ANALYSIS OF THE PRODUCT OBTAINED ON GLAZING A BODY CONTAINING KAOLIN TAILINGS AND CLAY FROM THE MUNICIPALITY OF BENTO FERNANDES (RN)

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ABSTRACT

Researches related to environmental impacts were able to increase the range of risk caused by the continuous production of modern industries. The socio-environmental sustainability-focused issue stands out in recent years as the main factor of change in the behaviour of Governments regarding their policies. One of the great challenges that every industry has to address is the issue of waste management. Every year, tons of economically unprofitable substances are dumped in inappropriate places or simply left outdoors, causing an imbalance in local entropy. In mining, it is possible to verify a large predation resulting from the production process, as well as huge amounts of waste material. In the kaolin processing industry, the tailings, consisting basically of kaolinite in addition to other oxides, are found in this context as a material to be reused, and its incorporation into clays could lead to an economically viable material for construction. This work presents the study of glazing on the product resulting from the incorporation of kaolin into clay from the municipality of Bento Fernandes (RN). The influence of the

variation of Fe_2O_3 content on the colouring of the ceramic mass was analysed by X-ray diffraction (XRD). We also analysed water absorption, linear shrinkage and density of the sintered materials, which were fired at temperatures of 1050 C, 1100º C, 1150º C and 1200° C. The results show that the waste can be incorporated as a raw material for use in the ceramic and porcelain flooring industry. For the temperature range studied, it was possible to observe that the glaze surface had good adhesion to the body, and the mechanical properties of the final product improved.

1. INTRODUCTION

In a survey conducted by the Foundation to Support Education and the Technological Development of Rio Grande do Norte - FUNCERN through the Project Industrial Profile (update) of Structural Ceramics of Rio Grande do Norte, it was observed that 38% of the deposits visited sold products from other member states, 20% did not sell tiles, 8% preferred the flagstones outside, and 4% did not sell native bricks.

Everything leads us to believe that it is necessary to supply a more demanding market segment, which demands differentiated products, with products that display the best properties. Changes in culture and behaviour such as those observed in recent years, make builders, who are the main consumers of products such as tiles and bricks, require manufacturers to have certificates of product quality, thus contributing greatly to the quality improvement process in the civil construction industry.

As described above, it becomes necessary to develop studies in the production chain, starting with the obtainment of the raw material, through the preparation of ceramic mass, to the finished product. The preparation of the ceramic mass often requires the inclusion of new raw materials with the main objective of improving the properties of the final product. This approach also allows us to target the many wastes from industry.

The glaze or enamel acquires, after sintering, a glassy aspect that contributes to the aesthetic and hygienic aspects, also improving the mechanical property.

The glaze can be prepared raw, with frits or mixed. The raw glaze, used for sintering at higher temperatures (usually above 1200oC) is prepared with a mixture of raw materials that help to form glass, such as feldspar, quartz, calcite, kaolin, etc. The glaze can be applied on ceramic object in different ways, which depend on the shape, size, quantity, including also the effects to be obtained in the surface gloss.

The objective of this work is to study the possibility of glazing the product of the incorporation of kaolin waste in ceramic masses for the future production of stoneware tiles, using as a basis the clay from the municipality of Bento Fernandes (RN).

2. MATERIALS AND METHODS

To conduct this work, kaolin waste was used, obtained between the municipalities of Equador-RN and Junco-RN and clay samples collected from the margins of the Stream Barreto, one of the tributaries of the river Ceara-Mirim located in the city of Bento Fernandes-RN. Glaze was also used, prepared with a mixture of raw materials: feldspar, quartz, calcite, kaolin, etc.

The clay used was dried in the open air and then placed in an oven at a temperature of 110°C for 24 hours. Subsequently, the comminution of the clay clods was manually performed, followed by the sieving at mesh 80; the material was then wrapped in plastic bags to prevent contamination. The waste was subjected to the same screening process. The methodology employed was performed according to the flow chart shown in Figure 1.

