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Characterization of Clay for Application in Ceramic Products

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Abstract- The ceramic industry is very important to the world's economy. For this reason, there is a necessity of finding new sources of clay with potential for ceramic materials production. The aim of this study was to characterize a clay from Alto Alegre region, and to analyze its potential in the use of slip production for ceramic pieces. To reach these objectives it was performed physical, chemical and mineralogical characterization of the clay and the slip. It was observed that the chemical and mineralogical composition of the Alto Alegre clay (AA) is different from the São Simão one (SS). About the physical properties it was noticed a higher linear retraction of burning in AA clay and a higher flexural strength of SS clay. As a result, the AA clay can be used, without chemical enrichment, in the ceramic block production.

Keywords- *Ceramic Products, Clay, Characterization*

I. INTRODUCTION

According to the most recent data from ANICER - Brazilian Nacional Ceramic Industry Association [1], the red ceramic segment represents 4.8 % of the Brazilian construction industry, with an annual revenue of R$ 18 billion and still providing great social impact by generating more than 290 thousand direct jobs and 900 thousand indirect jobs.

Brazil has a great notoriety in the ceramic coating production. The production and consumption of this material occupie the third position in the world, behind China and India only, with a total production of 792 million square meters of ceramic tiles in 2016. An important amount is destined for exporting, representing 47% of South American exportation [2,3].

In 2008, there were about 6900 red ceramic companies in Brazil [1]. A particularity of this sector is the great variability of these companies. There are small family potteries, factories of intermediate size with essentially manual processes and precarious quality control, and enterprises that use advanced technologies and produce on a large scale [4].

In those small family businesses, the presence of poorly qualified labor and uncontrolled manual processes is common, resulting in nonconstant quality products for the civil construction market [5].

The southwestern region of Paraná is rich in clay. However, not all have known chemical and physical characteristics. It is known that the characteristics of the materials vary widely, as the soil is somewhat heterogeneous, being composed of different layers. Therefore, in order to analyze the quality of a clay available in the southwestern region of Paraná, used by a small and old pottery in the city of Verê, the material was subjected to chemical, physical and mechanical characterization. Then, it was compared to São Simão clay, which is known for being purer and already studied in other works [6,7], seeking to insert it in the industry in search for a supposed profitable purpose for the material.

After characterizing the clay, it was studied the behavior of this material in the slip casting process, which is a very simple, old and low-cost process, originated between the years 1700 and 1740. It is one of the main techniques used in the production of ceramic pieces [8,9]

The slip is characterized as a stable suspension of ceramic powder in an aqueous liquid, which in the casting process is poured into a porous mold, usually plaster, which removes part of the water by capillarity forming a thin film of solid material on the surface of the mold and results in the green body. With this process, it is possible to obtain pieces of complex shapes, with thin and uniform walls [8,10].

However, there are some variables that influence the process of forming the parts and must be controlled, such as the concentration of solids in the suspension, particle size and flocculation state of the mixture. These characteristics change the viscosity of the suspension, which must have an adequate value so the particles do not deposit very quickly, generating segregation, which would harm the homogeneity in the density of the pieces [9].

Another factor to be noted is the resistance of the green body, which needs to meet the product's transport requirements. For the production of pieces with high green density, it is necessary to control the size of the particles, which influence the suspension viscosity due to the Van der Waals forces. These are attraction forces between the molecules that generate the agglomeration of particles. A flocculated system which sediment quickly [9].

When casting a flocculated system, the suspension has a low packing density, greater viscosity and instability when compared to the deflocculated system. Thus, the resulting piece will be of low homogeneity. The deflocculant stabilizes the suspension and prevents agglomeration between particles and then decanting [10].

This study aimed to characterize a clay obtained in the raw form in a lake in the lowland of the Chopim River, located in the southwest of Paraná, in the Alto Alegre region. Besides analyzing its potential in the use of slip production, for ceramic pieces and to compare the characteristics obtained with São Simão clay, already used commercially for these purposes.

II. MATERIALS AND METHODS

A. Sample Preparation

The characterized clay was obtained in a crude form in a lake in the lowland of the Chopim River in Alto Alegre, in the municipality of Verê, southwest of Paraná. The lake has central coordinates equal to 25° 50' 09.6" south latitude and 52° 53' 16.8" west longitude, and has already been explored by a family pottery located in the same municipality.

