The Methods of Producing Decorative Samples Using the "Hot Enamel" Technology

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Abstract. The article presents the methods of creating decor samples using the technology of hot enamel of a certain color palette based on selected (suitable) materials. These methods allow expanding the artistic and aesthetic ways of obtaining works of applied art and design objects on the basis of color and interior design principles. Taking into account the functional requirements for the design of banquet halls, the interior space was modeled in the program ArchiCad 16 with implementation of decorative samples of hot enamel. The authors developed decorative samples (triptych composition) for decoration the interior space of the institution banquet hall.

1. Introduction
The highest technical characteristics of enameled coatings expand the range of their application. One can find them in a tunnel under the English Channel, in Moscow metro stations, in deep-water bathyscaphes or industrial and residential interiors.

Application of different enamels is of natural interest in the creative process of a designer. This is a whole world of comprehension of traditions and innovation, plasticity and functionalism. Taking into account the rapid development of enamel creativity, such a state of individualization of authors’ diversity plays a positive role in the evolutionary process of this unique material development.

The reasons why creators-designers of works are attracted by the multifaceted world of enamels are in its durability, the resistance of the paint layers to the light flux of sunlight. Thus, the outstanding artist and innovator of his time, Leonardo da Vinci, compared enamel painting with sculpture and noted that the advantage of sculpture is its stability in time, but a pictorial composition can be just as stable. If a piece of painting is executed on a thick copper plate covered with white glaze with enamel paints and then baked in a fire, then it can surpass the work of sculpture in eternity. If bronze sculpture is durable, then painting on enamel will be perpetual. Bronze sculpture becomes dark black-brown over time, and painting made in the technology of hot enamel retains its original brightness, tenderness, color rendering of the palette and a huge variety [3].

2. Main body
Interior decoration is usually created according to the established canons in accordance with the chosen style concept. The choice of suitable style is one of the first and most important stages in creating a harmonious interior. Then it is necessary to place the main emphasis, that is, to carry out the selection of interior items, lighting and color of the whole room.
The organization of the interior space of the banquet halls and the introduction of decorative compositions (or its elements) into it with the help of hot enamel technology with regional themes will create a favorable environment for aesthetics and inclusion to the nature of the Far East. Wood-base material, foam rubber, felt coverings give the rooms a home comfort. Currently, instead of claddings made of expensive wood and veneered surfaces, cladding materials based on synthetic resins are often used to decorate banquet halls. They are durable, elastic, waterproof and resistant to chemical attack, are very diverse in appearance and have a wide palette of all kinds of colors and shades. [1]

Decor items and accessories play the most important role in the designed interior, being, depending on their arrangement and appearance, a linking chain or a highlighted accent in the joint perception of the room organization. Correct development of color composition and proper materials remain one of the leading means of interior decoration.

Decor items for the interior of the banquet hall (compositions in the technology "hot enamel") should fit in with the concept and decorate the interior, drawing all attention. When creating hot enamels, it is the responsibility of the designer to arrange them harmoniously; it is necessary to find a precise place that defines their character and style. Under optimal conditions, a holistic, artistically expressive interior can be created. However, in all the cases, hot enamels always enhance the overall decorative effect. The contrasts of the color of enamel and the color of metals are enhanced by the color and ideological expressiveness of the created composition of the whole work. The shine and play of hot enamel, its shimmer when changing the angle of view, not only enliven, but also give some mobility and variability to the work.

The proposed premises for the institution banquet hall is located on the ground floor and is a part of the dining room, however, it is rebuilt as a separate room. The banquet hall hosts meetings of various levels: Russian, regional, intercity meetings, both official and unofficial.

The banquet hall has following dimensions 5.4 * 3.5 m, ceiling height 3.05 m; in total, the total area of the hall is 18.9 m². The room has one window, one entrance door, a figured ledge on the wall, made of chipboard. The capacity of the banquet hall is 14 seats. The color scheme of the room is presented in gray-blue tones. The window is located in the left corner of the hall, it is small, but faces the sunny side, what makes the room bright during the day. The main light source is a chandelier in the center of the ceiling, additional light sources are six lamps built into the ceiling, three on two far sides. Curtains, chair covers and some elements of the tablecloth are designed in dark blue.

The ArchiCad 16 program was used for interior modeling. Knowing the necessary dimensional characters of the room, we design the layout of the banquet hall. For interior decoration we use light colors, so that a small-sized room visually looks more spacious. We use wallpaper without any pattern in light and gray colors. To reveal the contrast of the figured ledge, we perform paneling with dark wood species. The front door and window frame are also made of wood, but a shade lighter than the panels. To maintain the color of the dark panel, we place a small open cupboard in the corner of the room, the same shade of wood as the curly panel in the wall. Furniture (table and chairs) is made of light-colored material, dark table and dark chairs make the room heavier, taking over all the space. The table has an elongated shape, but not wide - this is provided for more free space in the aisles of the room. Chairs are with a high back, the back of the chair and the seat are covered with soft light upholstery. The curtains are made in a light blue shade to the full height of the wall, which will visually raise the ceiling. Also, to increase the small space of the room, we mount a large flat mirror on a free wall near the entrance door - from floor to ceiling, which reflects most of the room and visually stretches the space. Since the mirror is located in the far corner, it does not pose a risk of injury. Having studied the requirements for banquet halls, we place a small table for napkins, dishes, vases for flowers. We put the table with a transparent glass top; the table legs are curly made of dark color to match the color of the panel and cabinet. Carpet as a floor covering is in light green tones. Ceiling color is light and matte. We leave the main lighting of the room in the central part of the room with a small chandelier. Additional lighting is placed on the ceiling above the decorative enamels and
in the opposite corner on the wall above the cabinet and the mirror, the reflection of light from the
mirror will interestingly play the room with light. (Figure 1)

![Figure 1. The model of the banquet hall interior.]