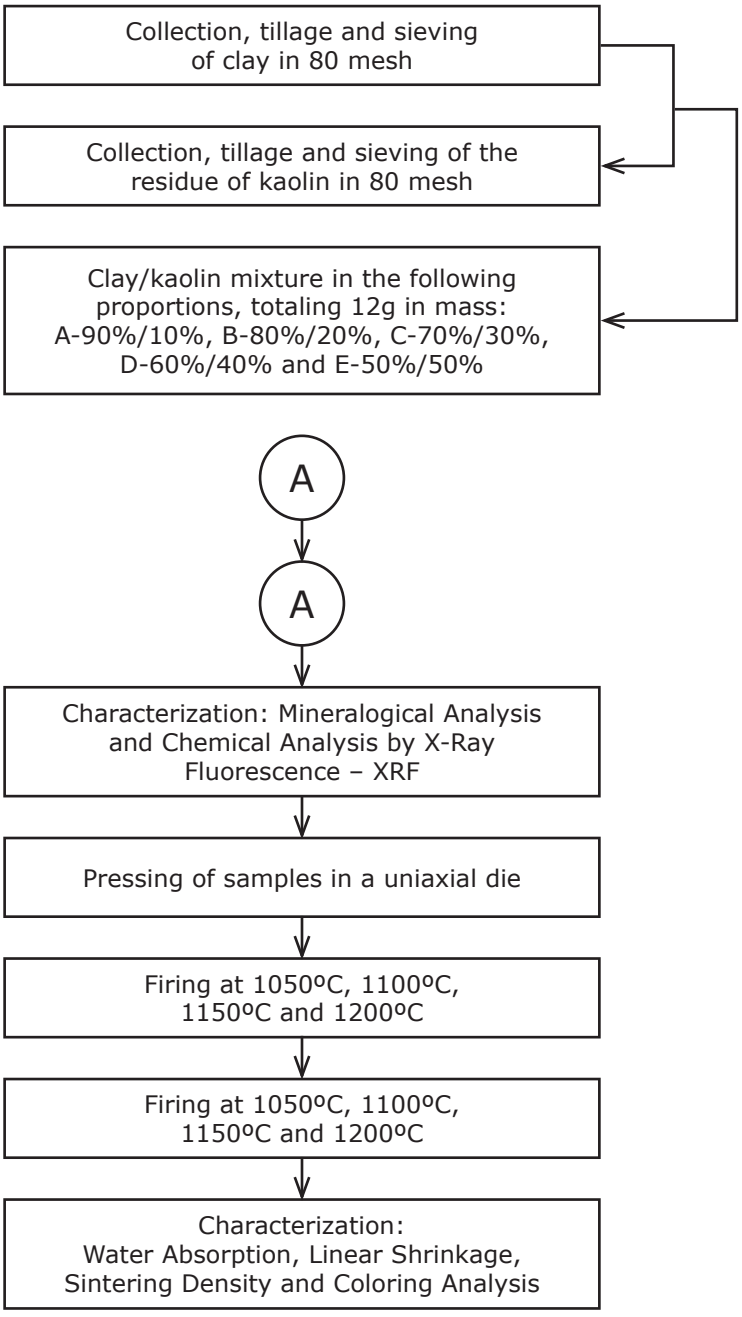

Figure 1. Generic processing Flowchart of the clay.

Chemical analysis was performed by means of X-ray fluorescence spectroscopy (EDX), and the results are presented as percentages of oxides present. The combination of different proportions of waste and clay were mixed and homogenized, using a precision scale for measuring percentages by mass.

For the preparation of test specimens, the formulations, even in the form of dispersed powder, were separated into small bags of material equivalent to 12g. They then had high humidity to 10% by mass in order to acquire consistency in the pressing process. The corresponding test specimens were uniaxially pressed in a rectangular shape, with dimensions of 60mm x 20mm x 5mm. Three specimens were made for each composition. After moulding, the green samples were bunched at the top surface and after 24 hours put into the furnace for firing. The sintering process was carried out in an electric furnace in groups of 15 samples for each temperature. Each composition was treated at temperatures of 1050ºC, 1100ºC, 1150ºC and 1200ºC. The heating rate was 10°C/min.

After sintering, the samples were subjected to tests to determine their physical and chemical properties, including specific bulk density, linear shrinkage, water absorption, visual analysis of colours and three-point bending strength.

