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Technological Aspect of Art Enamelling Within the Study of Arts and Crafts

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Abstract: The study describes the main points of artistic enamelling techniques during the study of national culture heritage in the form of arts and crafts products. The study of technical and technological characteristics of material allows to research using not only the traditional methods of artistic enamelling but also to create products using non-traditional materials for art enamel which significantly expands the range of artistic means of modern art product creation.

Key words: Art enamel, enameling, metal art processing technology, decorative and applied arts, the history of arts and crafts

INTRODUCTION

The art of artistic enameling art presents a huge part in the history of arts and crafts. A significant contribution was made by Russian scientists, artists, the masters of arts and crafts, enamel products in the era of the "Russian style" have a special significance. The study of art enamel within the arts and crafts is necessary for the following groups of knowledge: historical, cultural, art study, technical, technological and others. Undoubtedly, all this knowledge is necessary to create enameled artistic products (Fig. 1). We will focus on one aspect of art enamel study a technological one (Vargin, 1958; Vereshchagina, 1994).

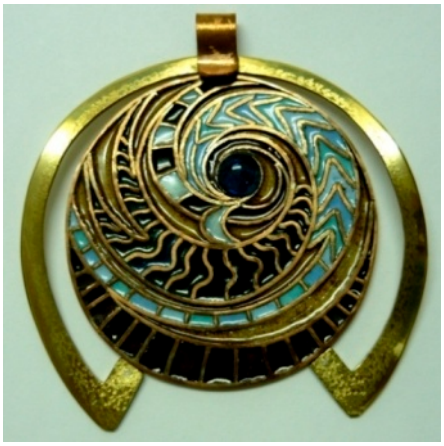

Fig. 1: I. Kapustina. "Third Eye" pendant, 2013. Copper, jewelry enamel (Head: candidate of pedagocial sciences Assoc. Professor, Gerasimova A.A)

Enamel composition: Learning the technological process of art enameling should be started with the basic points of jewelry enamel chemical composition as well as with the main components of enamel mass, called frit (Table 1 and 2).

The enamel base is a vitreous mass in which quartz is one of the main components. It is used as a pure sand, purified in a special way but at that the alloy has a number of impurities, particularly iron oxides. The resulting frit also has some impurities with other natural charge materials. The most active component of enamel which interact with each other in a melt are shown in Table 1 and 2.

The resulting substance of considered frit components is transparent and serves as the basis for transparent enamels. When you add it mufflers in it (Table 3) the transparency of enamel is decreased they are becoming opaque. This is the way of original material obtaining for opaque enamels. Silencing additives added in a transparent frit Silencing have other refraction values than a glass base.

Light passing through the enamel mass deviates irregularly, scattered and reflected. The greater the difference of main glass and muffler refractive values the greater the killing effect. The damping effect is increased with the increasing thickness of the enamel coating but the impact strength of coating is also reduced, internal stresses appear which affect the quality of enamel coating. Mufflers are not dissolved or dissolved partially in the process of burning in enamel (Sirotnikov, 2004).

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Table 1: Refractory raw materials for enamel production

Trade name	Chemical name	Influence on enamel properties
Quartz	Silica	Mechanical properties, compressive strength, elasticity and chemical resistance are improved
Feldspar: potassium, calcium, sodium	Aluminosilicate of: potassium, calcium, sodium	The impact of feldspars on enamel is determined by the properties of included oxides
Magnesite	Magnesium carbonate	Promotes the release of silencing, raises the melting point

Table 2: Low-melting components (flux)

Trade name	Chemical name	Influence on enamel properties	Trade name
Boric acid	Orthoboric acid	H_3BO_3	The most important glass former; lowers the surface tension
Borax	Tetraborate of sodium	$Na_2B_4O_7$	Improves mechanical properties, heat resistance
Soda	Potassium carbonate	Na_2CO_3	Improves gloss and melting; increases thermal expansion
Potash	Calcium carbonate	K_2CO_3	Makes an effect similar to soda but gives enamel a greater gloss
Calc-spar	Calcium carbonate	$CaCO_3$	Improves chemical resistance, increases melting temperature and elasticity; it contributes to killing
Barium carbonate	Barium carbonate	$BaCO_3$	Improves light refraction and bending strength
Red lead	Ortoplumbate of lead	Pb_3O_4	Acts as a universal flux for fusible enamels

