

EXPERIENCE OF RESTORATION OF MURALS OF THE TRINITY GATE CHURCH IN KYIV: OVERVIEW

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Abstract

The ensemble of wall paintings of the Trinity Gate Church of the Kyiv-Pechersk Lavra is the only entirely preserved example of the pictorial decoration of the Church, made in the 18th century (interior), early 20th century (exterior) by masters of the Kyiv school, in Ukraine. The historical review of the methods introduced during the restoration works on the murals of the Church is carried out in the work. The technology of application of a new range of synthetic materials during restoration and their influence on the further preservation of paintings is considered, emphasizing the changes in the materials of painting. The results of the research make it possible to trace the development of the Ukrainian restoration branch on the example of a separate monument, and the findings of the monitoring of paintings reveal the problems of the current state of the object and possible ways to solve them.

Keywords: *Trinity Gate Church, Oil monumental painting, Methods of restoration, Synthetic materials.*

Introduction

Despite the significant number of publications devoted to the study of the Trinity Gate Church [1 - 3] since the 19th century, some chapters of its history are insufficiently covered today. In particular, the history of the restoration of the Church murals is little known and almost unexplored. Information is scattered in various institutions, archives, partially lost. The lack of published professional research does not give a coherent picture of the previous experience of restoration, its basic principles and methods, whereas the choice of restoration materials is one of the most important stages of the restoration process. It is essential to summarize and evaluate the taken measures, which will allow a deeper approach to solving current problems of conservation [4-6].

Built in 1106-08, the Trinity Gate Church is the only church of the Kyiv-Pechersk Lavra that has survived to the present day, preserving its Old Russ core, as well as planning and spatial structure. The temple underwent some changes and reconstructions in the 17th century (vault and cupola were relaid). The Church acquired the final architectural forms, combined with pictorial and stucco decoration in the 20-30s of the 18th century after the devastating fire in 1718. A characteristic feature of the exterior design was the paintings on a plaster basis (crown pediments, upper register of facades, windows jambs and acroterion of the eastern facade) and on metal plates with vertical placement on the sections of divided parts and pilasters of the

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walls (11 images on the western facade and 19 on the eastern facade) (Fig. 1). At the same time, paintings were carried out in the interior of the temple.

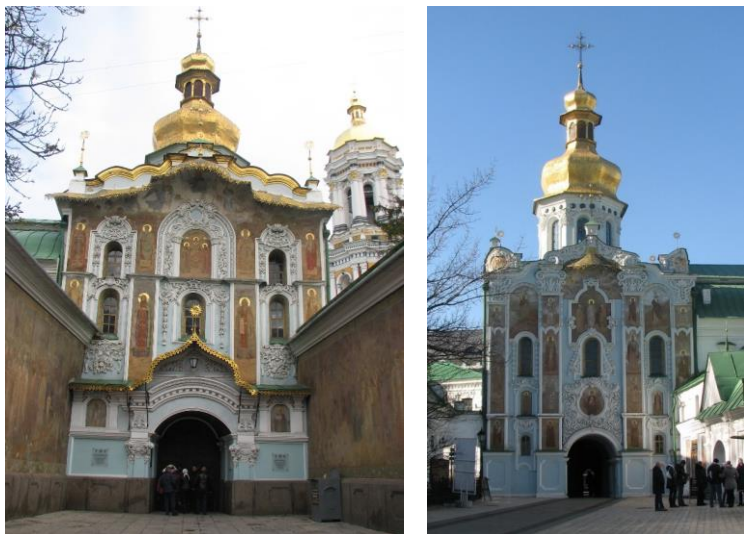


Fig. 1. Trinity Gate Church. General view of the western and eastern facades

Using samples of Western European engravings, the best representatives of the Kyiv school of painting decorated the Church with a unique mural in oil technique (Fig. 2). Since its creation, interior and exterior paintings have been repeatedly refreshed and renewed, which was seen as a manifestation of concern for ancient painting and was the only means of preserving it until the early 20th century.



Fig. 2. Fragments of the interior paintings of the Trinity Gate Church

This especially affected the external paintings due to their tendency to destruction caused by atmospheric factors. Thus, radical changes took place in 1881, when the old painting

was completely destroyed. The walls were re-plastered, the old metal sheets of iron were replaced with new zinc ones, and a new painting was made on them in the technique of oil painting [7]. In 1900-1902, the painting was renewed by the Kyiv artist Volodymyr Sonin on the same basis [8].