The sample preparation consisted of drying raw material in an oven at a controlled temperature of 105 ºC for 24 hours. Then, the quartering was performed in order to obtain a homogeneous sample of approximately 500 g. The selected sample in the quartering was then ground to a granulometry through the 850 µm sieve. The already prepared Alto Alegre clay is shown in figure 1.

Figure 1. Alto Alegre clay sample.

For comparison purposes, the São Simão clay was used. This clay can be commercially found and has been studied in previous works [6,7]. In the present work, this clay was obtained already prepared by a more sophisticated process. For this reason, its granulometry is finer and more uniform than the Alto Alegre clay.

B. Chemical and Mineralogical Characterization

- X-ay diffractometry (XRD)

The Alto Alegre clay was characterized in terms of its crystalline phases by X-ray diffraction (XRD). To be subjected to this analysis, the clay was ground to a granulometry through the 63 µm sieve.

The analysis was performed with the following parameters: wavelength of 1.54 Å; reading range from 3º to 80º (2Ɵ); 0.02º step with 0.4 seconds for each step; Cu-Kα radiation and 40 kV current voltage.

- Differential Scanning Calorimetry (DSC)

The differential scanning calorimetry (DSC) is a thermal analysis that allows the identification of decomposition and chemical transformations due to alterations in the alteration flow. Exothermic processes characterize an increase in heat flow and endothermic processes a decrease in heat flow.

This analysis was carried out with the following parameters: aluminum sample holder; heating rate of 10℃·min^{-1}; inert atmosphere of synthetic air with a flow rate of 100 mL.min^{-1}; temperature range from 30 to 600 ^{o}C.

C. Physical Characterization

- Granulation

After drying in an oven at a temperature of 105℃ for 24h, the collected Alto Alegre clay material was quartered. The collected material was divided into four equal parts, two of these parts were discarded, the rest was mixed and divided. This process was repeated until a sample of 682.37g was obtained, close to 500g.

The raw material, consisting of large pieces of dry clay, was manually ground using mortar and pestle and passed through an 850µm sieve. 8% of water was added to the sample, necessary for future pressing, which totaled 55g. This mixture was passed through a kitchen sieve for homogenization, and a small sample was passed through the 63µm sieve for sampling the procedures of XRD and DSC.

The ground clay, sieved and added with water, was stored in a plastic bag for proper homogenization of moisture.

A 100g sample of São Simão processed clay was also prepared by adding 8% of water, a total of 8.0g, mixed and passed through the kitchen sieve. This sample was also stored in a plastic bag.

The granulated clays were stored for 7 days in a sealed plastic bag to homogenize the moisture in the sample. After this period, a 5.0g portion of each clay was removed to verify that no moisture had been lost. It was found that the Alto Alegre clay had a humidity of 8.6% and São Simão with 8.2%.

- Specimen preparation

The specimens were made with dimensions 20x60mm through manual pressing of the Alto Alegre and São Simão clays already granulated and hydrated. 28 specimens of Alto Alegre clay and 5 of São Simão clay were made with 15.0g each (Figure 2).

Figure 2. Pressed samples.

The compaction pressure applied was fixed at 250 kgf/cm². As the surface of the specimen is 12 cm², it was assumed that the applied load should be 3tf. The load was applied in three periods of load increase. The press used as well as the mold during pressing can be seen in figure 3.

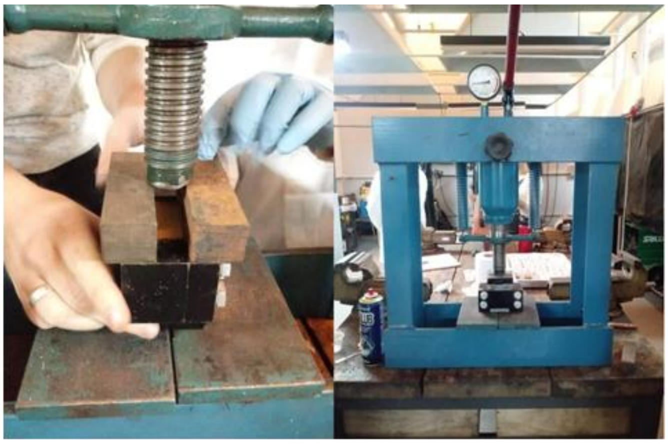

Figure 3. Pressing.