The composition of the work consists of three enamels, edged in wooden frames, which will
adequately decorate the interior of the banquet hall of any institution.

The theme of the works of hot enamels is the nature of the Far East, one of the most relevant in our
region. With the help of the completed samples of decorative elements, we will try to immerse in the
beauty of the Far Eastern nature through such a complex and interesting material as hot enamel.

The first stage of work in this direction was the compilation and selection of sketches. We were
inspired by the highly artistic work of the artist Gennady Dmitrievich Pavlishin, his huge mosaic
painting “The Poem of the Amur Region”, created from minerals with an area of 12 m² [4]. The choice
was made on the images of the Far Eastern animals, made in color (Figure 2).

![Figure 2. Color composition of sketches.]

Based on the projected premises, the samples for the triptych were composed of three vertical
pieces.

The next stage consisted of the direct development of a method for making samples using the hot
enamel technique. By the technical method of execution was chosen a variety called solid enamel.
This is the most accessible technique in the work with such complex material. Enamel powder is of
Russian manufacturer of the Dulevo paint plant. The technique of applying the powder is a brush on a
prepared copper plate without partitions.
The dimensions of the copper plates for work were chosen as 280 x 170 cm with an optimal thickness of 0.8-1.0 mm. These parameters are optimal for further baking products in a muffle furnace. In the model of the interior itself, the decor samples will be doubled.

To release the copper plates for enameling from internal stresses, the blanks were annealed and then given the desired shape. A rough surface is required for the best adhesion of the enamel coating. For this, frequent and shallow grooves were made on the surface of the plate using a graver (abrasive wheel). To enhance the roughness effect of the surface, the work samples were placed in a citric acid solution. After etching, the copper plates were washed with running water and acid residues were removed from the surfaces of the plates.

The next prerequisite in working with a sample is the preparation of a metal plate. Due to the fact that thin metal sheets were used in our case, the need for a double-sided coating is necessary in order to exclude bending and warping of the obtained samples due to the difference in the stresses that have arisen. Therefore, thin sheets of copper should be coated on both sides to resist deformation. [2]

For this, counter-enamel was applied to the reverse side of the copper plate and baked in a muffle furnace. This is necessary so that in the future, when baking from the front side of several layers of enamel, the copper plate does not deform and does not affect the final result of the work.

To prepare the enamel paints, the pieces were initially ground into powder in a steel mortar, breaking and periodically sieving the grinding through a sieve. The resulting relatively large pieces were used to incorporate the enamel layer into the base color. The finished enamel fraction was poured with clean water and stirred constantly. The process was repeated several times. However, cleanliness is especially necessary for clear enamels. Washing off opaque enamels can be completed when turbid water is obtained, which does not degrade the quality of obtaining the enamel surface of the sample. [6]

Final sketches are made at 1:1 scale in relation to copper plates. Using carbon paper, the contours of the images are transferred to the copper surface. Then the enamel powder was applied to the contour drawing, taking into account the selected color scheme. On the basis of the proposed color palette, one can create full-fledged artworks using the hot enamel technology for the designed interior. The selected palette best suits the solution of the set coloristic tasks, has sufficient aesthetic and technological properties for use as an enamel coating. In the process of preparing the samples, enamels of domestic manufacturers were used, the physicochemical composition of which allows for better adhesion to the metal surface. (Figure 3)

![Figure 3. Applying enamel to a copper plate](image)

Before the next baking, the applied enamel powder must be thoroughly dried, due to the fact that the liquid boils and evaporates at a high baking temperature. This may cause the enamel to chip off the metal substrate. To prevent this the samples prepared for baking were thoroughly dried. The optimal temperature for drying the enamel is 60-80 °C in order to avoid enamel boiling.
When baking samples in a muffle furnace, the optimal temperature was set in the range of 800-850°C, however, the enamel coatings turn into a fluid state already at a temperature of 800°C. In this regard, the time for heating the samples to the required temperature should be reduced.

By applying several layers of enamel, the results of previous baking can be corrected and specific color effects can be achieved due to the mutual penetration of these layers. (Figure 4, 5)

![Figure 4. Enamel application after the first baking.](image1)

![Figure 5. Correction of samples after the second baking.](image2)

For cooling after baking, the finished samples are removed from the stand and set out on a prepared asbestos plate, which slows down the cooling process and prevents deformation and warping of the enameled samples. This eliminates fragility and lagging of enamel layers.
Thus, enamel decor samples were prepared and manufactured with the account the functional requirements for the organization of the banquet hall interior.

3. Summary
As a result of the work the following conclusions can be drawn:
- the design of the banquet hall interior of the institution was modeled with account of the requirements for the organization of internal space in the ArchiCad 16 program;
- substantiation of the subject matter and methods of making decorative samples for a particular interior was made
- determined the color range for decor samples, materials with the account of the physical and chemical properties (pure copper, enamels of domestic production);
- the range of temperatures for baking samples has been determined;
- decorative samples were made in the technology of "hot enamel" of regional themes for the interior of the banquet hall.

4. References
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