THE INCLUSION ANALYSIS OF KAOLIN WASTE ON THE CLAY PROPERTIES OF BENTO FERNANDES CITY - RN

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Abstract. The clays are found in a nature state of relative purity or associated with various materials and may acquire, in this case, properties and specific names. Because of the growing advancement of the construction industry in the state of Rio Grande do Norte a great interest in the use of clays for the production of ceramic products with ever improving quality has been verified. Such clays must meet a series of specifications defined by its probable use, to require both the technical characterization of raw materials. This paper presents a series of physical and mechanical properties before and after firing the clay from the region of Bento Fernandes´s city (RN), which are influenced by the addition of kaolin residue in its mass. Was analyzed by x-ray diffraction and fluorescence spectroscopy x-ray, the influence of variation in the content of Fe2O3 ceramic on the coloration, besides the test of linear retraction, absorption and density of the sintered or burned at temperatures of 800ºC, 900° C and 1000° C. The burning of the ceramic body resulted in a variety of ranges from reddish hues, resulting in the amount of iron oxide found. The product after firing resulted in a low water absorption, demonstrating the technological potential of the clay of the region to produce high quality ceramic materials.

Keywords: Clay, Properties, iron oxide, Bento Fernandes.

1. INTRODUCTION

In the last years the construction industry has required products with superior quality every time, especially in terms of mechanical properties, and the Rio Grande do Norte region is the ten largest domestic producers of non-structural ceramic refractory for construction, being a major supplier of tiles and bricks in the regional market, with 138 productive units and employed 3,028 people in 2006, formally established in the market (Carvalho, 2006). The main factor for the large amount of red ceramic industries in this region, is the abundance of the main raw material: clay. However, this type of material requires a detailed characterization study to establish which processing to be adopted, and under what conditions we obtain the desired final properties (Dutra, RPS2006).

In a survey conducted by the Foundation for Support of Education and Technological Development of Rio Grande do Norte – FUNCERN through the Project Profile Industrial (update) of Structural Ceramic of Rio Grande do Norte Region was verified that 38% of deposits that were visited were selling products from other states, 20% did not sell tiles of this region , 8% preferred the tiles outside, and 4% were not selling bricks natives. Everything suggests that to meet a more demanding market segment and that demand differentiated products with better properties. Changes in culture and behavior as those observed in last years, makes builders that are the main consumers of products such as tiles and bricks began to require manufacturers of quality certificates for products contributing enough to the process of continuous quality in the construction industry. As described above, it becomes necessary to develop studies in the chain from the acquisition of raw materials, through preparation of ceramic mass to the finished product. The preparation of ceramic mass often requires the inclusion of new raw materials with the main objective of improving the properties of the final product. This method also allows the destination to the many wastes from industry. This study aims to verify the physical and mechanical properties of the inclusion of kaolin residual on the clay from the Bento Fernandes region from Rio Grande do Norte rovince in Brazil to use as a structural element (WALLS CLOSING) of high performance.

2. MATERIALS AND METHODS

The clay sample was collected on the Riacho Barreto´s banks one of tributary of the Ceara Mirim River in the city of Bento Fernandes-RN. The raw material was dried outdoors and then placed in an oven at a temperature of 110 ° C for 24 hours. Later, were the comminuting of lumps of on the clay through of manual process, and then made the screening process on 80 mesh sieve. The particles bystanders in this sieve were stored in plastic bags to avoid contamination and then used in the characterization tests. The kaolin waste was obtained between the cities of Equador, RN and Junco, PB BRAZIL. the same screening process on 80 mesh sieve, the material used in the passing of the ceramic mass composition.

The methodology for the development of the work was performed according to the flow diagram in Figure 1.

