Mediterranean Archaeology and Archaeometry, Vol. 19, No 1, (2019), pp. 85-91
Open Access. Online & Print.

www.maajournal.com

DOI: 10.5281/zenodo.2585977

CONSERVATION AND RESTORATION OF CHURCH ICON FROM BAPTISM MUSEUM, JORDAN: CASE STUDY

Sahar al Khasawneh*[1], Abdelrahman Elserogy[1,2]

[1]Faculty of Archaeology and Anthropology, Yarmouk University, Irbid, Jordan
[2]Faculty of Archaeology, Fayoum University, Fayoum, Egypt.

Received: 06/01/2019
Accepted: 02/02/2019
**Corresponding author: Sahar al Khasawneh (skhasswneh@gmail.com)*

ABSTRACT

Most of church icons are suffering of bad display and storage conditions that cause damaging of its physical and chemical structure. In this study, we identified the conservation state of an icon taken from the Bethany museum in Jordan. The icon was also investigated by means of Fourier Transfer InfraRed (FTIR) spectroscopy, and X-ray Fluoresces (XRF) to identify the chemical compositions for pigments, ground layer and varnish. Results were used to decide level of interventions to restore the icon. The choice for the intervening materials were based on compatibility with original materials and good reversibility.

KEYWORDS: Icons, FTIR, XRF, Restoration, Wooden panel, Byzantine art, Jordan

1. INTRODUCTION

Icons play a significant role in the spiritual life in churches. As icons are interpreted within the theological concepts of the Church; they are been used as means of connection between prayers and the main portrait of the icon. Mostly icons portrait the Father, Son, Trinity, Virgin Merry with Christ, saints and others like angels as visual reading of the Holy Book (Baggley & Temple., 1987; Benz, 2017). The existence of icons in church is always connected with ritual practices like, lightening candles or venerating the icons. Those actions usually play as damaging factors for the icons. In addition, wrong display or storage conditions will speed up their deterioration. In Jordan, despite the availability of icon works, several deterioration forms have been noticed in displayed icons. However, it is not a common practice for conservation and restoration works to take place, except for few works (Aldawood, 2017).

Restoration of icons are based on scientific analysis for their chemical composition. This will lead to avoid any potential of incompatible of the added materials with the original (Liritzisb & Polychroniadou, 2007). In this work, we have applied an analytical study in representative samples taken from different location of the icon in this study in order to obtain useful information about the chemical composition of the paintings, binding, coating materials and the ground layer. Examinations were also applied for the physical and biological changes that took place on the wooden frame. Results were used to determine restoration materials and methods for the painting.

Icon in this study

The studied icon, taken from the Baptism museum, Jordan, represents The Fiery Ascension of Prophet Elijah. The date or the writer of this icon has not been identified. But, according to museum curator, it is assumed that it was created in the late of 19th century. The icon tells the story of how Elijah the prophet was carried up in a fiery chariot, as adapted from the Second Book of Kings "behold, there appeared a chariot of fire, and horses of fire, and parted them both asunder; and Elijah went up by a whirlwind into heaven" (2 Kings 2:11). In another part of the icon, appears Elijah's pupil, Elisha, who observed the assertion and took up the prophet's mantle which fell as he ascended "And he saw him no more: and he took hold of his own clothes, and rent them in two pieces" (2 Kings 2:12). On the right side of the icon, Elisha use the mantel to strike the river of Jordan with it, so he can cross the waters "He took up also the mantle of Elijah that fell from him, and went back, and stood by the bank of Jordan" (2 Kings 2:13).

Technique of icon

The Icon was painted in a Byzantine art technique using tempera technique. The painting composed of two support, the secondary support, which is the wooden panel of dimensions 112cm x 80cm with two crossbeams (Figure 1). The wooden panel is covered with linen textile fixed by animal glue. The second support (the primary support of the painting) is a white ground layer covering the textile. Pigments were applied on the ground layer and covered by a varnish coating (Figure 1).

