

MAKING PORCELAIN SUNDIALS

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The porcelain artistic technique is too sophisticated to be widely used for making sundials. In this article we are very glad to share our experience with BSS *Bulletin* readers. Elena has developed the subject of the image and has made the main part of work. Aleksandr has delineated the dial and has written this text. He was extremely happy when ordered to make other casual work of the kind. The text enclosed in quotes is Elena's direct speech.

Making the slurry

Granulated porcelain imported from the renown region of Limoges (France) was dissolved in water and mixed carefully together with softeners that help to maintain the proper rheological features of the slurry. As a softener we used a mixture of sodium hydroxide, liquid glass and liquid ammonia. The total weight of softeners should not exceed the level of 0.4% and the percentage of water should be in a range 30-35%. The proper slurry should be homogeneous and should not be sedimented when storing.

Casting pottery in a mould

The pottery which we produce results from casting the slurry into a mould. The mould is a 3D mirror image of the resulting product. Commonly, a mould consists of three or more parts. But the form of a round dial is very simple and we have used a mould consisting of only two parts: an up-



Fig. 1. Mould with two funnel-shaped holes.

per and a lower, the upper one having two funnel-shaped holes for the slurry to flow into the mould (Fig. 1).

The pottery properties depend on the mould's suction capacity. We have made the mould in gypsum (plaster of Paris) that absorbs a part of the water, the solid fraction of the porcelain slurry being deposited onto the inner mould surface.

After the two parts of the mould are separated, the pottery ('greenware') is finally dried. When drying, in order to prevent the pottery cracking and distorting, we wrapped it in paper. The surface of the dried pottery is covered with very small pores and spots. We polished the surface with a sponge and a soft brush made of squirrel fur. Now everything is ready to make a scientific instrument and then to turn it into a piece of art.



Fig. 2. Transferring the dial drawing.

Scientific instrument

We have made a dial drawing calculated for the Moscow geographic coordinates and, with a pointed nail, transferred it onto the pottery surface (Fig. 2). Then, using a small sharp chisel, we have cut out the V-profile figures. The edges of V-profiles reflect and refract the rays in the best way. The figures will be visible from afar.

In order to make the gnomon we used the same method as described above. We have moulded a pottery slab, drawn the outline of the gnomon on it and cut it out (Fig. 3). We were eager to supplement it with nodus but we had to reject this idea because we needed the space on the dial plate for our experiments.

At this point we consider that the scientific features of the sundial are defined and we may start with the following



Fig. 3. Elena cuts out the gnomon.

stages: modelling, painting, firing and enamelling. All these stages are very laborious. It would be a disaster to have to remake the whole sundial simply because we had made a mistake in transferring the dial drawing onto the pottery. All the figures and lines should be checked carefully before we proceed with our work (Fig. 4).

Subject of the image

Elena writes:

"I draw sketches only rarely. I prefer to make sketches in my mind, improving them in the course of work and trying to obey the brush. The main matter is to start with work. I like to work with 'inspired rhythm' which means to me a combination of strength, proficiency, vivid sensation, generosity and equilibrium between art and nature."

"Two worlds, the earthly and celestial, are united in a sundial. I think that there is no more suitable subject to express the universe in a small object as a sundial. Unlike physicists and philosophers, I am freer to chose the method of analysis. I think that a sundial is the best subject to realize the entity of time by means of the artistic method."

"Time is probably the happiness to see stars through a grapevine and the vine connects the two united worlds. "I am the true vine" [John, 15(1)]. I have decided to create a 'grapevine river of life' which represents the entire universe and gives life to all living things."



Fig. 4 (top). The last examination before turning the pottery into the porcelain dial.

Fig. 5 (bottom). The 'grapevine river' made in porcelain paste.

Modelling and painting

For the modelling we use a porcelain paste. We put a small amount of slurry on a gypsum slab, dry it for a few minutes and then knead it until it does not stick to the hands. With this paste we have prepared the leaves and the bunches of grapes. Then, using the slurry, we have stuck them step by step onto the dial surface trying to produce the 'river of life' comprising the entire universe (Fig. 5).