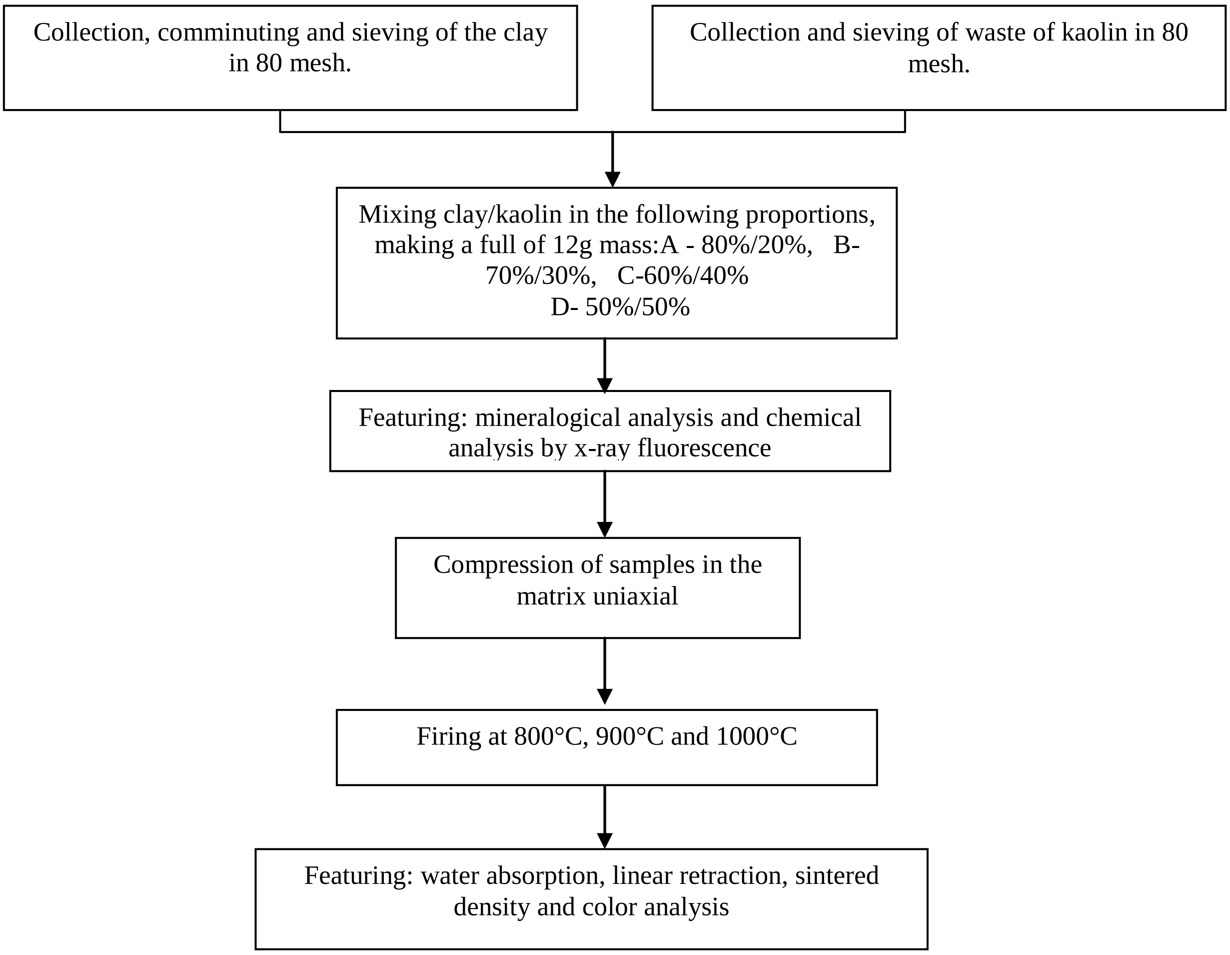

Figure 1: Flow chart of general processing of clay.

Chemical analysis was performed through of fluorescence spectroscopy x-ray (FSX), and the results are presented as percentages of oxides present. The tests were conducted at the Laboratory of X-rays of IFRN. The analysis by x-ray diffraction (XRD) and fluorescence spectroscopy x-ray , the samples were ground and passed through sieve No # 200 (Mesh - ABTN) and examined by powder method.

