spraying. For all samples the same amount of coating is used, which was 170 g/m^2, with deviation ± 5%. The conditions of application of the coating are given in Table 2.3.2.

After drying the underlying layers, and before application of the coating, manually intermediate sanding with sand paper with numbering N^0 240 is performed.

2.4 Determination of resistance to scratching

Property of scratching resistance is determined according to the standard EN ISO 1518. The procedure consists of controlling and setting the needle for scratching on the specimen, positioning of the weight for initial loading of the carrier and moving the plate tested under the needle that performs scratching on the coating.The occurring scratch can be seen with naked eye or a magnifying glass, and further investigation establishes whether the damage reaches the base. The result of the test is to determine whether the coating film already meets some predetermined minimum parameters for a given mass, i.e. whether the film coating passes or fails the test. The test ends when it is type "satisfactory/ unsatisfactory".

Table 2. *Conditions applying 2K alkyd-urethane coating*

Parameters	Value
Mode of spraying	Air spraying
Pressure of spraying	3,0 bar
Diameter of nozzle	1,2 mm
Distance of nozzle from the sample	250 mm
Temperature of coating	20 ^{o}C
Viscosity of coating	22 s (F4/20 ^{o}C)
Temperature of the air in the room	21 ^{o}C
Relative humidity of the air	60%
Amount of alluvium	170 g/m^2 ± 5%

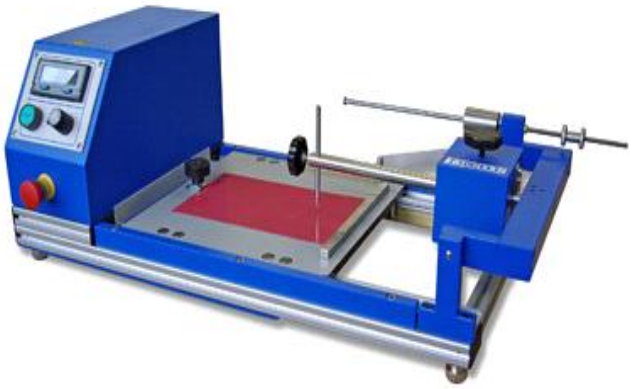

Figure 1. *Test Instruments for resistance of* scratching

Figure 2. *Testing resistance of* scratching

3. RESULTS AND DISCUSSION

The results of examination of the resistance of the coating film of scratching are shown in Table 3.1 and Graphical images 3.1 and 3.2.

Table 3. *Results of testing the resistance of the coating film* scratching

Nr	Wood base/ grinding system	Resistance to scratching (N)	Rating	Nr	Wood base/ grinding system	Resistance to scratching (N)	Rating
Basic polyurethane coating 2x + Final polyurethane coating 1x							
1.	Spruce / I	11	Satisfactory	5.	Oak / I	11	Satisfactory
2.	Spruce / II	15	Satisfactory	6.	Oak / II	14	Satisfactory
Basic polyurethane coating 2x + Final alkyd-urethane coating 1x							
3.	Spruce / I	15	Satisfactory	7.	Oak / I	15	Satisfactory
4.	Spruce / II	> 20	Satisfactory	8.	Oak / II	20	Satisfactory

From the values presented in Table 3.1, it can be deduced that final 2K alkyd-urethane coating has the greater resistance of scratching when the surface is prepared by the second system of grinding, for both types of wood. Lower values of resistance of scratching are measured with final 2K polyurethane coating, when preparation of the surface is performed by first grinding system for both types of wood.

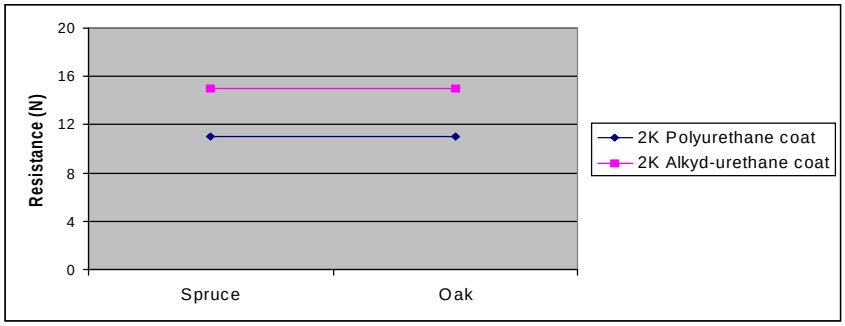

Figure 3. *Resistance of* scratching *of film coating - preparation of surface for grinding system I*

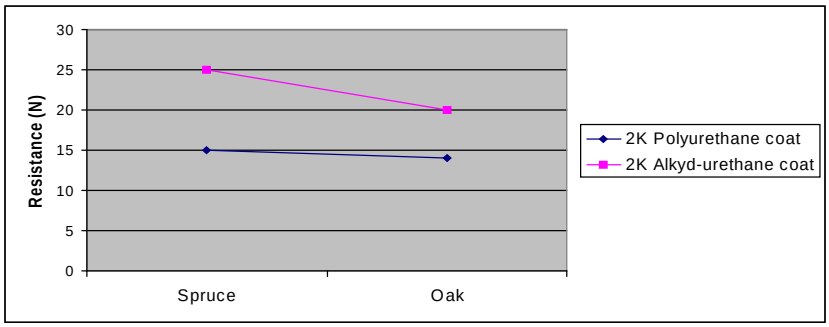

Figure 4. *Resistance of* scratching *of film coating - preparation of surface for grinding system II*

The magnitude of the resistance of the coating film of scratching influences the way of preparing the surface by grinding. The results of the survey show that more resistant film coating of scratching is achieved in the second system of grinding (grinding of third level). Regarding the type of finishing coat applied, greater resistance to scratching the film coating is achieved on the final 2K alkyd - urethane coating, while less resistance of scratching the film coating is the final 2K polyurethane

coating. Wood species has a minor impact on the value of resistance of the coating film of scratching, although it can be concluded that a little bit better values refer to the surface of spruce.

Overall, the results of the examination of the resistance of the coating film of scratching show that resistance in all cases is satisfactory.

The paper Jevtić, P, (2005) presents tests on resistance of the coating film to scratching for surfaces treated with 2K polyurethane coating, oil and wax. Regarding types of coatings applied, the best resistance was found with surfaces treated with 2K polyurethane coating.

4. CONCLUSION

The applied two systems of protection in these trials provided good protection to the surfaces of the wood. Their influence on the quality of surface treatment of wood is expressed through resistance of scratching of the film coating. In this regard, more affected is 2K alkyd -urethane system, which achieved higher values of resistance of scratching.

The results of the survey indicate 2K alkyd-urethane coating systems have higher quality compared to conventional polyurethane coatings that are used for wood surface protection. Modified coating systems (2K alkyd-urethane) ensure higher quality of protection for the final interior products from spruce and oak.

Good resistance of scratching, along with other quality attributes, gives to modified coating systems the recognizable features in the surface treatment of wood. These coatings form films that deliver excellent durability, adhesion and resilience that contributes to their wide application in the field of surface wood protection.

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