"Now it is time to make a decision on the gnomon. We can measure time but we do not really understand what it is



Fig. 8 (above). The first stage of painting (unfired).



Fig. 6 (right). The gnomon should be very simple.

Fig. 10 (below). The final product with the 'Grapevine river of life'.





Fig. 7. A butterfly as a central feature of the composition.

that we measure. Time is just a philosophical abstraction. So let this abstraction be very simple and let it be devoid of decoration.” (See Fig. 6.)

“Having installed the gnomon on the dial, I found that its architectural domination broke the composition of the ‘grapevine river’. In order to resolve this problem, an additional local centre was created. I think that a butterfly can serve as a sort of the local centre (Fig. 7). First, I love butterflies very much and, secondly, I believe that the butterfly, judging just from its appearance, denies Darwin’s theory of natural selection. My co-author Dr Boldyrev (PhD in biology) thinks that he is a convinced Darwinist but I must not take his private opinion into account.”

Painting

The paints (glazes) we use are oxides and salts of cobalt, nickel, chromium, titanium, iron and gold. The shades of colour depend on the concentration of the compound, the thickness of the colouring layer and on the firing conditions. To achieve the additive effect we usually mix the paints or apply them layer by layer. The final colour of such a mixture is not predictable to a high degree of accuracy. But the properties of pure compounds are well known. For example, the salts of nickel give a shade of beige. The compounds of chromium give shades of green. The neutral solution of nitrohydrochloric gold gives very nice rose colour. Fig. 8 shows how the dial looks after the first layer of paint is applied.

Firing, enamelling and gilding

As a rule, no fewer than four firings are required. The first



Fig. 9. The enamelled dial is ready for firing in a kiln.

of them is the initial stage of turning a pottery into a porcelain piece of art. Its aim is to eliminate the combined water and dissolved and trapped gases which tend to form hard and unattractive globules on the pottery surface. Globules can spoil the whole thing as it is very difficult matter to remove them with a hand diamond cutter. All gases are considered to be removed by temperatures in the range 800 – 1000 C.

Firing shrinks the size of a pottery in a range of 15–18%. The shrinkage is equal in all directions inside the porcelain body. Hence we were convinced that firing does not affect the relative positioning of the lines that form the dial.

Before the second firing, we have applied on the dial surface a thin layer of enamel with the help of an airbrush. Enamel consists of the same substances as a pottery but its structure is slightly different. In the course of firing at the temperature 1230 C, the enamel and the pottery turn into a single whole due to the similarity of the structures. Fig. 9 shows the dial covered with enamel and ready for firing in a kiln.

After the second firing, the co-authors disagreed on the way this piece of art should be advanced. Aleksandr was completely satisfied with the result and proposed naming the sundial ‘The Grape Galaxy’ and to sell it as quickly as possible. Elena was of opinion that only one third of the work was completed and that she could not allow “sticking anybody’s nose” into her business.

As a result, we have agreed that the rim of the dial plate, the narrow edges of the gnomon and the EoT diagram looked rather inexpressive and should be enriched with gold. Elena mixed powdered gold with a flux and, with a very small brush made from the fur of a Siberian weasel, applied this paint onto the dial. Thus the gold paint is applied right on the enamel surface. In order to fix the gold on it we have to make a third firing at the low temperature of 750 C. The flux serves as a combustible flux that allows the penetration

of the gold into the enamel. It is important to maintain the temperature accurately at 750 C: at lower temperatures the flux does not burn away and at the higher temperature the gold fades.

After this third firing, Elena decided to draw the wavy gold lines on the noble-greyish border that encircles the south part of the dial and turns into the hour marks on the north part of it. It was very dangerous decision as the previous gold paintings might have faded away during the fourth firing. But the risk was taken to achieve the ‘inspired rhythm’. The final results are shown in Fig. 10.

As far as we know, we have made the first porcelain sundial in Russia. We will probably make another porcelain sundial and we would be happy to receive any information on our forerunners and on porcelain sundials from all over the world.

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