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STUDIES ON WOOD CONSOLIDATION AND COMPLETING GAPS IN PANEL PAINTINGS

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Abstract:

This paper presents a method for consolidating and completing the missing surfaces of linden wood panels of old paintings. The artworks suffer from various cracks, separation and large losses of wood. To this purpose, the interventions must be compatible with the structural components of the painting and not affect the aesthetics of the artifacts. For the intervention is was used traditional fillings of sawdust, binders, resin and natural beeswax. The study presents some experiments conducted with these fillers.

Key words: *consolidation; cellulosic fillings; natural waxes; old painted panels; lacunae.*

INTRODUCTION

The filling of cultural heritage objects made of wood, which are in an advanced state of decay, raises serious issues to the restorer, issues that differ from one case to another. The structural lacks in a panel, in a patrimonial object destroy the work's unity and unbalance the composition, which draws viewers attention towards the deterioration. Therefore the applied treatments must be compatible with the essence, the age, the way the support is manufactured and used in work, state of conservation and patrimonial value.

The filling of the wood support is the operation through which are completed the missing parts and replaced the degraded ones. The material used as a replacement have to be treated with a biocidal solution (insecticidal and fungicidal). The substances used for wood protection must be efficient against insects and fungi, but must not have toxic effects on persons. Also, it mustn't change the wood's colour or have negative effects on its properties (Sandu 2007).

This degradations appear due to the fact the wood is hygroscopic, but also, anisotropic, which means the dimensional changes vary on the three directions: longitudinal, radial, tangential, but the swelling is higher on the tangential direction, where it can occur up to 80 times bigger than the longitudinal swelling. The expansion on the radial direction is only 40 times higher. Temperatures and humidity fluctuations lead to tensions, deformations, cracks and fractures in the panel (Mecklenburg *et al*. 1994). Wood losses appear when the support suffered an intense xylophagous attack that made the wood brittle or when the support had deffects (knots) (Walker 2006).

Next we will briefly present the most frequently used interventions for filling the lacks of wooden supports. The fillings based on animal glue are made of bone glue or hide glue 10-20% in distilled water, mixed with sawdust. After the sawdust absorbed the glue, it is applied warm in holes, dowels, knots and burrows made by xylophagous insects. After that it is pressed with a hot spatula to make adherence to the substrate and give it strength. The superficial lacunae are filled with fine sawdust.

To complete the fractures between the support's planks there are used the wedges made of dry limewood, with triangular section, which are introduced in the gap between the planks. The glue that is used is hide glue or casein glue, witch has the consistency of cream. It is recommended to remove the crossbeams before the wedges are placed in the gap, otherwise they will be introduced between them. The deeper cracks in the wooden panel can be completed with tow or with hemp rope. This material soaked in glue is introduced with the tip of the scalpel in cracks, over which is applied a layer of filling made of wax, rosin, chalk dust and pigment (Baroni 1992).

In the case of rotten or very frail panels due to xylophagous attack, it is used old wood for completion, a wood that has a state of degradation similar with the original. (Knut 2000) to provide aesthetic and structural integrity panels will then be impregnated with a consolidator will play resistance. This is cut to match the missing part, and the gaps between the original and addition are filled with a paste made of sawdust and glue (Knut 2000).

The structural consolidation of fragile areas is made with different synthetic consolidants and for replacing of the lost elements is used dry wood, of the same kind of wood or balsa wood (when the element has only an aesthetic, but not a strengthening role). For the completion of lacunae there are used synthetic or traditional fillings made of sawdust and hide glue. The crossbeams are glued with bone glue, and the gap between them is filled with sawdust, wood of the same essence or strips of balsa wood.

For rejoining the planks it may be used fixation with synthetic adhesive. The adhesive join may be supplemented with dowels buried in the board, after that the bamboo dowel is brought to the same level. The completion of missing parts is made with sawdust filling. This paste is applied in layers, only after the previous layer has dried.

The completion of wood with wood, referring to the extraction of spongy or dusty wood and structural reintegration with different fillings of sawdust, balsa wood or wood with properties similar to the degraded one.

The broken strength structures are mechanically bound with balsa wood, depending on the display and presentation of art work, and also depending on compression and tension forces which appear in the process of completion with new wood (Suciu 1971).