3. RESULTS AND DISCUSSION

Table 1 details the XRF chemical analysis of Bento Fernandes clay and Figure 2, its Chemical Composition analysis.

SiO_2	53.423%
Al_2O_3	21.781%
Fe_2O_3	11.979%
K_2O	4.389%
MgO	3.390%
CaO	2.566%
TiO_2	1.307%
BaO	0.486%
SO_3	0.286%
MnO	0.255%
P_2O_5	0.139%

Table 1. Chemical Composition of the clay from Bento Fernandes-RN (% by weight).

Figure 2 shows the powder diffractogram of clay, highlighting the main elements present in the clay, which were: minerals responsible for formation of product structure (quartz), minerals responsible for plasticity, surface finishing, and green and dry strength (the clay minerals - illite) and the fluxing agents, responsible for strength after firing (feldspar - $NaAlSi_3O_8$ and mica - $KAl_2(AlSi_3O_{10})(OH)_8$).

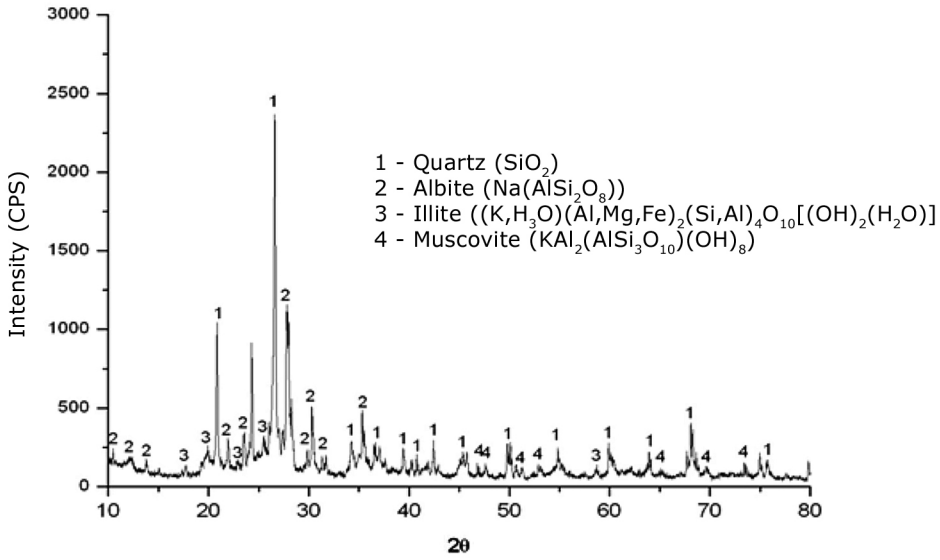

Figure 2. Shows the X-ray powder diffractogram of Bento Fernandes clay.

Figure 3 shows the result of water absorption as a function of composition.

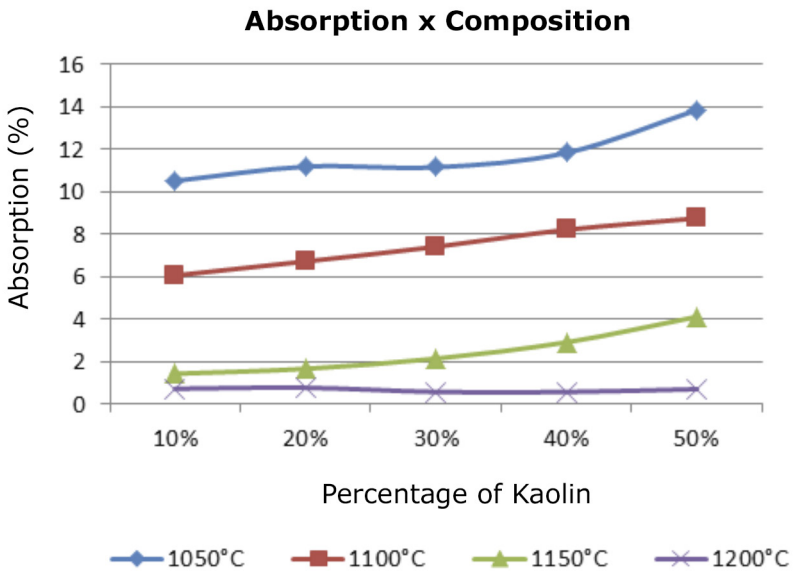

Figure 3. Water Absorption.