Prior to each pressing, a light layer of oil was applied to the mold assembly (Figure 4) for lubrication. The pressed specimens were carefully removed from the mold and identified. All of them were put in the same position, for later standardization of the dimension measurement points.

Figure 4. Pressing mold set.

The specimens were subjected to a constant temperature of 105 ºC for 7 days for drying and their masses and dimensions (length, width and average thickness) were then measured and tabulated. With these data, the density of each specimen was calculated and these were grouped for further burning so that all groups had an average density as similar as possible.

- Gresification curve

The gresification curve illustrates the clay's behavior when subjected to an increase in temperature. This is usually done by plotting the values of linear shrinkage and water absorption as a function of the different burning temperatures of the material [11].

In this work, it was decided to work with 3 firing temperatures: 1000, 1100 and 1200ºC. The fires were carried out in a muffle furnace with a heating ramp of 10ºC.min^{-1} and with a 60-minute threshold at the maximum temperature.

The firing groups consisted of 5 specimens of Alto Alegre clay and 1 of São Simão clay. These were placed on a refractory plate with an alumina coating and taken to the muffle, as shown in figure 5a. The already burned specimens are shown in figure 5b.

After firing, new measurements of mass and dimensions were taken in order to obtain the linear retraction of burning (LR_B). This value is obtained through Equation 1, where L_D is the length of the specimen after kiln-dried and L_B is the length of the specimen after firing. The linear firing retraction value for each specimen was the arithmetic mean of the linear retraction of each dimension.

$$LR_B(\%) = \frac{L_D - L_B}{L_B} \times 10 \quad (1)$$

For the water absorption test (WA), after burning the specimens were immersed in water until the mass stabilized. After that period, they were removed from the container and weighed with the dry surface. The water absorption content was calculated using Equation 2.

$$WA(\%) = \frac{m_{sat} - m_B}{m_B} \times 10 \quad (2)$$

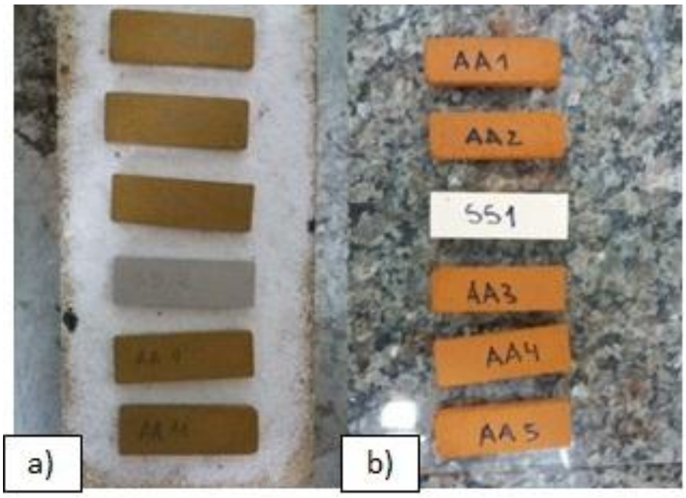

Figure 5. Specimens (a) before and (b) after firing.

The density of the specimens after burning can be calculated using the mass and dimensions already obtained.

After burning, the loss on ignition (LOI) information can be obtained, which is the mass that is lost due to the release of free water and combustion of organic matter. The percentage of loss on ignition can be calculated by Equation 3.

$$\mathrm{LOI}(\%) = \frac{m_D - m_B}{m_D} \times 100 \quad (3)$$

- Modulus of rupture (MOR)

To obtain the three-point flexural rupture module (Figure 6), the fired samples were subjected to an automatic press with a loading speed of 1 mm/min and a distance between supports of 5 cm.

Figure 6. Flexural strength test.

D. Slip Casting

- Plaster mold production

To make the plaster mold, a cylindrical plastic container of approximately 2000 cm³ was used. A consistency was chosen, that is, water/plaster ratio, equal to 0.75. Thus, the mass of water and plaster mixed was 1260g and 1680g, respectively.

After mixing, the plaster paste was poured into the plastic container up to the edge and a piece of nylon was positioned in the central region. After the plaster has dried, which takes minutes, the nylon piece can be removed. The finished mold is shown in figure 7.