3. RESULTS

Table I presents the results of chemical analysis for the percentages of the oxides present in the ceramic mass from pure clay to pure kaolin.

Table I - Chemical composition of ceramic mass (weight %).

	SiO_2	Fe_2O_3	Al_2O_3	K_2O	MgO	CaO	TiO_2	BaO	SO_3	MnO	P_2O_5
Pure Clay	53.423	11.979	21.781	4.389	3.390	2.566	1.307	0.486	0.286	0.255	0.139
90%/10%,	53,29	10,91	23,45	4,24	2,96	2,25	1,22	0,35	0.25	0,22	0,12
80%/20%,	55,19	9,39	24,66	4,14	2,73	1,99	1,01	0,31	0,22	0,21	0,098
70%/30%,	56,54	7,96	26,03	4,07	2,34	1,63	1,04	-	0,19	0.17	-
60%/40%	57,20	6,76	27,33	3,92	2,00	1,44	0,70	0,26	0,18	0,17	-
50%/50%	58,65	5,50	28,26	3,72	1,59	1,14	0,61	0,28	0,14	0,13	-
Kaolin	63,44	0,67	32,31	3,56	-	-	-	-	-	-	-

The chemical composition shown in Analyis I, shows the increasing of silicon oxide (SiO_2) content and a lower potassium oxide K_2O content. This decrease reduces the formation of liquid tendency phase during sintering at temperatures above 1000°C. It was also noted that the relation alumina / silica always remains below 1, thus forming a raw material of mullite at high temperatures, which facilitates the improvement of mechanical properties of sintered. We also note that the increased amount of kaolin in ceramic mass causes an increase in the content of silicon oxide (SiO_2) and the content of aluminum oxide (Al_2O_3), but there is a substantial decrease in the concentration of iron oxide (Fe_2O_3). It is observed that the reddish color after the sintering process has a strong contribution to the high content of iron oxide, although it may turn a little red to orange due to the amount rutile (TiO_2 - 1.307%). The reduction of Fe_2O_3 causes a great variation in the number of colors (Table II), which is commercially very interesting architectural point of view, because it gives the customer a wider choice of colors. (Ponte, 1986 and Petrucci et al., 1998).

Table II - Change the color based on the percentage of kaolin and temperature.

Temperature(^OC)					
800					
900					
1000					
KAOLIN	50%	40%	30%	20%	10%

The figure 2 shows the behavior of linear retraction on the percentage of kaolin. It is observed that because of the presence of a large percentage of SiO_2 from silicates from the clay, mica and feldspar, and free silica, this causes a reduction not only plasticity but also leads to a low linear retraction (Santos ,1989).

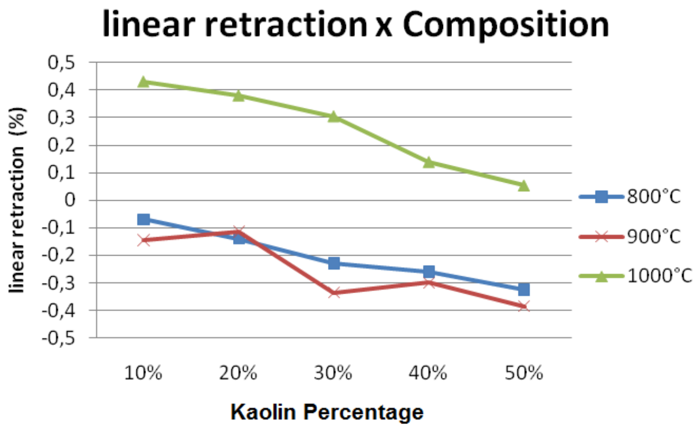

Figure 2: Behavior of the linear retraction behavior based on the percentage of kaolin.

