Interpretations of ancient technologies in personal art

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Abstract: *The theoretical basis of my project is not based solely on hypotheses, but also on assumptions, as well as on what I really know about pottery making, based on chemical analyzes, as well as previous experimental approaches.The purpose of this project is to reconstruct the operational sequence for the manufacture of ceramics, from the purchase of clay to the burning in a reconstructed furnace. In addition to burning 78 replicas of Greek culture vessels, the experiment revealed data on loading and setting the ancient kilns. The experiment showed that the ceramic produced from local clay (Dobrogea) does not require a combustion temperature greater than 950-1000 ° C, with a burning time of 14-15 hours. As some researchers have already shown, a higher temperature and a prolonged burning time can have negative effects on clay.*

Key-words: *kiln; clay; experiment; combustion; oxidizing; temperature.*

1. Introduction

Starting from a controversial subject, which is interpreted both as a drawback and as a potential trace of the techniques used - that is, the lack of kilns discoveries in the archaeological excavations in Dobrogea - I proceeded to identify an analogy consulting the specialized literature on how the hypothetical establishment of the reaching the technical parameters imposed by the type of studied artefacts. The identification of both an adequate operating principle and a model kiln, which was in line with the requirements imposed by the characteristics of the studied artefacts, was made in the court of the Constanta Branch of The Visual Artists' Union of Romania. Through this replica, I managed to analyze a number of technical aspects and to appreciate the complexity of the different characteristics of the furnace: the heart, the combustion chamber, the grill, as well as the chimney for the evacuation of gas and smoke. In order to obtain the most accurate reference for the intended experiment, I also drew attention to the technical details.

2. Objectives

The purpose of the experiment was to build a furnace that could replicate the necessary conditions to create the red chromatic effect on the surface of the test pieces made from local clay. My main concerns were that the procedure used is efficient and should not require special laboratory conditions or involve materials or actions that were technically beyond the period studied. The results were recorded and measured with modern equipment, this being the only intrusion of the current technology in the experimental work.

3. Material and Methods

The kiln is composed of two chambers: one with a supply tunnel and the other with a vertical outlet for the elimination of gas. This opening, at the top, guarantees the hot air circulation from the combustion chamber to the chamber where the vessels are placed. The first element

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that was built was the hearth, dug into the ground at a depth of 40 cm, in the form of a circle with a diameter of 140 cm and a height of 70 cm, as shown in Figure 1 and Figure 2. The wall of the combustion chamber was raised above the ground at about 30 cm and had a thickness of 26 cm at the lower point, the total size of the oven being 2.50 m.

Fig. 1. *Construction of an archaic bicameral brick oven*

Fig. 2. *Work steps for the construction of the oven.*

From the wall of the combustion chamber were made stands to sustain the perforated plate of tiles that separate the two chambers of the furnace, the thickness of the wall remaining the same. Under experimental conditions, I chose to build a bicameral type kiln, because its operating principles allow fine control of air temperature and combustion. Therefore, I partly used the space for arranging the vessels in the combustion chamber.

The clay, obtained from a local quarry (Medgidia), was mixed with water, river sand and added to bond the bricks. In the front part, the oven was extended with a supply tunnel, with a length of 35 cm and a width of 50 cm (Figure 3 and Figure 4); the thickness of its wall is similar to that of the base of the oven, that is, 26 cm. The chimney has been designed to allow the gas and smoke to escape during combustion, but also to facilitate the blocking of circulation for controlling the combustion atmosphere and temperature. Designed as a moving part of the combustion chamber, the experimental furnace was allowed to be used for burning vessels of varying diameters and heights. The oven has been gradually dried for two weeks, away from inadequate atmospheric conditions, such as direct sunlight and rain.

A notable feature of the local pottery is that some artefacts indicate a production process that involves pressing the clay in precast moulds (concave), while others were made using the wrapping technique. Therefore, in my experiment, some vessels were made by using manual pressing techniques for the bottom of the vessel and windings for its top, while other vessels were constructed using the mould pressing method. All the pieces conformed typologically to the original vessels, namely the biconic bowls and the amphorae.

Fig. 3. *Work steps for the construction of the furnace*

Fig. 4. *Work steps for the construction of the furnace, combustion chamber*

The surfaces of the experimental vessels were treated in different ways. Mainly, they were smoothed with water and then polished with a stone. For the surface of other vessels, I used wooden tools to remove imperfections, and the surfaces were smoothed with water, using circular motions. The pots I made for this experiment can be seen in the photos below in Figure 5, Figure 6 and Figure 7.

Fig. 5. *Preparation of works for burning*

Fig. 6. *Works for burning*

Fig. 7. *Works for burning*

After drying, the dishes were placed from the bottom up on the perforated plate.

An important step was the firing of the furnace and a long burning, a process that provided information on how to control and maintain the temperature, as well as the essential data regarding the burning of vessels of different sizes and the processes of reduction and oxidation atmosphere, essential determinants of the Greek ceramic style.

The combustion took place in 15 and a half hours; the temperature rise was made gradually and was constantly recorded by an electronic thermoregulator.

In the first hour, the temperature increased slowly and did not exceed 100 ° C. After another hour and a half, the increasing temperature inside the oven doubled, and the dishes began to change their colour. At the same time, small cracks appeared when joining the bricks; these were caused not only by the contraction that appears with the internal vitrification, but also by the high temperature inside the combustion chamber. After three hours, a temperature of 350 ° C was reached.

During the last hour of combustion, after a continuous supply, the desired temperature of 1000 ° C was reached and kept for an additional 30 minutes (soaking time) before stopping the fuel supply (Figure 8 and Figure 9). In fact, the plant could have reached temperatures higher than 1000 ° C, as it was very efficient, but the parameters of the experiment required this lower limit. The slow and prolonged cooling of the oven over a period of 16 hours guarantees the recovery of the vessels in an almost perfect condition.

Fig. 8. *Burning, about 1000^{o}C.*

Fig. 9. *Burning, about 1000^o C.*

6. Results and Discussions

The experimental results obtained can be used to establish general principles regarding the production of ancient ceramics in Dobrogea.

The experiment showed that the ceramic produced from local clay (Dobrogea) does not require a combustion temperature greater than 950-1000 ° C, with a burning time of 14-15 hours (Figure 10 and Figure 11). As some researchers have already shown, a higher temperature and a prolonged burning time can have negative effects on clay.

Regarding the surface of the vessels created experimentally, it can be stated that any treatment of the vessels had no influence on the decoration used or on the colour of the vessels, the intense polishing before burning, which increases the shades of red and makes the vessels impervious.

Fig. 10. *Works after completion of the combustion process*

Fig. 11. *Works after completion of the combustion process*

7. Conclusions

As expected, for an oxidizing combustion around 1000˚C, even if the raw material comes from different sources, there are no visible colour differences from one sample to another. The different shades of red were the result of the raw materials used, because it is known that the clay used in the production of ceramics has different qualities, depending on the composition and the mineralogical characteristics.

It should be noted that the surfaces of the vessels exposed to the oxidation burn did not obtain a uniform red-brick hue. This aspect was related to the positioning of the vessels in the combustion chamber and their direct contact with the flame.

The graphical representation of both the combustion atmosphere and the temperature distribution in the combustion chamber during the 15 and half hours provides a perspective on how the operation has actually progressed.

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