Figure 7. Plaster mold.

- Slip production

For the slip casting, the same formulation for the Alto Alegre and São Simão clays was used. The formulation proportions are shown in Table I.

TABLE I. SLIP FORMULATION

Material	% in mass
Clay (from Alto Alegre or São Simão)	38.5
Orthoclase	40.0
Quartz	21.5

The clay was processed with wet grinding in a ball mill for 15 minutes. Each grinding was performed with 500 g of formulation, 40% water, 0.3% sodium silicate deflocculant and a mass of grinding balls equal to 930 g. The amount of water and deflocculant were calculated in relation to the total formulation mass (500 g).

At that moment, it was possible to estimate the density of the slip, with the aid of a beaker, and the viscosity, through the flow time in a funnel of a known volume of slip. Before any procedure, the slip was manually mixed again for 1 minute to avoid solids settling.

- Slip casting

The prepared slip was poured into the plaster mold until it was completed (Figure 8) and after approximately 3 minutes the excess was drained off. The take-off took place after about 30 minutes and the newly molded part was placed in an oven at 100ºC for one week.

Figure 8. Molds filled with slip.

It was necessary to increase the amount of water by 10% and double the deflocculant content (0.6%) in the slip produced with Alto Alegre clay. This may have happened due to the presence of vermiculite in the Alto Alegre clay.

- Firing, Retraction and absorption

One piece of each clay was subjected to muffle firing at a temperature of 1200 ºC for 1 hour and heating ramp of 10ºC/min. To measure the firing retraction of the part, the diameter was measured before and after firing. For absorption, the piece was immersed in water and its mass was measured after saturation.

III. Results and Discussion

A. Chemical and Mineralogical Characterization

- XRD

The diffractogram of the Alto Alegre clay before firing is shown in Figure 9. The crystalline phases present are: quartz (SiO_2), a commonly found non-clay mineral; sodium feldspar, also called albite ($Na_2O.Al_2O_3.6SiO_2$); goethite iron ore (α-FeO.OH); kaolinite mineral clay ($Al_2Si_2O_5(OH)_4$); and vermiculite, also a mineral clay.

The presence of goethite, confirmed in the XRD, justifies the yellowish coloration of the Alto Alegre clay. The association of this color with goethite has been made in several studies [12-14].

The X-ray diffractogram of the São Simão clay is shown in Figure 10. Unlike the Alto Alegre clay, there is no diversity of crystalline phases. The phases found are essentially quartz (SiO_2) and kaolinite ($Al_2O_3.SiO_2.2H_2O$).

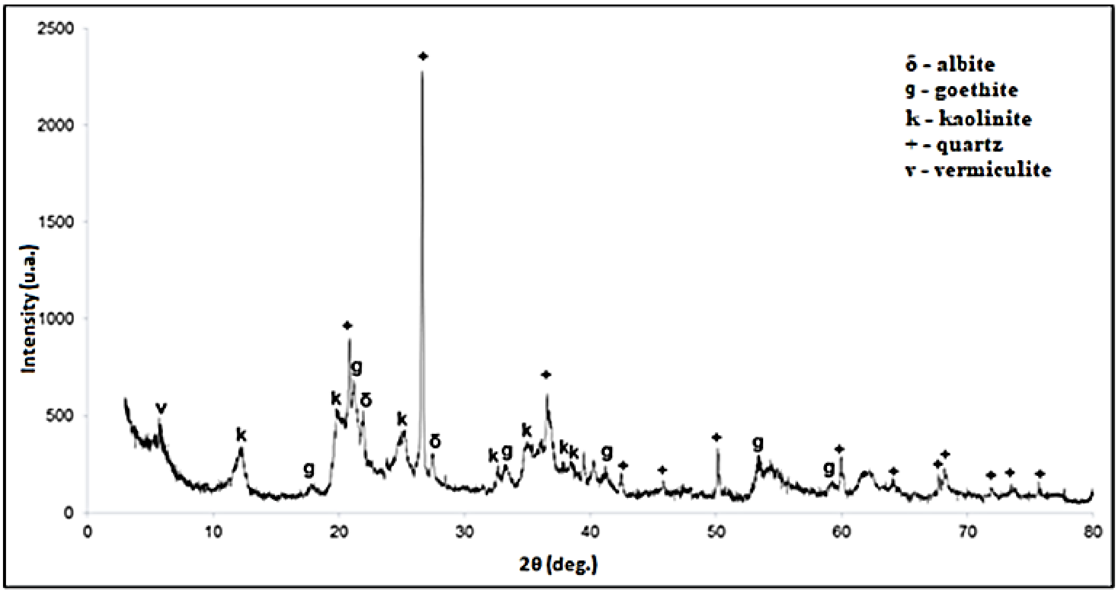

Figure 9. XRD Alto Alegre clay.