Figure 1: General view of the icon before treatment. (a) the back side of the icon; (b) the front side of the icon

State of conservation and causes of damage of the icon.

The icon has been stored in an uncontrolled condition, which led to several damage forms on the wooden panel and the painting. In the backside of the icon, the wooden support has been deformed either during storage or previous displaying. Cracks and growth of fungi in different areas are clearly identified.

In the front side of the icon, the ground layer has been lost in different areas. cracks and loss of paintings spread because of the mechanical stress caused by the wooden support deformation. Large area had suffered of separation and flakes for the paintings. The varnish layer and the gilded areas were dark, and real colours were not clear due to dust and soot which were accumulated over time (Figure 2).

Figure 2: Examples of deterioration forms in the icon, (a) The icon before treatment; (b) Loss of ground layer; (c) Flakes in the paintings; (d) opaque of the varnish layer; (e) detachments of the paintings

2. ANALYSIS AND INVESTIGATIONS

Sample collection and instrumentation

The chemical compositions of the icon parts were identified before any restorations or treatment took place. Samples were taken from different parts of the icon representing the textile, ground layer, paintings (green, red, gold, black and white), and varnish layer. All samples were taken in a manner that do not disturb the integrity fabric of the icon. They were taken from the edges and deteriorated parts by rubbing small amounts using scalpel.

Energy-Dispersive X-ray fluorescence is used to determine the chemical composition of the paintings and the ground layer (Aquilia et al., 2011; Civici *et al.*, 2005; Meilunas *et al.*, 1990). Analysis were undertaken using MiniPal 2 energy-dispersive XRF desktop spectrometer, installed in the labs of Faculty and archaeology, Yarmouk University. The apparatus is equipped with X-ray tube (9W) with power specifications of the 4- 30kV; 1μA- 1mA.

The varnish material, ground layer and binding material were investigated using FT-IR spectrometer of Bruker Tensor 27 FT in the spectral region 400 to 4000cm^{-1} with a spatial resolution of 4cm^{-1}. FT-IR spectra were compared with IR spectra database and with data reported in different sources. Samples were homogenized with KBr and prepared in a pellet geometry (Genestar & Pons, 2005; Meilunas *et al.*, 1990).

3. RESULTS AND DISCUSSION

XRF spectroscopy

Elemental data obtained from XRF analysis of paintings and gold layer are listed in Table 1. Lead has been identified in both red and green pigments. Because of the absence of Fe in the red pigment, Pb_3O_4 was used as red pigment instead of Hematite, which is common in Byzantine icons.

In Byzantine icons, malachite and other copper oxides were routinely used for green. In this icon,

cupper oxides were not detected by XRF. However, the high percentage of lead present in green pigment with the absence of any of Cu products, indicates of the use white lead ($PbCO_3.Pb(OH)_2$) as a white pigment, and green acrylic dyes were applied on top (Civici *et al.*, 2005).

The gold layer was marked by the intense peak of Au in XRF analysis. The existence of Fe, as Fe_2O_3, is likely used as a base layer under gold to give the smoothness of the surface.

The ground layer was identified as Calcium sulphate (Gesso, $CaSO_4.2H_2O$) indicated by the existence of S and Ca in XRF analysis.

Samples of the colour black taken from the frame of the icon were identified as oil paintings covering red pigments, which could be added to the frame as previous restoration works. This has been confirmed during cleaning procedure, when the black colour starts to dissolve, and red frame appeared.

FTIR

FTIR was applied to identify the binding materials and varnish layer. For the pigments, the FTIR spectrum showed the existence of amide groups of proteins by observing the NH bending band (between 700-1500 cm^{-1}) combined with the C=O bond, CH_2 bond of the methylene group (in the region 1500 and 1700 cm^{-1}) and CH_3 methyl group band (in the region 2900 cm^{-1}) (Figure 3). This means the use of egg yolk as a binding material for pigments.

Calcium sulphate can also be identified in the FTIR spectrum in the region 1120 to 1153 cm^{-1}, which confirms the using of gypsum plaster ($CaSO_4.2H_2O$) mixed with animal glue as ground layer.