The figure 3 shows the behavior of sintered density on the percentage of clay. There was a decrease in apparent density with increase in the percentage of kaolin. This result can be explained by the increase in the number and size of pores in the material because of overfiring and "swelling" ("bloating"). This porosity was probably caused by the expansion of gases trapped in the initial stages of burning. These gases are continuously released during the burning, which may originate from the decomposition of raw materials, the burning of organic compounds and reduction reactions at high temperatures, etc.

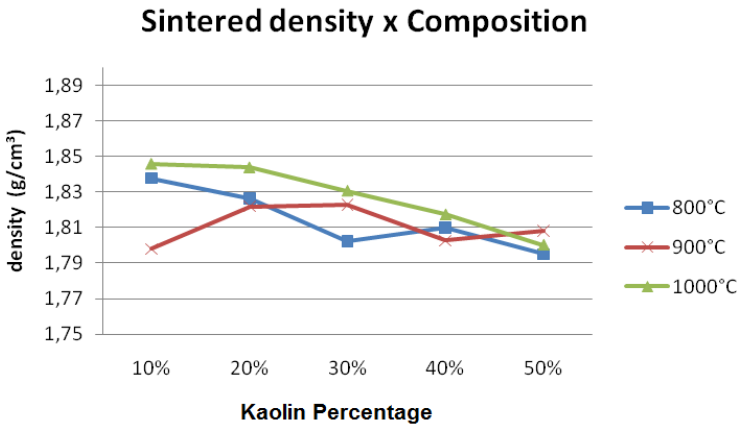

Figure 3: Behavior of sintered density on the percentage of kaolin.

The picture 4 shows that the absorption decreases with increasing sintering temperature and remained almost stable between the levels of 15% to 18% from the percentage of 20% kaolin. This porosity range is classified by ISO13006 as porous material, recommended for use as bricks or floor (slab) for internal application. It is also observed that the absorption keeps almost constant with the increase in the proportion of kaolin in ceramic mass after 20%.

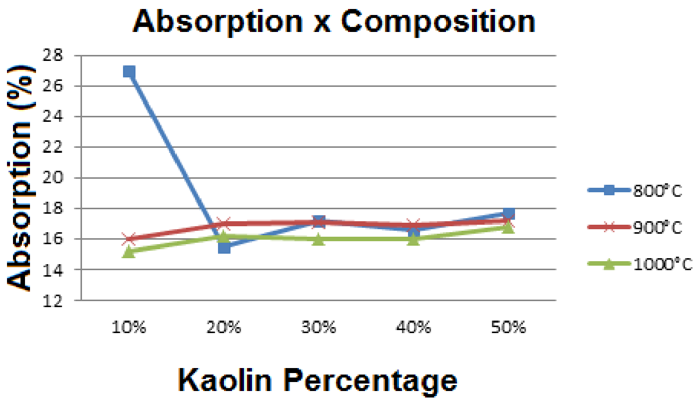

Figure 4: absorption behavior of sintered on the percentage of kaolin.

4. CONCLUSIONS

- The increased amount of kaolin in a ceramic sample causes an increase in the content of silicon oxide (SiO_2) and the content of aluminum oxide (Al_2O_3), but there is a substantial decrease in the concentration of iron oxide (Fe_2O_3);

- The reduction of Fe_2O_3 causes a great variation in the number of sintered colors, which is commercially very interesting, because it enables the customer to have a wider choice of coloring;

- The presence of a large percentage of SiO_2, mica and feldspar mainly due to the kaolin addition causes a reduction not only in plasticity but also leads to a low linear retraction;

- The apparent density of sintered decreases with the increase in the percentage of kaolin. This result can be explained by the increase in the number and size of pores in the material due to subsequent overfiring and bloating. This porosity was probably caused by the expansion of gases trapped in the initial stages of burning;

- The absorption remains almost constant with the increase in the proportion of kaolin in aceramic sample after 20%, independent of temperature.

5. REFERENCES

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