After the Second World War, several cycles of restoration work were carried out on the monument. The primary task for Ukrainian chemists-technologists and restorers was to find and implement into restoration practice new methodological developments for the conservation of paintings that are in conditions of changing temperature and humidity or in the open air, where paints lose their binder more intensively. Examination of the murals condition in the interior showed the characteristic destruction of all the paintings: the loss of the paint layer binder, peeling, signs of decomposition and scattering of the lacquer film, late records, crackles and natural aging. In many areas, detachment from the masonry and cracks in the plaster layer were observed due to deformation processes in the church structure caused by the presence of a network of underground passages and subsidence of loess soils. The exterior oil painting of the Church was immensely affected by atmospheric factors: temperature changes, humidity, sunlight and polluted air of the industrial city. Sharp changes in temperature and humidity have a detrimental effect on the preservation of paintings made on a metal basis. This is due to the ability of metals to expand and compress under the influence of temperature changes, liability to corrosion and poor bonding to soil and oil paints [9]. Prolonged exposure to moisture and its sudden drying caused numerous small losses over the entire surface of the images. The paint layer was worn out, dry, covered with a mesh of hard crackles. The cover layer darkened, hardened, cracked, undergone deep decomposition [10].

Materials and Methods

Exterior painting materials

According to the results of research by methods of microchemical, thermochemical, emission spectral analysis and study of microsections of the cross section of the paint layer and base coat, zinc-based painting was performed in several steps on a layer of red lead (tetraoxide of lead (Pb_3O_4) on oil binder. According to archival documents of 1899, the author of the painting V. Sonin had to impregnate a metal base "*with hot boiled oil to full saturation and cover it with red lead with Sannikov white lead*" [8]. This base coat was chosen by the author not by chance, knowing the quality of red lead to resist corrosion [11-19]. As a preparation, a layer of white lead is applied and the painting is made directly on it. The paint layer is oily, dense, textured, using white lead even in the shadows. Iron-containing yellow and brown colors, chromium oxide, lead whitewash, blue pigment is used in the palette. The cover layer is drying oil. It is not unlikely that the general coloration of the painting has changed over time - it has become warmer. This could be due to a decrease in the refractive index of the oil paint binder, which is typical for painting done on tinted or dark base coats [14-20]. In addition, red lead, like all lead paints, turns black under the action of hydrogen sulfide, but shows stability on the oil binder [21].

The plaster base of the facades is uneven with a thickness of 3 to 7cm, has a different composition: lime-sandy and lime-gypsum of medium strength with sand filler. There are areas with cement content. The diversity of plaster solutions is evidence of numerous repairs. The plaster is covered with lime-glue (initial) paint layers and painting on various binders, including synthetic (a total of about 10 layers).

Interior painting materials

The painting is made on plaster of 2-3cm thick, which includes identified lime in the form of inclusions up to 5mm and filler - sand of average grain size of quartz composition in the amount of 30%, the size of the fraction 0.1-0.5mm, ivory. Vegetable adhesive was also

found in the sample. The study of the structural layers of the painting showed that a layer of adhesive red ocher and a layer of adhesive-chalk gesso glued with gelatine were applied on top of the plaster. The presence of red paint layer is a characteristic feature of the murals of the 17th century [22]. According to the results of probes made by restorers in some areas, most of the ancient masonry of the Church has preserved the original plaster with the remains of a painting that could date back to the 17th century. The probes showed ocher, black, red, gray and blue colors (Fig. 3). In general, the probing method found only about 100m² of adhesive painting on the vaults of the Trinity Gate Church. In the 20-30s of the 18th century the interior of the Church was renovated in oil technique. Lead whitewash, ocher, bleu d'azur, verdigris, copper lapis-lazuli, indigo, cinnabar was found in the palette of used pigments [13-17].



Fig. 3. Probe with the disclosure of the remnants of the adhesive painting on the composition of the southern vault of the transept

Applied restoration techniques and materials from different periods

The post-war restoration of the facades of the monument in 1956-58 was based on emergency prevention works and included the removal of destroyed plaster, restoration of lost molding details and replacement of the iron coating of cornices, ledges, canopies. Painting on pilasters and niches of facades, made on zinc sheets, was proposed to fix with the emulsion based on natural drying oil, oil varnish, wax (70:25:5%). The plaster layer was fixed with dowels, the places of plaster losses were supplemented with a new lime-sand solution, pre-installing the reinforcement in the form of a grid of metal wire.