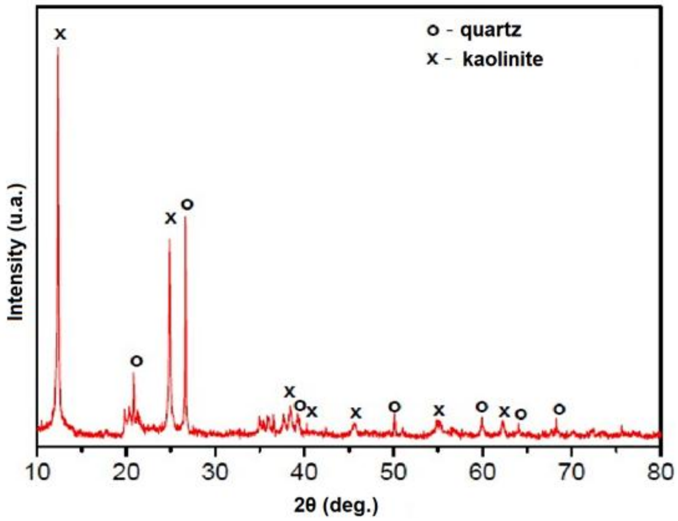

Figure 10. XRD São Simão clay [6].

- DSC

The DSC analysis for the Alto Alegre clay is shown in Figure 13. The first region of the curve, up to a temperature of 100 ºC, shows an endothermic peak that is attributed to the elimination of moisture present in the sample. Between 300 and 400ºC, the peak of water loss from kaolinite (hydrated aluminum silicate) is observed. At 350ºC, a small endothermic peak, due to the transformation of goethite into hematite, is observed. This transformation has already been observed by other authors in this temperature range [15,16]. The largest endothermic peak is found 400 and 500ºC and it is due to the combustion of the large amount of organic matter present in the clay.

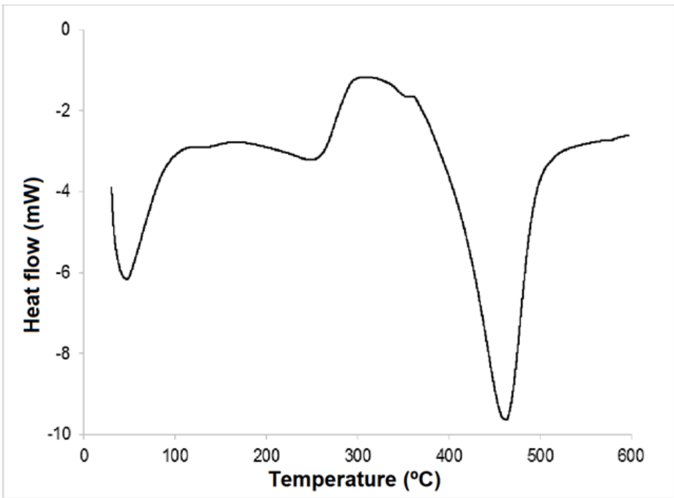

Figure 11. DSC Alto Alegre clay.

B. *Physical Characterization*

- Gresification curve

Tables II and III show the values of mass, dimensions and density after kiln-drying of the 3 firing groups formed from the Alto Alegre and São Simão clay, respectively.