The existence of animal glue was indicated by the strong absorption bands in the range 1628-1636 and 1528-1539 cm^{-1} due to amide I (C=O stretching) and amide II (C-N stretching and N-H bending) of the glue in conjunction with the strong peaks related to methylene groups at around 2929 and 2850 cm^{-1} and its fingerprints around 604 cm^{-1} (Figure 3).

The varnish layer applied on top surface of the icon is identified as mastic. It can be identified using the absorbance peak around 2874 cm^{-1} for (C-H) and the fingerprint region around 1462 and 1160 cm^{-1} (Azemard *et al.*, 2014). Mastic coating, like most of coating resins, oxidize and discolour over time, which make it obscures the true colours and cover some detail.

Table 1: Major Element Concentrations as Measured by X-Ray Fluorescence

Element	Sample				
	Gold	Gypsum	Green	Red	Black
%S	27.7	38.3	4.8	20.7	10.2
%Pb	0.3	2.5	58.8	25.7	0.9
%Ca	47.3	51.5	25.5	46.1	73.1
%Fe	2.7	0.6	0.7	0.7	
%Au	6.4				

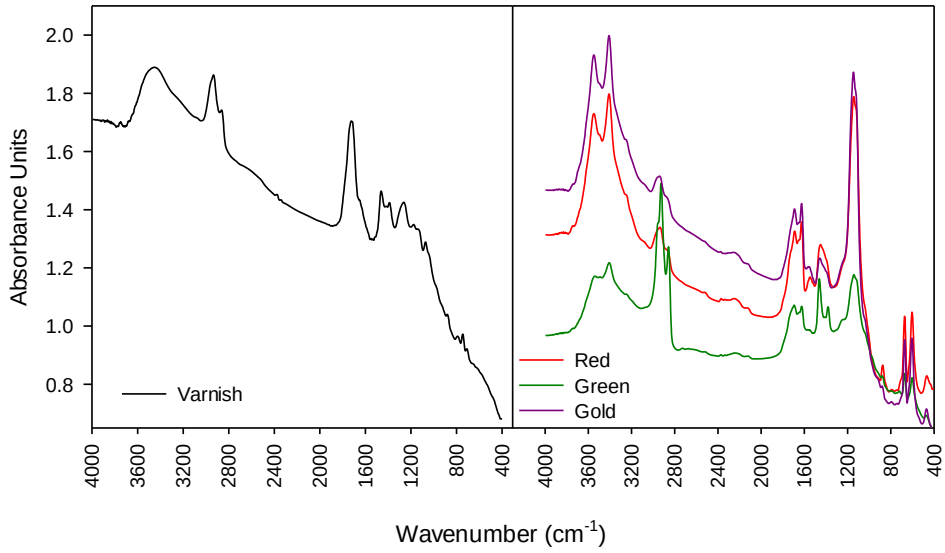

Figure 3: FTIR spectra of the paintings and varnish samples

4. CONSERVATION WORKS

Conservation works aimed to restore the icon's aesthetic and religious significances, without making a historical or aesthetically damaging. It includes intervening new materials for treatment, gap filling and stabilizing. Those interventions are based on two main principles of conservation; first, restoration interventions must be detectible and distinguishable of the original, but, at the same time, invisible from a distance for optimal view of the work to reinstate the icon unity. Second, interventions must be, as much

as possible, reversible and compatible with the original materials (Schniewind, 1988). Defining the original components by means of XRF and FTIR, helped in deciding the new restoration materials.

Back side of the icon, wooden support

As described above, the wooden support suffered mostly from insects and fungi growth and deformation. Cleaning started by mechanical techniques on the backside of the icon. Scalpels and dental tools were used to softly brush affected areas. To prevent further growth of fungi and halting insects attack, a biocide (coside 200) was used through injection and brushing in the effected parts.

To repair the deformation of the frame, the wood was wetted with ethanol and then forced to lie flat and lose its curvature by pressing the panel using metal vices. The panel was also supported by cross beams to give extra support (Fig. 4).