Given the low efficiency of organic materials and emphasizing a more careful scientific approach to the choice of methods during restoration work in 1976, the most durable coatings recommended for restoration work by the Ukrainian research laboratory were used to protect paintings from the effects of destructive factors. To solve the problems of fixing the plaster base and as a protective coating, new methods of fixing using high molecular entities - synthetic resins, the main attribute of which was resistance to weathering, biological factors, frost resistance and water-repellency [23, 24]. They include: synthetic organosilicon resin

polyvinyl chloride (PVC) and organosilicon resin K-42, developed for conservation of wall paintings by Ukrainian chemist and technologist O. Pliushch in 1955, as well as synthetic polymer, introduced in restoration in 1949, polybutyl methacrylate (PBMA), solution of fluoroplastic F-42 L (fluorine-containing copolymer, that was used in the 70s in various fields of restoration due to its positive qualities, and above all, resistance to destructive factors: the action of acids, alkalis, oxidants, ultraviolet radiation).

To fix the oil painting on a plaster basis, the traditional method tested on many monuments of Ukraine with oil painting is used. It is wax and varnish mastic (the mixture is prepared from purified wax and soft resins (rosin, dammar, mastic, etc.) with pinene (terpentin). The fixed areas were saturated with hot solution (1:1:3) for 3-5 days through to complete strengthening of the mastic and evaporation of the pinene. Peeling and painting cracks were applied with a cauter heated to 60°C through a calking paper. Then the excess of mastic and calking paper were removed. Areas that were too dry and worn out were additionally saturated with a solution of linseed oil, mastic varnish and pinene. Surface contaminants and the layer of destructed varnish were removed with a mixture of such solvents as pinene:alcohol:acetone (2:1:1). Complementation of base coat losses was carried out with a mixture of 15% solution of PBMA in acetone and filler - chalk. Tinting of painting losses was performed with dry pigments with a binder, which consisted of a composition of resins K-42 (15g), PBMA (4g) and xylene (80g). As an experiment, different parts of the facades were covered with different protective varnishes: resistant to temperature and moisture alkydosilicone varnish with anti-corrosion properties (12% solution in white spirit), 5% solution of fluoroplastic in a mixture of ethyl acetate with butyl acetate solvents, as well as a solution of K-42 resin.

For the painting made on a zinc basis, the technique based on archival, technical and technological researches and experimental preservation and restoration works carried out directly on separate sites of painting was applied. Microbiological studies have revealed lesions of painting by *Penicillium* and *Cladosporium* fungi. Microbiological studies of building materials of facades, which were carried out by visual inspection and inoculation on medium, found fungi in the flora, as well as representatives of other groups of microorganisms - green and protococcal algae, lichens, including: *Lecanora disperse*, *Placolecanora muralis*, *Caloplaca sp.* According to researchers, oil is the least suitable material for murals [20]. The oil binder, creating an airtight film, provokes the appearance of condensation on the surface of the painting and its accumulation between the base coat and the paint layer, which creates a favorable environment for the development of mold fungi. Therefore, the mandatory work program included cleaning the painting [25-31] from surface contamination and disinfecting it with a 1.5% alcohol-water solution of bactericidal catapine. Also fixing and laying of craquelure of the paint layer and base coat (wax-resin mastic with pinene (1:1:3), replenishment of base coat losses, regeneration of the cover layer and removal of records (alcohol:pinene:acetone = 1:1:0.1) were carried out. It was decided to tint the painting losses with dry pigments with 10% K-42 and 5% PBMA in xylene, and a 12% solution of alkydosilicone varnish in xylene with acetone was used as a protective layer.

Fixing the plaster base on the emergency areas of the vaults, where detachments from the masonry were observed was the main task in the interior of the Church. The situation was aggravated by the number of structural cracks with an opening width of about 2cm passed through the vault. In the places of plaster detachments and structural cracks, it was decided to use the method of fixing with cramps and solution based on PVC resin with filler by injection (18-20% PVC in tetrahydrofuran, the filler is finely sifted chalk to a creamy consistency). To prevent the collapse of the plaster from wooden rolls and plywood panels, support presses were made. In order to eliminate the undesirable movement of the church structure, it was decided to fill the underground passages.

The paint layer was fixed with a wax-varnish solution. The process of removing the late records, layers of oil paints and darkened varnish was the most important. Records were removed in layers using compresses with compositions of individually selected chemical solvents (ethyl acetate:ethyl alcohol:water = 1:1:0.5; acetone:alcohol:ammonia = 1:1:0.5 and alcohol:acetone:pinene 1:1:0.5). In some areas of the mural with the image of the text, where compresses were difficult to apply due to poor paint connection, the removal of records was carried out in a dry way with a scalpel.

