

**DURABILITY OF PROTECTIVE COATS, FORMED ON BUILDING
WOODEN PRODUCTS USED IN OUTSIDE IN NESEBAR REGION**

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Abstract

It is perform an analysis of state of polymer protective and decorative coatings, formed on wood devices, outdoor exposed in the region of Nessebar town. It is established that the coatings formed on railings and floorings are characterized with lowest durability. Their durability is 1 year. The coatings which are formed on garden articles and equipment (benches, flowerpots, pergolas, lounges) also have a low durability. Relatively more durable coatings are formed on wood products and facilities which are exploiting under the canopy (window, doors and pergolas). It is made recommendation about the conduct of appropriate activities for coating refresh.

Key words: wood elements, protective coats, garden furniture, windows, doors, building products;

1.INTRODUCTION

From antiquity to the present day wood is used for production of structures, equipment and devices (doors, windows, fences, wooden houses, wood paneling, children's facilities, outdoor furniture, floorings). Wood and articles made from it are characterized by limited durability in outdoor exposure or under canopy. The wood is capillary pore and limited swelling solid substance which are characterized with ability to absorb and devote water to swell and shrink and crack and infected by microorganisms in results of it. The solar radiation caused chemical changes in wood surface as visible changes of color and texture. In parallel, entered during a rain storm, moving air mass, bearing and solid hit in contact wood surface away from its substance. To reduce the level of these destructive effects the wood must be glued, impregnated and coated with appropriate protective compositions [8,9, 10]. Lacquering on the surface of wood articles have a main aim to make them more resistant to physical, mechanical, chemical and biological disrupting factors. The coatings protect bonded connection between wooden elements of structures, facilities and products also.

2.ANALISYS OF PROBLEM

Wood in its natural state has limited durability due to its specific features and characteristics (knots, porosity, anisotropy). This requires some bad areas can be removed by cutting across the grain and results in shorter sections be spliced in longitude. Obtained, free of knots, boards are glued in thickness and width thus obtained materials with less anisotropy with better construction and more comfortable measurement. Long life of wood and of manufactured by it reduces the necessity of logging-green treasures of the earth. The forest absorbs carbon dioxide and oxygen was released, the most important element in supporting life on earth. That is why all the technologies that reduce the feeling of the forest called "green technology". Globalization of the worlds breeds promoting these technologies. They are developing in all spheres of industry. Trees have much greater impact on climate than previously thought. It is clear that incur as result of his research team of scientists from Great Britain and Germany [15,16,17,18]. Coniferous forest in northern areas- Canada, Scandinavia,

Russia separated substances called terpenes, which is due specific flavor. The scientists try to understand what exactly is role of terpenes many years. Recently discoveries suggest that terpenes contribute to hardening of clouds above the forests and water vapor and converted into aerosols. Thicker clouds reflect sun and thus lead to lower temperatures, therefore forest occur as “natural air condition”. Wood outdoor exposed in normal atmospheric condition affect the color and texture due to the impact of UV spectrum of light [5]. These changes are denoted by the term weathering. The appearance of flat wood of spruce can be seen in Figure 1.



