ANALYSIS OF THE REASONS FOR DEFECTS DURING FORMATION OF PROTECTIVE-DECORATIVE COATINGS ON WOODEN SURFACES

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INTRODUCTION

A defect in a surface coating can be the result of a number of causes:

- defects due to usage of varnishes with poor quality;
- defects caused by conditions (regimes) of the coatings appliance;
- defects result of processing, storage, transportation and usage of the furniture.

- Usually, the identification of defects on coatings is executed by visual observation.
- Most of the defects appear during the production process itself. Thus, once they are detected, the respective actions for their elimination are taken.
- Often, the low adhesion of the coatings leads to defects that appear much later, while the furniture is being used by the consumers (whitening of coating, cracks, peeling).
- The removal of this kind of defects causes to the producer problems from technical, juristic and financial nature.



AIM AND TASKS

- The article pays attention to the causes for the most common defects by through-feed layering of UV hardening protective-decorative coatings over wooden surface.
- The main conception is that by define the level of adhesion, indirectly could be determined the potential “hidden” defects in the production.
- Thus, a standard methodology has been used to determine the adhesion and gloss of water-dispersed coatings applied at industrial conditions.

MATERIALS AND METHODS

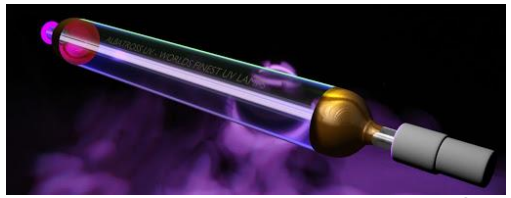
- The research has been conducted at production environment. The samples tested are the usually produced in the factory seats made of pine solid wood.

The used protective-decorating materials are the following: water based stains (black-brown color - ESP 273-99620), base coat - UV Filler (Uvett™ Fill UK1373); clear topcoat - UV curable lacquer (Uvett™ Clear UM1178).

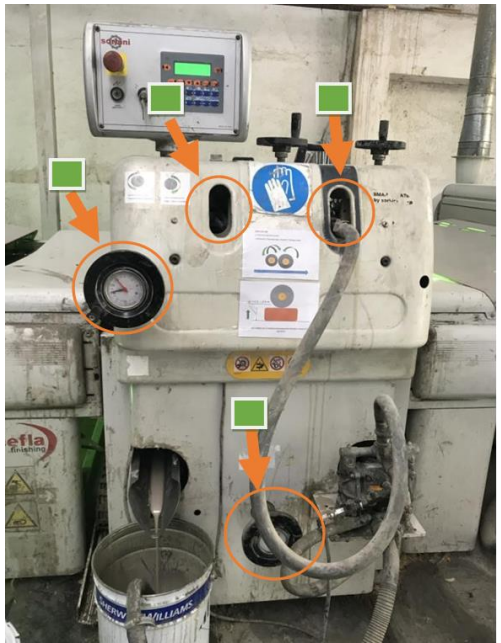
TECHNOLOGICAL REGIME

- The surfaces of the samples have been sanded, stained and vanished with UV roller coating machine at a feeding speed of 10 m/min. The initial sanding of the surfaces has been made with sandpapers P100 and P150.
- The quantity of the applied stain was 35 g/m^2, while on the UV filler was 45 g/m^2. The hardened filler has been sanded (P320/P400) and second layer is applied (20 g/m^2). Afterwards, the lacquer (5 g/m^2) is applied followed by UV hardening.

The radiation in UV roller coating machine is generated by two types of UV-curing lamps: mercury Hg (280÷320 nm) and gallium Ga (390÷450 nm)

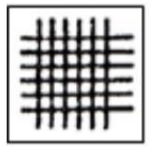
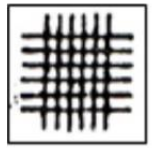


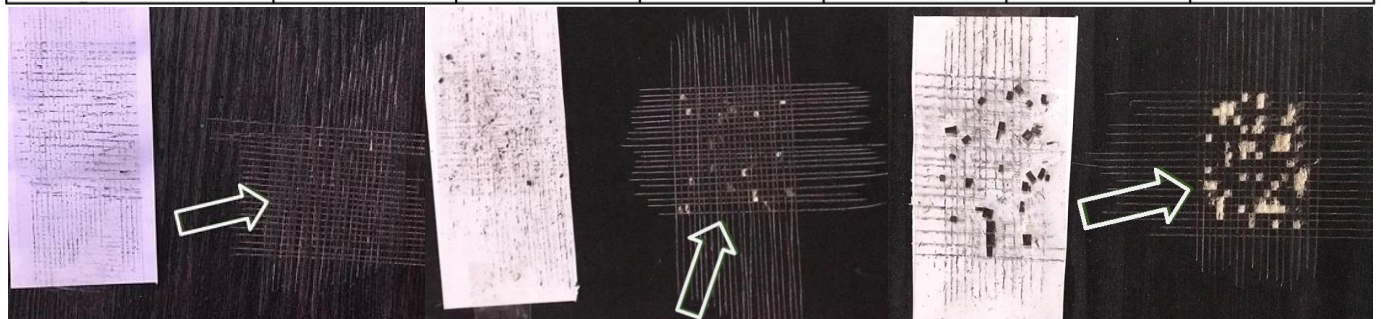
- Often, due to pollution of the UV lamps and the reflectors, the coatings are irradiated at less radiation than those set by technological regimes. In this relation, the experiment at lower values of UV radiation has been done.