The cracks in the wooden support were filled with linen fibres and glued together with calcium carbonate ($CaCO_3$) mixed with (PVAc) adhesive (Grattan & Barclay, 1988). Small voids and cracks were injected with paraloid B72 (5% w/v) dissolved in toluene to ease its spreading. The same procedure was also applied to the cracks and voids found in the front side of the icon. Because of parolide features in showing minimal shrinkage, strong adhesive and good reversibility, the whole back side of the wooden support was covered by parloid as a protective coating (Brommelle, 1984; Koob, 1986).

Front side of the icon;

1. Cleaning varnish layer

First step in restoring the front side of the icon is by removing the old varnish layer to reveal the original colours of the icon. Mastic varnish, as identified by FTIR, is easily dissolved using diluted ethyl alcohol. This was applied by cotton swabs immersed the alcohol. For Hard spots, where the varnish had accumulation of dust, stronger cleaner was used composed of a mixture of ethyl alcohol, toluene + Dimethyl Formamide with ratios of (1:1:2) (Burnstock & White, 1990; Wolbers, 2003). Focused and spot test were undertaken before using this mixture to avoid dissolving the original pigments. The black frame of the icon turned to be dyes added later and not original of the icon. It was completely dissolved while cleaning, so it had to be replaced later with new dye.

2. Gaps filling for the ground layer

The next step is gap filling for the missing parts of the ground layer. The residual of the ground layer was removed by cotton swaps and small badges immersed in acetone. Gaps in the ground layer were filled by gypsum mixed with Polyvinyl acetate dispersion (PVAc) as an alternative to animal glues (Williams, 2011). The application of the new layer was undertaken in two stages to ensure a fully dry and minimal shrinkage of the surface. Each layer was about 2mm thick. Coarse gypsum was used in the first layer, after drying, a finer grain of gypsum was used for the second layer. After drying in room temperature, the surface was brushed and smoothed using microgrits sandpaper to a degree that made the surface suitable for pigments applications (Fig. 4).

3. Paintings and gilding surface

Missing parts of the gilded layers were restored by using water gilding technique. After filling the missing parts with gypsum mixed with polyvinyl acetate dispersion (PVAc), a layer of pre-mixed Armenian Bole (a clay containing iron oxide and organic additives) was applied. The structure of this clay, plates, formed a smooth cushion on the gypsum layer so gold sheets can be smoothed to high sheen and prevents water absorption by the gypsum. The gilding layer were coated by 10% shellac varnish dissolved in ethanol.

The missing parts of the pigments were repainted using acrylic paints dissolved in water. Acrylic paints are chosen because of its good reversibility. The colours were added in several layers. in every layer, the contrast was deepened until we reached a degree closer to the original.

The most critical part was reconstructing the facial features of profit Elijah where the right side of the face is extensively damaged. There is no previous documentation of this icon showing the whole face to reconstruct the missing side. However, by comparison with similar icons and copying of the undamaged left part of the face, we could have the best estimates of the missing part to be reconstructed and save the aesthetic and religious values for the icon. Accordingly, we used tracing paper with low opacity to copy of the left side of the face. Later, the drawing was applied on the new gypsum layer using a sheet of carbon paper under the tracing paper and traced the main features and lines with a ball-point pen. Acrylic paints were also used in this part (see Fig. 5).

At the end, the full surface of the icon was coated with paraloid 72 (3% w/v) to form a protective layer for the icon and the lustrous appearance to the surface (Koob, 1986).

Figure 4: Examples of restoration interventions applied to the icon, (a) correcting the deformation of the wooden panel; (b) painting the back side of the icon with paraloid 72 as a protective coating layer; (c) cleaning the varnish layer and revealing the original colors (left side before cleaning, right side after cleaning); (d) gap filling for the missing parts

Figure 5: General view of the painting after restoration works are completed.