Figure 1. Appearance of weathered *spruce* wood



Figure 2. Wood coated with transparent decorative protective coating

Although UV rays penetrate into the wood to a depth of not more than 75-100 μ m, they are main cause for initiation of weathering it, due to the conduct of complex and physical- chemical processes. As a result of the combined effects of climatic factors, significant structural changes occur in the surface layer (surface erosion). This is impact on the aesthetic appearance of the product and the quality of protective coatings. UV rays penetrated into the wood surface and imported activation energy, which causes a chemical transformation of lignin, therefore switches easily soluble in water. After his partial destruction, water wash this substance destroyed and weakened links between the cellulose fibers. On the other side, this factor causes repeated swelling and shrinking due to forming cracks and thus opens up new areas for UV radiation. The water plays an important role for wood destruction. It generated and developed of free radicals, which cause wood surface destruction. Another important element in the complex factors influencing the processes of atmospheric degradation is oxygen from environment [9]. In the process of photo oxidation, oxygen joins other free radicals and the end of process forming peroxide compounds. The presence of aggressive gases in atmosphere such as nitrogen oxide and sulfuric dioxide also contribute to degradation of polymeric materials such as wood, plastics, elastomers, polymer coatings and leathers [9,10]. The content of sulfuric dioxide into the environment accelerates the erosion of wood surface because it is easily soluble in water. In the winter, the crucial importance of aggressive gases in determined by the intensive heating, as well as accumulation of fog, which leads to critical concentrations of these gases. The weathering is surface phenomenon and it could be minimize with surface treatment. These treatments can be performed both with soaking up funds forming protective and decorative coatings. These coatings are polymer obviously. The function of these coatings is to receive and minimize external impact and thus extended to life of articles, therefore increase their durability. In the Figure 2 presents a segment of siding protected with color transparent coating, therefore the coverage that doesn't hide the wood texture. In these coatings are imported darker pigments (brown, reddish brown) and other special additives that have the ability to capture the energy of the sun and decompose it into a safe form. These substances are called photo defencesors [11]. Film forming compositions like this is presented to the Bulgarian market from many companies (German, Finnish, Danish, Italian, Greek, Turkish, Spanish, Czech, Slovenian, Bulgarian, etc.). These coatings and paints are made on different chemical basis, but most obvious are alkyd, alkyd-urethane, acrylic, ester akrylate. Which of these groups will be used depends on the location of the device. For example, finishing the surface of the vessels are recommended alkyd urethane and alkyd paints and varnishes, as they are more resistant to water and temperature effects. For dry areas is recommended transparent and acrylic paints and those based on natural products. For floor elements recommended oil paints and varnishes based on linseed, tung, teak and castor oils, added to their natural waxes such as carnauba wax and beeswax [9, 10, 11, 15, 19, 20]. In assessing the condition of the paint, the requirements of BS EN ISO 4628/1 [6]. Specific indicators for qualitative assessment of the surfaces of wood products is the indicator "appearance". It covered a set of signs, which receives visual representation of the state of the polymer protective and decorative film coatings. Assessing the destruction of protective and decorative coating to determine the amount, intensity and size of defects that occur are governed by BS EN ISO 2810: 2004 [7]. This standard applies to defects due to aging of the coating and the wood, the influence of weather factors on it, and change color over time. An single agreement to determine the quantity and size of defects, as well as intensity changes of this type, by evaluating a numerical grade scale from "0 to 5" and score "0" is given in the complete absence of defects a score of "5" is given when defects or changes are so significant that their additional distinction has no practical significance.