Table 3: Silencers

Trade name	Chemical name	Chemical formula	Properties
Bone ash	Calcium phosphate, calcium carbonate	$3Ca(PO_4)_2$, $CaCO_3$	The muffler widely used before is superseded now by other materials
Tin dioxide	Tin dioxide	SnO_2	Causes killing as it is mostly insoluble in a melt; soluble particles are released again at cooling. The muffler is expensive therefore it is replaced by other substances
Rutile, anatase, brookite	Titanium dioxide	TiO_2	The 8% TiO_2 are soluble solid glass therefore killing is observed only at the introduction of TiO_2 10-18%. Increases shine, reduces elasticity
Zirconia	Zirconia	ZrO_2	Killing occurs due to the formation of basic silicates and zirconium aluminates. Improves brilliance and luminosity, reduces thermal expansion
Fluorspar, fluorite	Calcium fluoride	CaF_2	CaF_2 content should not be higher than 10%. Killing is performed due to CaF_2 and NaF release
Cryolite	Sodium aluminum fluoride	Na_3AlF_6	It is used for preliminary killing of light or white enamels

Modern enamel compositions used in artistic products: In the modern arts and crafts, along with jewelry enamels, the authors widely use technical or dish enamel, similar in composition to the art one but with a number of advantages and disadvantages. The main advantage is its low cost which allows to expand the range of products, their sizes, the methods for enamel mass application on a substrate and the variety of colors obtained by adding metal oxides (Fig. 2 and 3).

During the work with this enamel, a pre-primer must be applied on the product surface. The primer is needed for plate fixing which eliminates deformation when heated and to prevent the formation of oxides on the surface (Martirosov, 2009). The primer mass consists of quartz, fluorite, borax. All components are melted in a crucible, crushed after cooling and sieved through a sieve with a medium sized sieve. During manufacture, Silica, clay, borax and are added during manufacture and mixed with water to a paste state.

The composition of white enamel is the following one: fluorspar, zinc oxide, tin oxide, bone meal, shmaltin, borax, crystal soda, sodium nitrate. All this is melted and if necessary, a mixture of white clay, water and zinc oxide is added.

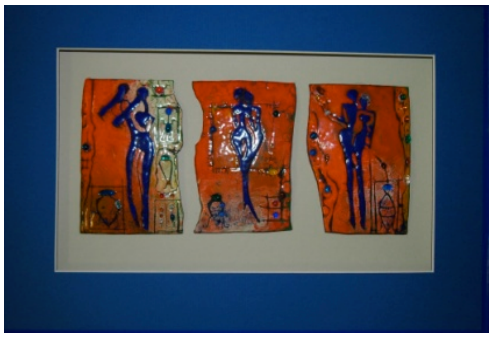

Fig. 2: Researcher N. Dolgova "Replica", 2014. Copper, glass and opaque enamel, mixed technology (Head: ped. science candidate Assoc. Professor, Gerasimova A.A.)

The prepared enamel substance is colored with the additives of different metal oxides-pigments (Table 4). It should be noted that:

- Transparent enamels consist of frit and ink additives (dye)
- Opaque colored enamels consist of frit, muffler and ink additives

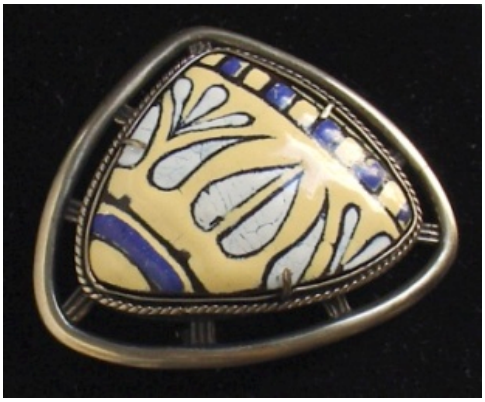

Fig. 3: Kasatova G.A. Brooch "Travel to Egypt". Melchior, copper, opaque technical enamel.2005

Table 5: The initial components of jewelry enamel

Jewelry enamel components	Percenatge
Quartz	34-55
Borax (boric acid)	0-12.5
Soda	3-8
Potash	1.5-11
Red lead	25-40
Fluorite	0-2.5
Cryolite	1-4
Potassium nitrate	0-2
Arsenic	0-4
Coloring oxides (oxides of copper, iron, cobalt, chromium, manganese)	0.1-5.0

- Opaque white enamel consists only of frit and white muffler
- Black enamel is related to colored enamel as it is obtained by the addition of dyes

When coloring oxides are mixed experimentally one may get an unlimited number of enamel colors used in arts and crafts. It is impossible to foresee many factors in the production of enamels because the interaction of their components in the melting process leads to different results and deviations. The composition of enamel depends on the set technological parameters, aesthetic and artistic needs of an artist. You must provide an original formulation of jewelry enamels. It provides the ratio of the main components, reflected in Table 5.

CONCLUSION

The presented material shows that the use of technical enamel in art is reasonable primarily by economic indicators it has low cost which is beneficial in enamel art teaching; this enamel is more resistant to adverse environmental influences during the process of product manufacture. By technical characteristics, it is not inferior to the jewelry enamel. Technical enamel is inferior only to the decorative qualities the absence of gloss on a product surface. An example of technical enamel application in products is presented on Fig. 2 and 3.

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