Results and Discussions

Further research and observation of paintings using synthetic materials showed that after the introduction of organosilicon resins (PVC, K-42) into the paint layer on the plaster support, there were changes in the porous structures, which caused a decrease in permeability to gases and water vapor, respectively moisture absorption. In particular, significant disadvantages were relatively lower resistance to aging compared to other materials, poor penetration, high toxicity of the resin solvent and the negative impact on the pigments of the paint layer. The main factors of material aging were due to the action of oxygen, ultraviolet radiation and mechanical stress. In the study of the PVC resistance to atmospheric factors, changes in the material (blushing) were observed after 18 months of testing [32]. The list of disadvantages also included the darkening of the paint layer and increasing the rate of contamination of the treated surface [33, 34].

The use of wax-resin solution during preservation and restoration measures against moisture protects them only from condensation, which appears only when warm air comes into contact with a cold wall. However, the wax-resin film is able to disrupt the vapor permeability of the walls and plaster, which leads to the accumulation of capillary moisture in the pores of the materials [35]. It is undesirable to use wax on surfaces exposed to direct sunlight. However, the most significant drawback is the irreversibility of this material [21]. Another material - PBMA, in its turn, creates a shiny film on the surface of the painting, which is characterized by low heat resistance and is sticky, retaining dirt. However, recent studies have shown the resistance of PBMA to UV rays [37].

According to Ukrainian restorers, 60 years of experience in the use of PVC-based solutions for fixing plaster bases and wax-varnish compositions for fixing oil paintings indicates the overall satisfactory condition of the fixed painting under a stable temperature [24, 25, 34]. However, visual conclusions need to be supported by accurate scientific research, but unfortunately, they have not been conducted at this object. Therefore, during the subsequent restoration works on the facades of the Church in 2001-2002, a proven method with wax-varnish and pentaphtol filler was used.

Today, the general stable condition of the paintings is noted only in the interior of the monument. The condition of the external wall painting on both plaster and zinc basis is unsatisfactory. There is loss of binders, peeling, local loss and hard crackers with raised edges and the risk of falling (Fig. 4). As a result of application of experimental varnishes on a painting surface destruction of a covering layer in the form of a white plaque and considerable change of tone and color of the restoration toning having bad binding with a basis is observed (Fig. 5). The surface is covered with a layer of compacted dirt. There is a wavy deformation of the zinc base, its general depletion, corrosion and insignificant metal losses at the points of attachment to the wall surface.



Fig. 4. The state of painting on metal. Fragment of the eastern facade

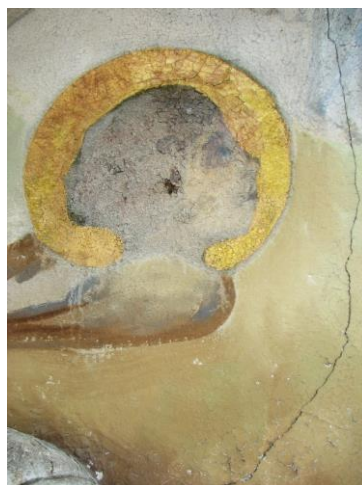


Fig. 5. Blushing of lacquer film and change of tone of restoration tinting. Fragment of the western facade

Conclusions

During the period of development of the restoration sphere, the materials and methods of application for conservation and restoration processes in monumental painting have changed, having been tested in different conditions on different monuments. The use of synthetic high molecular resins had both positive and negative consequences. Today, the issue of preservation and restoration of the external murals of the Trinity Gate Church has not lost relevance. The fact of lack of timely restoration, "natural aging" of materials, aggressive environment, anthropogenic and man-triggered factors led to the emergence of negative processes in the state of preservation of wall painting and its basis. Microbiological factors that affect the state of preservation of paintings should not be ruled out either [37, 38]. Under such conditions, the materials used in the restoration quickly age and break down, and painting requires re-intervention by specialists. The ability to simulate the conditions in which the object is located is limited and does not give a complete picture of the aging of materials [39, 40].

Today, in order to create a comprehensive restoration program, it is necessary to conduct new chemical and technological research related to the study of changes in the material structure of painting due to the action of restoration materials used in the past. Ensuring the protection of paintings from external climatic influences requires the improvement and implementation of new restoration methodological developments, taking into account their effectiveness and international experience. The question of the durability of the applied restoration materials for the preservation of already restored paintings becomes essential.

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