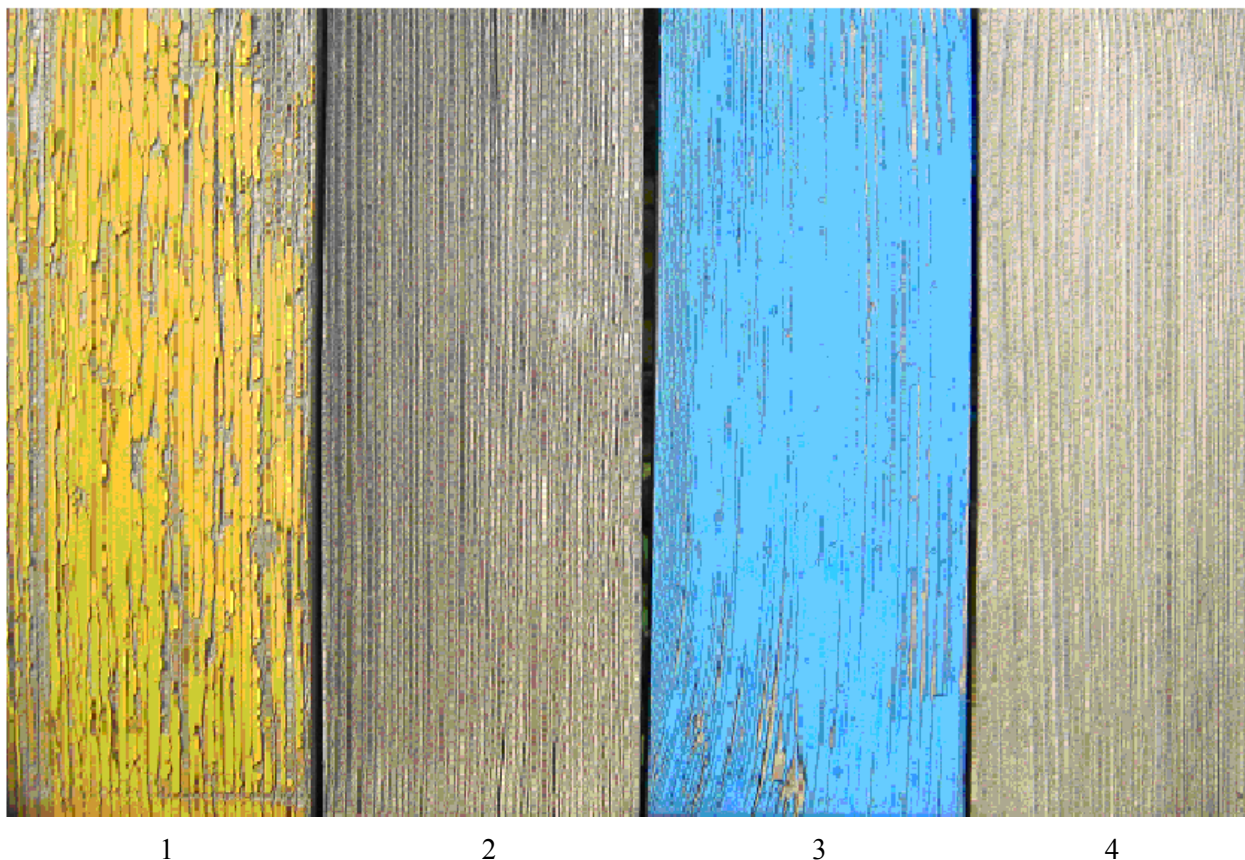


Figure 3 . Spruce etalon samples outdoor exposed for period of 5 years

- 1-left yellow paint NC -11 Lackprom-Sofia; 2. -chlorine rubber lacquer POLD-transparent with light resistance additive- University of forestry- Sofia; 3.- chlorine rubber paint Lackprom-Sofia ;
4.-mono component alkyd-urethane lacquer with light resistance additives PU-102.

3.ANALISYS OF THE STATUS OF THE PROTECTIVE COATING EXPLOITED IN NESSEBAR

To establish the status of the protective coating film formed on the surfaces of structures, facilities and products, is made of the hotel complex "Emerald Resort" - Ravda, situated on the southwestern outskirts of the town of Nessebar. and assessed the changes occurring in coatings of windows and entry doors, railings on the balconies, parks and beach facilities, and articles in the last 5 years of exploitation. In determining the amount of defects are taken in mind that all deficiencies in coverage, scattered more or less evenly over the surface being tested. The defects were evaluated by the quantity, size and intensity of destruction and are illustrated with photographs. Products are made from "FAMOZA LINE" Sofia triply bonded profiles with a cross cut section and 72x86 72x115 mm, of pine wood. The analysis of the technical documentation of "FAMOZA LINE" manufacturer of windows in the complex "Emerald Resort", it is found that the coatings are formed by products of the company SIKENS-Belgium (Division of AkzoNobel Corporation) delivered by the distribution company VAMKO '94 - Sofia. For every order respecting technological requirements of the supplier of film-forming systems. Wood frames are moistened to swelling of the fibers by immersion in tank with size 140 x 250 x 2500 mm. After drying the grind are sanded to remove fluffing fibers. Then

immersed in a bath with primer-sealer. After the drying is done by grinding № 240 sandpaper or a scotch brite lapping with № 320. After cleaning by blowing clearcoat is applied to form a coating thickness of 200 µm. After drying, filling crack, sanding and cleaning is applied a coat with reference thickness 350-400 µm formed with lacquer or paint by etalon and again follows drying.