As for the consolidation with different types of sawdust fillings, Dionysius of Fourna wrote in his book that first the rotten wood and the dust must be removed. After that a large amount of glue is applied, so it penetrates the planks and the holes are filled with sawdust, layer by layer, once the previous has dried. The same author speaks about the rotten icons and tells how we should intervene in this kind of situations-removing the bore-dust and filling the place (Dionysius of Fourna 2000).

The fillings based animal glue mixed with sawdust and chalk dust, as the ones made of wax and resins (rosin, dammar) have been used for a long time, especially for the structural and aesthetical restoration of art works with fragile wooden support. All these methods have been tested in time, with great results (Baroni 1992, Knut 2000, Kucerova 2012, Tuduce-Traistaru *et al*. 2013).

Wax and wax based emulsions are the best solutions for wood protection. The wood treated with wax stops the influence of bad weather upon the photodegrading processes and prolonges wood's life (Zahora 1991). Today there are many treatments based on wax. The wood treated with wax resists to the open - air use, so the wax has a great influence in stopping degradation as wood loss. The wax applied as an emulsion reduces water absorption during bad weather. Likewise, wax treatments delay the photodegradation processes in wood (Lesar *et al.* 2011). Wax can be used in all the situations. The inconveniences of wax is that it increases the weight of rosin mixed with painted panel.

Wax and paraffin have special properties (Hong and Shi-Xin 2000), such as high melting point, strong cooling, low vapour pressure when melting, chemical inertness and stability. Also, they are available on the market at a relatively good price. The melting temperature is between 30°-90°C. The length of the carbon chain increases the molecular weight and leads to a higher melting temperature than of other materials. Specific heat capacity of wax is approximately 2,1J/kgK. Melting enthalpy is 180-230kg/J, very high for an organic material (Molefi *et al*. 2010).

OBJECTIVES

In this paper we will present a few comparative experimental applications of consolidation and filling of wooden support lacks, using different treatments: the consolidation with wax, rosin,chalk powder and filiing made of coarse sawdust. The interventions are reversible because wax and animal glue can be removed after, with chemical interventions (solvents: xylene, white spirit to wax and glue with hot water) or mechanical interventions (scalpel); the materials are cheap and easy to find.

EXPERIMENTAL WORK. MATERIALS AND METHODS

For the experimental part we used panel painted icons, with brittled support. The icons support is made by linden wood, by multiple boards linked together with animal glue, having cross beams for planarity. These were previously consolidated with a synthetic resin, which restored aesthetically and structurally work's integrity, and original wood species, offering enough flexibility and strength, the posibility of behaving as an adhesive for the detached parts, which might be lost,as well as maintaining mechanical properties of wood, stable in time (Sandu 2008).

Choosing the right consolidant is essential for the recovery or improvement of the physico-chemical characteristics of a wooden object, especially if the object belongs to the cultural, historical or artistic heritage. The consolidant must be selected depending on wood's characteristics and the different degrees of embrittlement (Crisci *et al*. 2010).

During the impregnation there have been examined wood's permeability to liquids, the impregnation method and the physic-chemical properties of the consolidant solution (the relative molecular weight, concentration, viscosity). Consolidant penetration is an important parameter which influences the impregnation results. The xylene solvent is recommended in conservation treatments, according to the paper (Knut 1996). This is why we used a solution of Paraloid B72 dissolved in xylene (20%). Paraloid is used in 20% to give it strength, as the wood is quite weakened. This consolidating which has the optimum ability of penetration (Kucerova 2012).

In the case of "Crucifixion" icon, belonging to a private collection, it was used a filling made of sawdust and hide with a concentration higher than 20% (because of its greater elasticity) for the structural restoration of the bottom right corner. The paste was applied on a skeleton made of bamboo sticks inserted in the frail wood by light pressure at different depths (3-4cm), so they won't create a straight line which might be the profile of a new fracture in the wooden panel. The sticks were put in a single row, with a gap of 1-2cm between them. Hemp fibers were woven on the bamboo sticks, as a support for the sawdust paste and after that the brittled panel was impregnated with consolidant. Successive layers of sawdust filling were applied on the bamboo skeleton and molded with a scalpel until the original form was restored.

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Fig. 1
Icon "Crucifixion".