5. CONCLUSIONS

The analytical investigations conducted on the studied icon have revealed the chemical compositions for the pigments, binding materials and coating layers. Earthen colorants were used by mixing with organic binder (egg yolk), while the ground layer "gesso" is identified as gypsum mixed with animal glue. Those revelations had established the basic perception for the restoration interventions to retain the icon's significances. The choice for the intervening pigments, ground layer and coating materials were based on compatibility with original materials and good reversibility.

Church icons have highly ritual and spiritual significances. However, in Jordan this art has been neglected in the restoration works and plans. We hope that this study highlights the potential of analysis and restoration works that can be undertaken to preserve icons and paintings.

ACKNOWLEDGMENT

Analysis conducted in this work was supported and funded by Yarmouk University

REFERENCES

Aldawood, R (2017) C*onservation of Byzantine icons from Georgios Church in Ajloun and magtas Museum-Jordan*. Master Thesis, Faculty of Archaeology and Anthropology, Yarmouk University.

Aquilia, E, et al. (2011) Multi-technique characterization of ancient findings from Gela (Sicily, Italy). *J. Anal. At. Spectrom., 26*, 977–983.

Azemard, C., Vieillescazes, C, and Ménager, M (2014) Effect of photodegradation on the identification of natural varnishes by FT-IR spectroscopy. *Microchemical Journal, 112.* (2014): 137-149.

Baggley, J and Temple, R (1987) *Doors of perception: icons and their spiritual significance.* Mowbray.

Benz, E, (2017) *The Eastern Orthodox Church: Its Thought and Life.* Routledge.

Brommelle, N. S. (1984) Adhesives and consolidants. *IIC Paris Congress,* September 1984.

Burnstock, A. and R. White (1990) The effects of selected solvents and soaps on a simulated canvas painting. *13th Biennial IIC Congress Cleaning, Retouching and Coatings, International Institute for Conservation of Historic and Artistic Works*. Brussels, 111-118.

Civici, N, Demko, O and Clark, R (2005) Identification of pigments used on late 17th century Albanian icons by total reflection X-ray fluorescence and Raman microscopy. *Journal of Cultural Heritage 6.2,* 157-164.

Dorge, D. and F. C. Howlett (1998) *Painted Wood: History and Conservation*. Vol. 1st Edn. Los Angeles, USA.: J. Paul Getty Trust.

Genestar, C. and C. Pons. (2005) Earth Pigments in Painting: Characterisation and Differentiation by Means of FTIR Spectroscopy and SEM-EDS Microanalysis. *Anal. Bioanal. Chem. 382*, 269-274.

Grattan, D. W. and R. L. Barclay (1998) A study of gap-fillers for wooden objects. *Studies in Conservation 33.2,* 71-86.

Koob, S. P. (1986) The use of Paraloid B-72 as an adhesive: Its application for archaeological ceramics and other materials. *Studies in Conservation 31(1)*, 7–14.

Liritzis, I., and E. Polychroniadou. (2007) Optical and analytical techniques applied to the Amfissa Cathedral mural paintings made by the Greek artist Spyros Papaloukas (1892–1957). *Revue d'Archaeometrie (Archaeosciences)* 31, 97-112.

Meilunas, R. J., J. G. Bentsen and A. Steinberg (1990)Analysis of Aged Paint Binders by FTIR Spectroscopy. *IIC-Int. Inst. Conserv., 35*, 33-51.

Schniewind, A.P. (1988) *On the reversibility of consolidation treatments of deteriorated wood with soluble resins. In Wooden Artifacts Group Specialty Session*. New Orleans, Washington, DC: American Institute for Conservation.

Williams, D.C. (2011) Some Experiences with Flexible Gap-Filling Adhesives for the Conservation of Wood Objects. Phenix, Alan and Sue Ann Chui. *Facing the Challenges of Panel Paintings Conservation: Trends, Treatments, and Training.* Los Angeles: Getty Conservation Institute.

Wolbers, R. (2003) *Cleaning Painted Surfaces, Aqueous Methods.* London: Archetype Publications.