There is a greater water absorption at lower temperatures, and an equal increase of absorption at higher values of kaolin. Only at 1200ºC was a decrease observed in water absorption at values above 20% waste.

In Figure 4, we can observe the results related to the density of the sintered ceramic versus its composition. We can observe that at lower temperatures – between 1050ºC and 1100ºC – there is a slight drop in density of samples up to 40%. From this point on, it increases. At a temperature of 1150ºC there is a reduction in density in all the compositions. Then, at a temperature of 1200°C, from 30% it is possible to verify a significant increase in sample density.

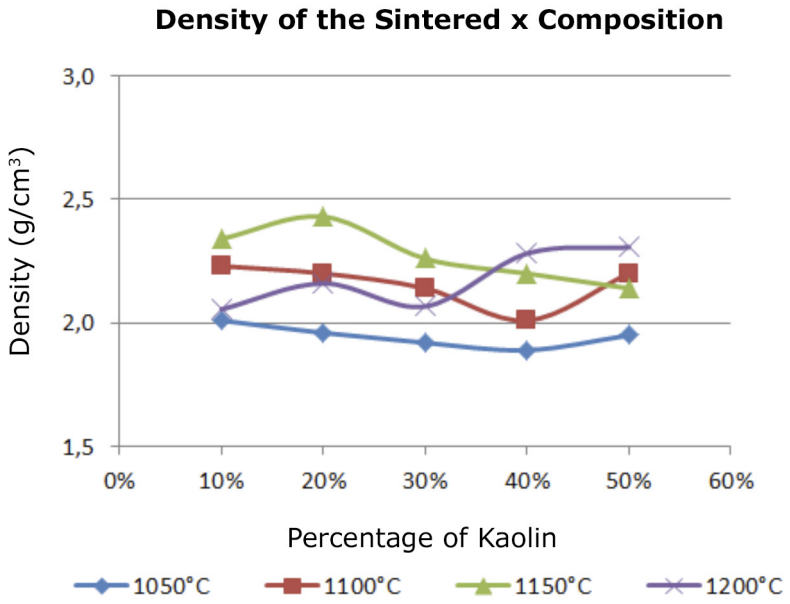

Figure 4. Sample density after firing.

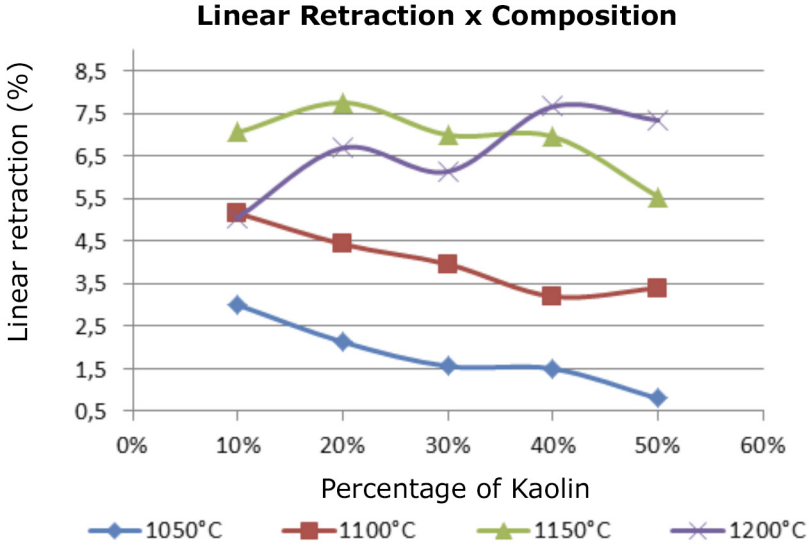

Figure 5. Linear Shrinkage of the sintered samples.

As was expected, the biscuit suffered greater linear shrinkage at higher temperatures, and smaller shrinkage at lower temperature. However, the group sintered at 1200°C only presented higher values, in relation to 1150ºC, from 30% of kaolin wastes in its composition.

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