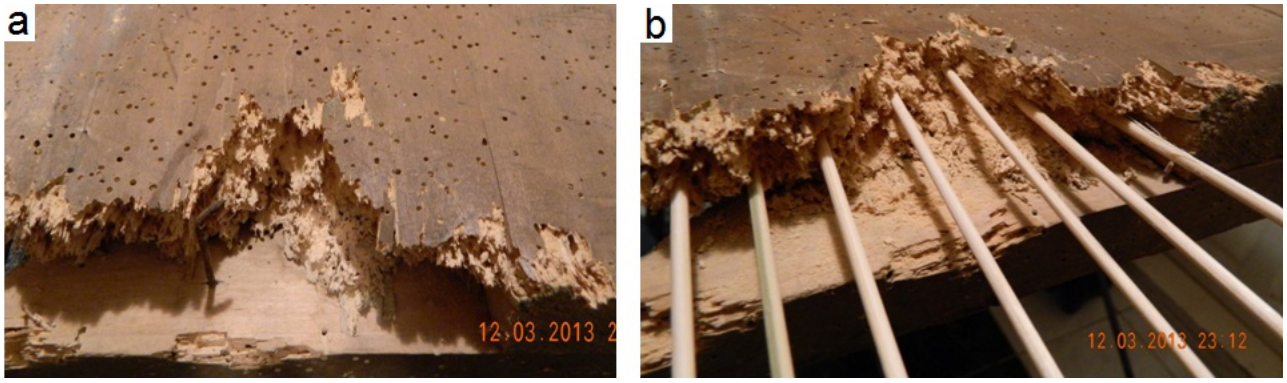

Fig. 2
Filling gaps in the panel
a - Icon "Crucifixion" deterioration and degradation; b - Introducing bamboo sticks.

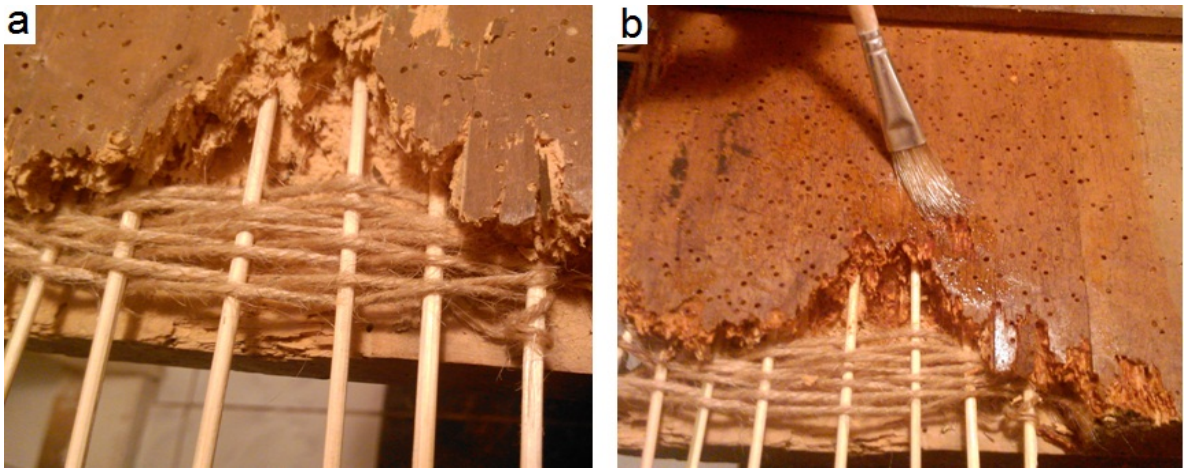

Fig. 3
Consolidation of the wood additions
a - Hemp fabric knitted between the bamboo sticks; d - Impregnation of the support.