In the result of the inspection is found to have serious defects occurred after 4-year operation which are:

1. Ninth-floor -sky bar with terrace decking flooring teak wood overlooking the sea (south east). Coverage on horizontal and vertical surfaces of the framework friezes doors at the bottom is about 60% detached, the remaining upper protective layer is easily separated into fine flakes appear underneath layers of yellow brown primer. On the horizontal surfaces of the slats fixing glass, the coating is completely stale and gray wood is visible, therefore is impaired adhesion between the wood base and between the primer and topcoat and primer (photos 1, 2, 3 and 4). The coatings formed on rustic balustrade handles are highly damaged: cracks, and loss or stale (photos 5 and 6);
2. Eighth floor (apartment facing north). Coating on the handles parapet top is cracked and partially stale, but relatively preserved by the color red has become darker. Coverage on horizontal and vertical surfaces of the lower friezes is partially destroyed and there slaughtered resin (photo 7);
3. Seventh Floor (studio facing northwest). Coating on the parapet above handles 70% stale links and end-arcs are loose. Bare wood areas is partially cracked (Photo 8);
4. Third floor (Suite 311 - northwest exposure). Coating on the parapet above handles 50% is stale and end-connections are loose arcs. Bare wood areas is partially cracked. The top layer on the horizontal surfaces of the lower friezes with initial signs of failure;
5. Ground floor to the outdoor pool (southeast). Coatings on the doors (FOUR bunk) under canopies are relatively preserved, but on the lower friezes initial signs of deterioration. Coatings are formed on the windows and operated in locations where no peaks are completely eroded on horizontal surfaces of crepe battens and vertical surfaces of the lower horizontal friezes.
6. Entrance doors - finish with a lighter color with early signs of a fracture of the upper layer and the neighboring wood finishes with a darker brown color are relatively preserved (photo 9), ie the pigment had no effect (the dark pigment is more resistant to solar radiation).
7. External railings made of meranti. Coatings on the horizontal surfaces of the balustrade handles are partially destroyed (Photo 10);
8. Structural elements of woodwork made from finger jointed lamellas glued triple-Pine wood are in very good condition. Profiles are skewed to 180, allowing rainwater to drain quickly. The edges are rounded (rounded to within 4 mm), which ensures continuity of coverage. The windows are fully hydro with silicone, which prevents ingress of rainwater. Sustains external battens are tight fitting.