TABLE II. DENSITY DATA AFTER DRYING ALTO ALEGRE CLAY

Groups	Specimens	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	Volume (cm^3)	Density (g/cm^3)	Average Density (g/cm^3)	DP
1	AA1 AA2 AA3 AA4 AA5	13.48 13.58 13.60 13.61 13.62	59.98 59.98 59.98 59.98 59.95	19.87 19.86 19.93 19.96 19.90	7.04 7.16 7.16 7.17 7.13	8.38 8.53 8.56 8.58 8.51	1.61 1.59 1.59 1.59 1.60	1.60	0.01
2	AA6 AA7 AA8 AA9 AA11	13.61 13.47 13.61 13.61 13.61	59.97 59.95 59.98 59.98 59.97	19.86 19.92 19.90 19.96 19.95	7.13 7.11 7.19 7.14 7.07	8.49 8.49 8.58 8.54 8.46	1.60 1.59 1.59 1.59 1.61	1.60	0.01
3	AA12 AA14 AA15 AA16 AA18	13.62 13.62 13.62 13.62 13.60	59.93 59.87 59.98 59.99 59.98	19.83 19.93 19.87 19.95 19.95	7.11 7.18 7.09 7.03 7.21	8.45 8.56 8.45 8.41 8.62	1.61 1.59 1.61 1.62 1.58	1.60	0.02

TABLE III. DENSITY DATA AFTER DRING SÃO SIMÃO CLAY

Groups	Specimens	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	Volume (cm^3)	Density (g/cm^3)
1	SS1	13.58	60.32	20.01	7.05	8.51	1.60
2	SS2	13.62	60.42	20.04	7.09	8.58	1.59
3	SS3	13.60	60.39	20.04	6.96	8.42	1.61

TABLE IV. ALTO ALEGRE CLAY LINEAR RETRACTION OF BURNING

Groups	Specimens	T (ºC)	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	Average LR_B (%)	DP
1	AA1 AA2 AA3 AA4 AA5	1000	12.09 12.17 12.20 12.24 12.21	57.36 57.49 57.56 57.58 57.55	19.06 19.10 19.08 19.03 19.02	6.68 6.73 6.56 6.48 6.66	5.16	0.65
2	AA6 AA7 AA8 AA9 AA11	1100	12.12 12.01 12.12 12.11 12.04	55.19 55.18 55.20 55.22 55.15	18.25 18.27 18.29 18.31 18.27	6.40 6.41 6.41 6.58 6.38	8.56	0.29
3	AA12 AA14 AA15 AA16 AA18	1200	12.13 12.13 12.13 12.12 12.12	54.96 54.86 54.99 55.04 55.94	18.17 18.29 18.33 18.32 18.30	6.31 6.34 6.29 6.23 6.28	9.39	0.11

TABLE V. SÃO SIMÃO CLAY LINEAR RETRACTION OF BURNING

Groups	Specimens	T (ºC)	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	LR_B (%)
1	SS1	1000	11.60	58.62	19.45	6.98	2.19
2	SS2	1100	11.59	58.23	19.25	6.64	4.74
3	SS3	1200	11.56	55.74	18.47	6.28	8.58

As expected, the higher the temperature, the greater the dimensional reduction of the specimens. It is also possible to observe that, for the three firing temperatures, São Simão clay has less burning retraction. All values, between the two clays, were below 10%.

The higher the firing temperature, there is a decrease in water absorption and, therefore, in porosity, for both clays. São Simão clay showed higher water absorption values at all temperatures.

São Simão clay showed greater absorption and less shrinkage than Alto Alegre (Table IV and V). It is due to the fact that it is composed essentially of kaolinite, a raw material considered refractory (high water absorption and low linear shrinkage) [6]. The results of water absorption for the Alto Alegre and São Simão clays are shown in Table VI and Table VII, respectively.

TABLE VI. ALTO ALEGRE CLAY WATER ABSORPTION

Groups	T (ºC)	Specimens	M_{sat} (g)	Abs. (%)	Average Abs. (%)	DP
1	1000	AA1 AA2 AA3 AA4 AA5	15.06 15.27 15.32 15.37 15.27	24.57 25.47 25.57 25.57 25.06	25.25	0.44
2	1100	AA6 AA7 AA8 AA9 AA11	14.30 14.21 14.34 14.39 14.27	17.99 18.32 18.32 18.83 18.52	18.39	0.31
3	1200	AA12 AA14 AA15 AA16 AA18	14.10 14.09 14.08 14.02 14.06	16.24 16.16 16.08 15.68 16.01	16.03	0.22

TABLE VII. SÃO SIMÃO CLAY WATER ABSORPTION

Groups	T (ºC)	Specimens	m_{sat} (g)	Abs. (%)
1	1000	SS1	14.91	28.53
2	1100	SS2	14.78	27.52
3	1200	SS3	13.57	17.39

Based on this information, it was possible to plot the gresification curves of each clay (Figure 12).