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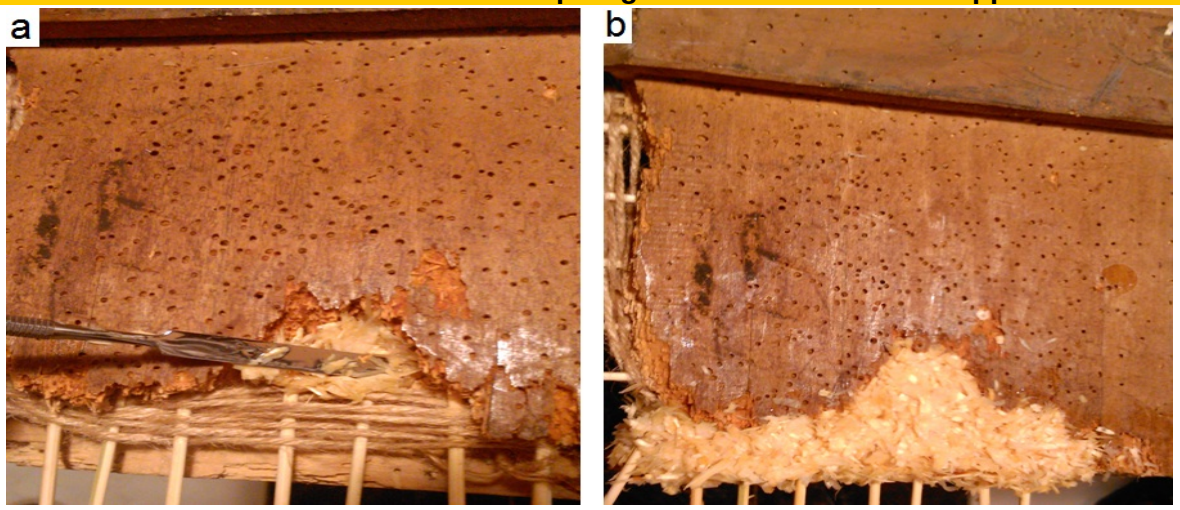

Fig. 4
Consolidation of the wood additions
a - Applying wax paste with sawdust; b - The altered zone after applying the paste of sawdust.

In the case of other icons from a private collection, the fillings were made by beeswax and rosin, in a 60-40% proportion and chalk powder, because the wax is stable in time and to climatic variations, and it can adapt to the panels movements. Another solvent wasn't necessary because the mixture becomes liquid after melting at high temperature. The wax and rosin were melted separately on bain-marie, and after that they were mixed. The chalk dust was added to give hardness to the mixture. White spirit is applied as a solvent in 100% proportion, which was applied by brush on the wood surface. The white spirit was used to ease the penetration of the Paraloid B 72 from the previous treatment.

After the edges were protected with paper duct tape, the fluid mixture was poured in the gaps which were previously brushed with white spirit. After the area was warmed with thermo blower machine Steinel German Quality, HL 1910 E electronic, Type 3484, 230V – 2000W, until the fluid took the shape of the support lacunae. The filling excess was chemically and mechanically removed with xylene and scalpel.

Fig. 5
Second wax treatment.

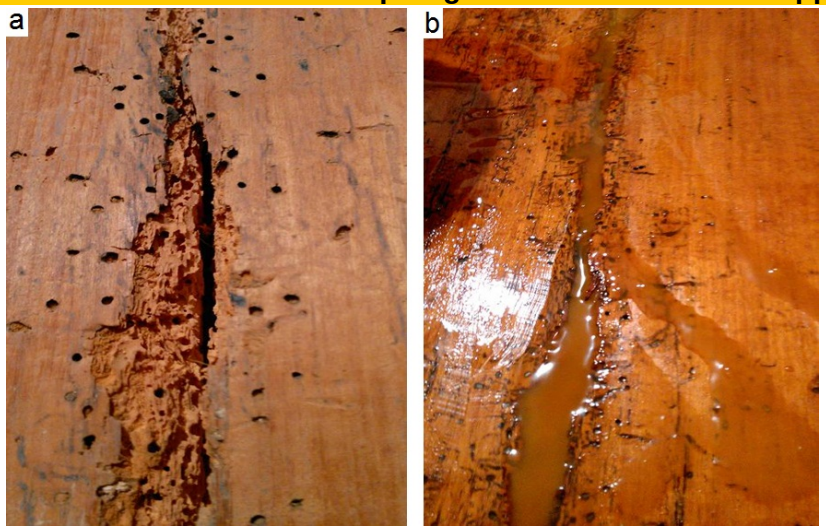

Fig. 6
Degradation and consolidation of the wood panel
a - Gap in the wood panel; b - Filling the gap with wax mixture.

RESULTS AND DISCUSSIONS

In the first experiment, due to wood embrittlement (Fig.1), the bamboo sticks skeleton (Fig. 2) was introduced before consolidation after the support was cleaned and the wood powder emoved. The low mechanical resistance and the highly degraded state of wood enabled the sticks thrusting at different depths. The hemp netting (Fig. 3) realized between the bamboo sticks gave stability and reinforced the structure of the sticks' construction, but the consolidation of this skeleton was fully accomplished with the impregnation of Paraloid B72 in xylene 20% (Fig. 4).