MEASUREMENT METHODS

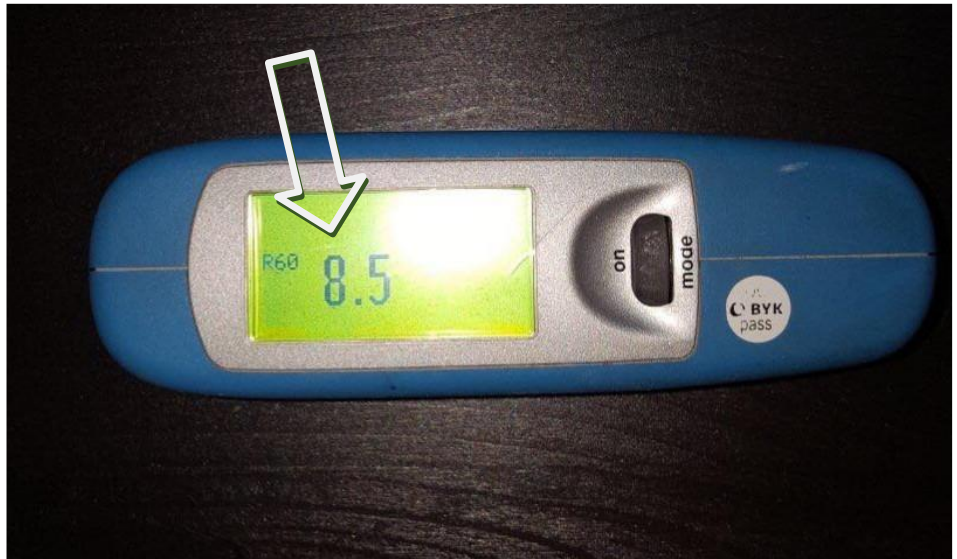
- Adhesion strength of the coating films was determined by the Cross-cut test according to the standard STN EN ISO 2409 (2013)

Classification	0	1	2	3	4	5
Surface of cross-cut area from which flaking has occurred						
Detachment	none	< 5%	5%-15%	15% - 35%	35% - 65%	> 65%



MEASUREMENT METHODS

- The gloss was measured at 60° incidence angle according to the ASTM D523-14 (2018) using a glossmeter (BYK Gardner micro-gloss, Germany)

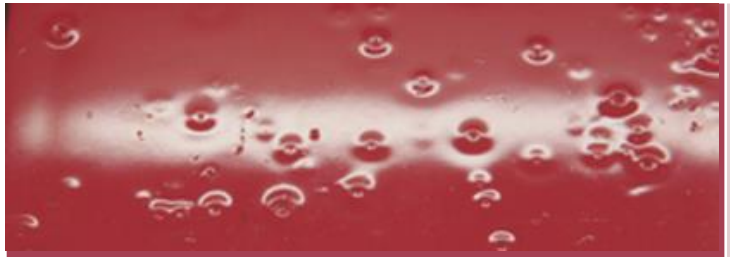


RESULTS

Most common defects during formation of coatings

at production environment

Defects	Probable causes	Preventions
 Bubbles	Thick applied lacquer layer; foamed lacquer; airflow and / or direct sunlight; hardener overdose; high temperature in the room.	Applying thin coatings; before applying the varnish, heat the wooden surfaces by 10-15 °C higher than the room temperature.

 Craters	Chemical incompatibility of some substances contained in wood (resins, essential oils) with the varnish systems used.	Pre-priming with appropriately selected insulating primers.
 Orange peel	Poor varnish spillage; high viscosity; incorrectly dosed composition; unsuitable technological regimes; airflow; high temperature drying.	Observing the technological regime, as the defect is very difficult to remove. It does not disappear completely even after sanding.
 Loss of gloss (less gloss)	Poor quality of varnishes; inaccurate dosing of components; sanding the film before it has reached technological hardness; unsuitable polishing regime.	Sanding and re-polishing; sanding and applying a new layer of high quality gloss varnish.

The results from the experiment for determination of the influence of the UV-lamps and reflectors pollution on the properties of the roller applied coatings

Technological operation	Standard UV radiation		Reduced UV radiation for curing coatings	
	UV energy, mJ/cm^2	UV radiation intensity, mW/cm^2	UV energy, mJ/cm^2	UV radiation intensity, mW/cm^2
Complete hardening of UV filler (two Hg lamps)	400	300	350	280
Incomplete curing of UV filler (one Hg lamp)	150	300	100	280
Complete hardening of UV top lacquer (two Hg lamps)	270	300	220	280
Cross-cut adhesion test	0 (ISO 2409:2013)		3 (ISO 2409:2013)	
Gloss value at 60° angle	13,9		8,5	

CONCLUSION

The most effective way for fight against defects in lacquer coatings is mainly focused on:

1. Use of highly qualified staff for execution of all operations in the areas for lacquer coatings formation.
2. Organization of incoming control, including checks of all materials supplied in the factory.

3. Work upon experimentally tested regimes for coatings formation.

4. Regular conduct of ongoing technological control on the appearance and the main quality indicators of the finished lacquer coatings (adhesion strength, hardness, etc.).

5. Keeping a diary for defects in production.

THANK YOU

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