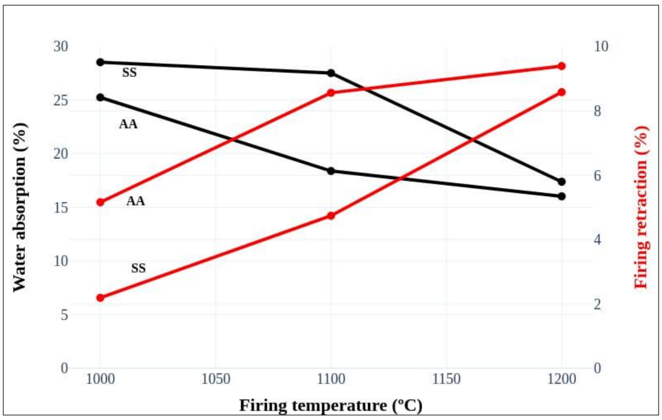

Figure 12. Gresification curve Alto Alegre and São Simão clays.

Alto Alegre clay showed less water absorption because it has feldspar in its composition, a fluxing agent, which reduces the porosity of ceramic pieces [17]. Table VIII shows the average density after firing the two clays at different firing temperatures.

With this grouping for the Alto Alegre clay, it was possible to obtain an average density of 1.60 g/cm³ for the three groups. For São Simão clay, samples were also selected with the closest possible density to this value.

Subsequently, groups 1, 2 and 3 were submitted to firing temperatures of 1000, 1100 and 1200 °C, respectively. Table IV presents the measurements after the firing of the Alto Alegre clay and its linear retraction of firing and Table V shows these data for the São Simão clay.

TABLE VIII. DENSITY AFTER FIRING

Clay	T (ºC)	Average density (g/cm^3)
AA	1000 1100 1200	1.68 1.86 1.91
SS	1000 1100 1200	1.46 1.56 1.79

São Simão clay has a lower density than the Alto Alegre clay at all firing temperatures. This result agrees with the higher water absorption content of São Simão clay observed in the gresification curve.

In Table IX, the results of loss on ignition are presented. It is observed that São Simão clay has the highest percentage of loss on ignition at all temperatures.

TABLE IX. LOSS ON IGNITION

Clay	T (ºC)	LOI (%)
AA	1000 1100 1200	10.28 11.06 10.94
SS	1000 1100 1200	14.58 14.90 15.00

- Flexural Strength

After firing an automatic press was used to obtain the flexural rupture modulus. All samples were tested to obtain the rupture loads and the flexural strength was calculated in MPa, as shown in Table X and XI.

TABLE X. ALTO ALEGRE CLAY FLEXURAL STRENGTH

Groups	Specimens	Load (kN)	MRF (MPa)	Average (MPa)	DP
1	AA1 AA2 AA3 AA4 AA5	0.023 0.012 0.011 0.011 0.011	2.03 1.04 1.00 0.94 0.98	1.20	0.467
2	AA6 AA7 AA8 AA9 AA11	0.021 0.021 0.019 0.015 0.015	2.11 2.10 1.90 1.42 1.51	1.81	0.324
3	AA12 AA14 AA15 AA16 AA18	0.023 0.032 0.029 0.031 0.026	2.39 3.27 3.00 3.27 2.70	2.93	0.381

TABLE XI. SÃO SIMÃO CLAY FLEXURAL STRENGTH

Groups	Specimens	Load (kN)	MRF (MPa)
1	SS1	0.072	5.70
2	SS2	0.098	8.66
3	SS3	0.207	22.31

The higher the firing temperature, improvements in mechanical properties are observed. Group 3, which was burned at the highest temperature (at 1200ºC), was also the one that obtained the greatest resistance, both for São Simão and Alto Alegre. As seen in Figure 13, the Alto Alegre clay had a linear increase, while the São Simão clay had an exponential increase, responding better to the temperature increase. In addition, at all temperatures, São Simão clay had the highest MRF. This is believed to be due to the lower fineness that the Alto Alegre clay had at the time of pressing the specimens. This factor meant that the degree of compactness of the samples of the different clays was not the same, having an influence on their mechanical strength.