The sawdust-hide paste was hard to manipulate and to introduce in the bamboo sticks- hemp fibers construction when applied because of the high volume of the coarse sawdust. Therefore high pressures were exerted with a spatula, so the paste was moulded on the skeleton. Afterwards, we have created a support surface for the sawdust filling using a wooden slat, which assured the necessary pressure and flatness, on which the consolidant material was moulded.

It took 2-3 days for this composition to dry, during which we intervened periodically, exerting pressures with spatula on the sawdust paste in the lacuna. This intervention was necessary due to the rabbit skin-glue dehydration and also, to the sawdust high volume. After 3 days the filling mass gained the same strength as the panel, but its volume decreased. The levelling was necessary and it was done with filling of fine sawdust and chalk powder, but it can also be applied a wax, rosin, chalk dust mixture.

The experiment objects were achieved. The structural and aesthetical reintegration of the panel, as well as the increasing of mechanical resistance in time and the resistance against the xylophagous attack were obtained. The method took into account the principle of materials compatibility.

For the next experiment, the consolidation and the in-filling of lacunae with wax (Fig. 5), rosin and chalk powder were done succesfully, firstly because of the thermoblower, which ensured an optimum impregnation of the material, due to the high temperature. Thus, the wax mixture could penetrate through all the wood fibers, flight holes and cracks (Fig. 6a), the joining of the split boards, and also the structural and aesthetical restoration of panel, mechanical strength and resistance in time (Fig. 6b). The excess of wax was removed using the edge of a card, at the same time finishing the surface. In the hard accessible areas, the excess of wax was eliminated mechanically with a scalpel, and the surface was cleaned with a cotton swab soaked in white spirit.

For the aesthetically integration of the panel some pigment may be added in the wax mixture, so the colour will resemble wood's colour. Also, shellac may be used. This process is not necessary,because, without it the interventions are legible.

From the two experiments we can observe that the results were satisfactory in both cases, but the treatment with wax, rosin, chalk powder (Fig. 5) offers a better resistance to microclimatic variations, xylophagous attack and mechanical strength. The filling with coarse sawdust, animal glue and chalk powder (Fig. 4b) is susceptible in time to xylophagous attack and it changes dimensions when microclimatic variations occur. If this filling is made with wax and rosin, the mechanical resistance in time and the protection against woodboring insects would be higher.

The filling made of wax, rosin and chalk dust gives strength, durability and viability in time because of the optimum consolidation and special properties of wax. The mixture is sensitive to the panel movement

determined by microclimatic fluctuations. The treated panel becomes more resistant to humidity higher than 65%, to the xylophagous attack and to the dust. For these benefits after the mixture is applied, the wood surface is covered with shellac and then varnish.

CONCLUSIONS

The two methods applied, the mixtures made of wax, rosin and chalk powder or sawdust and rabbit skin glue reinforced and consolidated the wood, giving it a higher mechanical resistance. Besides that, the completions that were done had transformed in a shield against atmospheric moisture and microclimatic variations.

Whatever the nature of materials used in restoration interventions, of great importance is the relationship between them and the original materials, which must respect the restoration principles (the compatibility, reversibility, the physico-chemical stability). Also, it must be avoided the use of the products that are insufficiently known, tested or have damaging side effects.

The approach between the restorer and the work of art must be done respectfully, because it becomes the messanger of an aesthetic-historical reality. For the conservation of object's originality, preservation-restoration interventions must conform to certain principles. For optimum results the approach must be done using information from different scientific fields or applying successful experimental results of various researchers.

This way the restorer and preserver are the ones who render the object's health, being responsible for the chosen treatments. The consolidation and completion treatment used for the wood panel, can support the weight of the whole icon.

During these studies it was observed that no matter the method used for icons preservation, the materials and substances were compatible and passed the test of time.

In our modern society, the idea of cultural heritage preservation has an important place. In the case of an important degraded work of art (icons in our case), due to ageing or improper microclimatic conditions, the minimum, but effective interventions are the ones recommended by specialists. The biodeterioration control and the consolidation of painting layer degradations are fundamental actions for icons preservation, including their unaltered historical message.

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