KAOLINITE CHARACTERIZATION FOR CERAMIC GLAZE MANUFACTURE

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ABSTRACT

The rise in the Brazilian ceramic tile business and the need for knowledge in glazes and engobes inspire this paper. The focus of this paper is the comparative characterization of Kaolinite in the formulation of glazes. We performed an initial rheological characterization (viscosity), fired colour, SEM, optical microscopy and colorimetric measures. This was done to characterize the different geological origins of the kaolinites. The study examined the differences among the kaolinites in the glaze formulations. The pegmatitic kaolins show the best qualities in these formulations, and they are well accepted kaolins on the market; the others show different aspects in the grain size characterization and in the physico-chemical characterization.

This paper has the global objective of characterization and knowledge of the proprieties that increase the kaolin uses in the glaze formulations. Industrially supplied kaolins that have already been commercially used, as well as others with a different geological origin, were analyzed.

The specific objective was the characterization of reference kaolins (which have already used by industries) in order to determine technically and scientifically the formulation of glazes and engobes. And besides, it was intended to analyze other kaolins that can be used at this industrial segment.

1. METHODOLOGY AND MATERIALS

1.1. VISITING THE GLAZE AND FRIT INDUSTRY

For first-hand knowledge of the industrial process *in loco* and to obtain some kaolin, three visits were made to the glaze and pigment industry. These companies are located near the ceramic tile companies. These industries are known as ceramic glaze and colour manufacturers, produce material for the tile finish. The important ingredients being the ceramics frits, which are made with select materials that are milled and melted in the furnace, after which the resulting melt is solidified by pouring it in water, where it undergoes thermal shock and breaks into little fragments of glass. This material is used because it prevents release of materials that can cause environmental problems and affect the durability of the glaze.

1.2. KAOLIN SELECTION

The visits to the Industry were needed to collect some samples of kaolin and obtain information about the origin of this material. Besides these kaolins (four kaolins), two others were added from the Project "Study of the typology and geological and technological characterization of the deposits of plastic clays and masses for developing for white ceramics" (Fapesp Process 03/13762-4). This Project was conducted at the Institute of Technological Research of São Paulo (Instituto de Pesquisas Tecnológicas de São Paulo), in which the author took part. The selection was made by considering the origin and fired colour from a group of more than 30 kaolins.

1.3. LABORATORY STEP

In the laboratory, the different kaolins were characterized by: X-ray diffraction, scanning electron microscopy (SEM), X-ray fluorescence, optical microscopy, grain size analyses, rheology and colorimetric tests. The formulations in this study were based on the industry formulation obtained in the visit.

The tests and some analyses were done at the São Paulo State University (Universidade Estadual Paulista – UNESP- Departamento de Petrologia e Metalogenia) – Petrology and Metallogeny Department, and some were done at the Institute of Technological Research of São Paulo and in the Polytechnic Scholl (POLI) - in the University of São Paulo (USP), some tests by the author and others by technicians.

1.4. CHEMICAL ANALYSES

Chemical analyses were performed to determine the major and lesser oxides. The methodology used was X-ray fluorescence, which determines the major and lesser elements through atomic excitation, and there are Standard spectrometric samples which allow verification with the samples of the test.

1.5. MINERALOGICAL ANALYSES

This was done by X-ray diffraction analyses and optical analyses of the kaolinites by immersing the test pieces in a liquid with a known refractive index.

1.6. GRAIN SIZE ANALYSIS

The grain size analyses were done using a Malvern, model Mastersizer S long bed Ver. 2.19 instrument.

1.7. CERAMIC ANALYSES

Part of kaolin samples was used to prepare some test bodies consisting of 70% kaolin and 30% albite, which was used to decrease the firing temperature of the kaolin. These bodies were used for the colorimetric evaluation with the "*Colour Guide Sphere d/8º Spin*" colorimeter, made by *Byk Gardner*, with a D65 illuminant and standard observer at 10º.

The colours are defined by three coordinates: "**L***", "**a***" and "**b***"; the coordinates are orthogonal to each other. The coordinate L* is brightness and darkness; a* is green on the negative side and red on the positive side; b* is blue on the negative side and yellow on the positive side

Some deflocculation tests were conducted to observe the reaction of the glaze with each kaolin.

2. CONCLUSIONS

The kaolins must be in ideal conditions of purity, grain size, colorimetry aspects, and mineralogical composition. The pegmatite ones are brighter and have a peculiar grain size distribution. The viscosity varies with the kaolin. The viscosities of the kaolins in the glaze formulations decrease and reach a critical point, and then rise. The kaolinite Mariana Pimentel must be classified on grain size because it contains a lot of SiO_2, as observed in the chemical analyses. Some formulations were made with alumina but their viscosity became high because this alumina was micronized. The kaolin Horii shows a great rise in viscosity; this kaolin is not too bright, and displays a kind of pink colour by visual observation. The kaolinite Pantano Grande shows certain quantities of magnesium, observed in the chemical analysis.