Photo 1 . Appearance of door coating of sky-bar 9-floor



Photo 2 . Appearance of door coating of sky-bar 9-floor



Photo 3. Appearance of coating formed on horizontal door bars of sky-bar 9-floor



Photo 4. Appearance of coating of horizontal bars of door of sky-bar 9-floor



Photo 5 . Appearance of coating formed on rustic parapet handles



Photo 6. Appearance of coating formed on handle, jointed in length

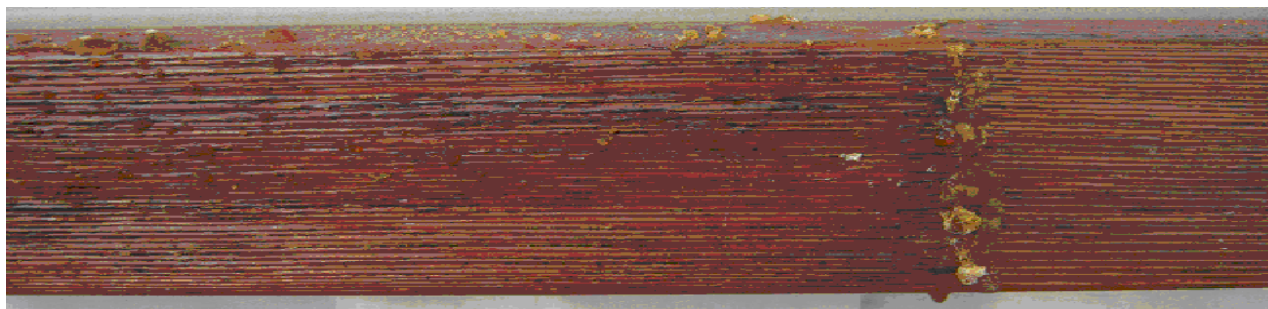


Photo 7 . Appearance of coating formed on vertical surface with resin exudation

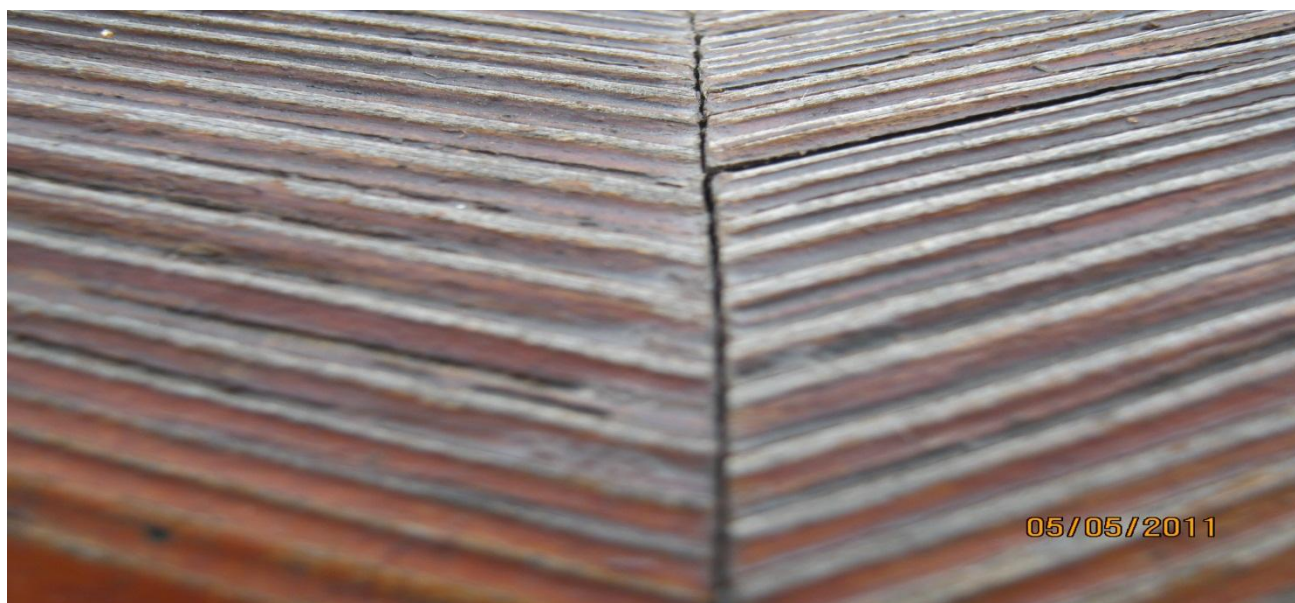


Photo 8 . Appearance of coating formed on the arc handle



Photo 9. Appearance of coating formed on door bars and siding



Photo 10. Appearance of coatings formed on parapet handle horizontal surfaces, made of meranti

Based on observations made, discovered defects and analyzing the probable causes of these defects (shed the finishing layer, sputtering, weathering of the coating) can be assumed that:

1. The coating haven't the necessary hydrophobicity (has greater permeability compared to that which is allowed by BS EN 927-5: 2007), due to which water penetrates through it and distort its adhesion with the intermediate layer.
2. Pigments used have sufficient light protection properties. For these reasons, after 2-3 years durability outdoors began to destruct the coating (cracking, shed, dust, weathering). Consequently, the impact of destructive factors and reached the open wood surface, and then she begins to degenerate (gray, cracking).
3. The coatings formed on the parapet handles are unsuitable. It haven't the necessary elasticity and is very quickly destroyed. This destruction has occurred in the first place of finger-joint, which makes the adhesive film formed with polyvinyl acetate glue class D3. Therefore, in these areas is water, causing swelling and shrinkage of the wood, hence the same is cracked. Balustrade handles are strongly cracked and likely to collapse completely.

To check these assumptions are studies on window frames, nodes with attached fittings (nick and burr, burr and drove) and test objects with dimensions 50x50x20 mm, suitable for tracking the change of adhesion (adhesion) of the solid finish to the wood surface caused by artificial wetting and drying. The coatings were formed with the same composition and the same workflow. Sample units are divided into three series: the A-samples subjected to artificial wetting and drying; B-coated samples in both series, but with an extra buried hlorkauchukovo finishes; C control samples coated both series are not subjected water-thermal effects.

4. CONCLUSIONS AND RECOMMENDATION

It was established, that the degree of destruction depends on the chemical and physical and chemical characteristics of wood each wood species (density, hardness, etc..) And also by the type of protective and decorative means. The durability of coatings for exterior was not more than 3 years. This requires organizing periodic and timely refresh and recovery the protective decorative coatings.

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