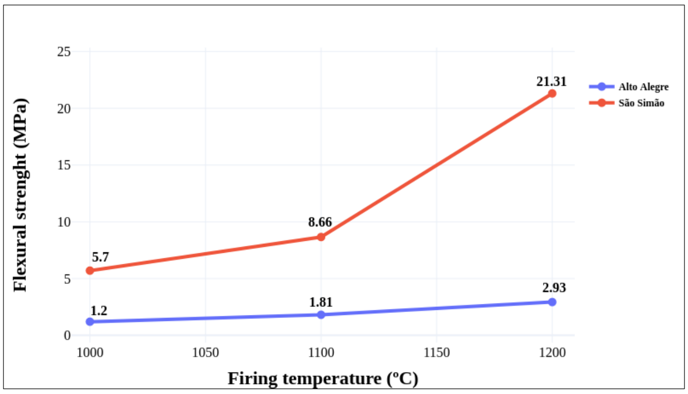

Figure 13. Flexural strength curve.

- Slip casting and firing

With the slip produced, density and flow time in the funnel were obtained. These data are presented in Table XII. Even with a larger amount of water and a deflocculant, the Alto Alegre clay presented a much longer flow time than São Simão clay, which indicates that it has higher viscosity. This effect may have been caused by the vermiculite present in the Alto Alegre clay.

TABLE XII. DENSITY AND FLOW TIME OF SLIP PRODUCED

Slip	Density (g/cm³)	Flow time (s)
AA	1.65	77
SS	1.73	32

The firing retraction and water absorption of the parts are shown below (Table XIII).

TABLE XIII. BURNING RETRACTION AND WATER ABSORPTION OF PIECES

Clay	Firing retraction (%)	Water absoption (%)
AA	-	0.789
SS	10.92	0.439

The piece made from AA clay is less thick than the piece made with SS clay, in addition to having brought more water into the mixture. Thus, with the firing process, the piece suffered great deformation, as can be seen in Figure 14, due to water loss and shrinkage, making it difficult to collect data on the diameter of the piece after firing.

Figure 14. Pieces before and after firing.

This pyroplastic deformation may have been caused, in addition to the greater amount of water present in the slip, by the greater total amount of fluxes in the formulation of the Alto Alegre clay, which already contained them in its composition.

IV. CONCLUSIONS

The main objective of this paper was to understand and analyze the clay collected in Alto Alegre. As a comparison object used, it is a small sample of São Simão clay, by a clay that has already been analyzed in previous works [6,7].

For the chemical and mineralogical characterization of the Alto Alegre clay it is possible to observe the various crystalline phases, among them quartz, albite, goetite, kaolinite and vermiculite. This clay is yellowish in color due to goetite, which is an iron ore., On the other hand, in the São Simão clay can only observe the crystalline phases of quartz and kaolinite. The color of São Simão clay is almost white, this is because the quartz tends to be almost colorless and the kaolinite is white.

For the Alto Alegre clay, the variation of the linear firing retraction from groups 1 to 3, was from 5.16% to 9.39%. While São Simão clay presented 2.19% in group 1 and 8.58% in group 3 almost equaling the Alto Alegre clay. For the industry, the lower these retraction values, the greater the dimensional control of manufacturing and the higher the temperature, the higher operating costs and energy consumption.

The flexural strength of São Simão clay was higher due to its chemical composition and because it is in a finer granulometry state. The resistance of the Alto Alegre clay varied from 1.20 MPa to 2.93 MPa, while the clay of São Simão varied from 5.70 MPa to 21.31 MPa.

The ceramic's ability to absorb water is directly linked to the presence of voids, and the more voids, theoretically lower the mechanical resistance. However, the São Simão clay, despite having better mechanical characteristics, such as flexural strength, lower linear shrinkage, etc., showed greater water absorption in all groups of samples. This was due to the presence of kaolinite, which is essentially a refractory raw material.

Crossing the information collected in the ceramic industry in general with the data obtained in the present work with the Alto Alegre clay, it can be said that this clay can be used, without chemical enrichment, in the ceramic block sector, due to its resistance above 1 MPa and absorption within the range of 8% and 22%.

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