Combustion plant – experiment

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Abstract: *In this experiment I tried to make an oxidizing combustion, building a kiln with clay from the Medgidia and Cobadin quarries, and I was going to burn pots made especially for this purpose in it. The main objective of the reconstruction of this experiment was the repetition of the previous experiments from Mangalia, respectively obtaining an oxidized burnt ceramic, but in an enclosure made of clay mixed with chamotte with a granulation between 0-7 mm and adding a quantity of zinc oxide to give the combustion plant a resistance to thermal shock. The experiment shows that it is difficult to build an oven to guarantee a successful combustion. However, it should be noted that, once fully charged and lit, no potter could control all the processes that take place inside the oven.*

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

1. Introduction

From traditional to avant-garde art, new production procedures have explosively energized the ancient art of ceramic: digital technologies, mixed-media, multimedia, 3D printing but also "author" techniques, invented by artists for new materials and chemical processes, unique, gives the ceramic field an accentuated experimental dimension, highly diversified and increasingly personalized. The freedom to try everything, the interdisciplinarity, the transfer between modern and postmodern artistic techniques and currents explosively mark this art of clay, sandstone, tiles and porcelain, in the field of which concept and historic ceramics, ceramics-installation and sculptures can be discovered, experimentalist and culturally quoted ceramics, combined in the most diverse and inventive ways.

2. Objectives

The purpose of the experiment was to obtain an oxidizing combustion, using a vertical kiln. The main objective of the reconstruction was to obtain an oxidized burnt ceramic, in an enclosure constructed of clay mixed with sand and chamotte with a granulation between 0-7 mm.

3. Material and Methods

The modelling was done using the technique of overlapping strings that were fixed by hammering them with a small wooden paddle.
The shape of the oven was inspired by the amphorae of the Greek era, discovered on the territory of Dobrogea, with a diameter of 50 cm and a height of 1,60 m, as you can see in Figure 1.

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Fig. 1. *Combustion plant, chamotte clay*

The pots used in the experiment were made by direct modelling by hand, of the same type of clay, used also for the construction of the oven, but also from different ceramic pastes obtained from Dobrujan quarries. The modelling was done using the same technique used in the construction of the oven, the technique of overlapping strings that were fixed by hammering them with a small wooden paddle.

The oven is a circular structure with two compartments: the lower one, where the fuel is burned, and the upper one, where the ceramic is placed. The two compartments are separated by a perforated floor, which allows the heat to move into the upper compartment, as shown in Figure 2.

Fig. 2. *Perforated floor*

An important step was the ignition of the furnace and the long burning, process that provided information on how to control and maintain the temperature. I also obtained 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 started slowly, placing the fire outside the combustion plant, as shown in Figure 3. After about two hours, the fire was also introduced inside the oven, Figure 4 and Figure 5.

Fig. 3. Burning

Fig. 4. Burning stages

Fig. 5. Burning stages

4. Results and Discussions

Although in this experiment I paid particular attention to the combustion process, when I reached temperatures of 400 ° C, cracks began to appear on the combustion chamber and the fireplace.

In any case, after eight hours, the maximum temperature did not exceed 600 ° C (Figure 6.), fact attributed to the construction of the oven; the wall thickness did not exceed 3.5 cm. The cooling was done slowly in about three hours, in order not to cause thermal shock to the combustion plant. After the fire was extinguished and the combustion process was completed, the temperature dropped controlled to 200 ° C.

Fig. 6. *Burning stages, about 600^{o} C.*

5. Conclusions

The experiment was conducted to find how good is the function of the furnace that was made of clay with a wall thickness of 3, 5 cm. At the beginning of the experiment, several points had to be considered: the combustion process, the durability of the kiln and the behaviour of the fire. This kiln has been designed to burn ceramic, using approximately 600 kg of wood as fuel.

Before starting the combustion, the oven should be completely dry, so as not to prevent the absorption of heat during the combustion and to not produce a heat shock.

The result of the combustion was a negative one, because during the combustion process quite large cracks appeared on the wall of the furnace, causing a significant loss of temperature.

It can be concluded that the design of furnace was not done correctly and so the furnace could not function according to the operational standard of the traditional ceramic oven. The standard temperature of a traditional oven is about 800 ° C, which did not happen in this experiment where I reached a maximum temperature of 600 ° C. The fuel, estimated at about 0.6 tonnes, was acacia wood.

If we do a simple analysis of the wall of the furnace and the burnt dishes inside, we notice that we have not reached an optimum combustion temperature, the inside has a light brown colour and on the outside we see a gray colour, as you can see in Figure 7 and Figure 8.

Fig. 7. *Partial burning of the clay*

Fig. 8. *Different colours of the clay*

The experiment shows that it is difficult to build an kiln to guarantee a successful combustion. However, it should be noted that, once fully charged and lit, no potter could control all the processes that take place inside the kiln (Figure 9).

Fig. 9. *Objects burned in the kiln*

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