OBTAINMENT AND CHARACTERIZATION OF CERAMIC MATERIALS FROM SOLID WASTES AND CLAY OF THE ELIANE CERAMIC TILE COMPANY

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1. INTRODUCTION

The environmental concern is currently one of the functions of all executives and managers in industry, particularly those that they lead companies which are great users of environmental resources. The Brazilian ceramic tile companies have made a series of investments, in the course of the last years, in all of their departments, having as objective beyond becoming a competitor in the domestic and international market, that of minimizing the percentage of generated residues, as well as better managing what cannot be reused yet.

As for raw materials, it should be realized that this problem is being solved with the addition of alternative components or recovery of the extraction areas. However, in relation to waste, the environmental problem has an incommensurable largeness. Currently, the biggest problems for the ceramic companies are the residues proceeding from the equipment laundering during the phase of the production, called "silts", and the most current issue, which would be the residue proceeding from the sector of polishing of ceramic porcellanato sheets.

The action to concentrate these wastes in a specific area consists of a palliative and also harmful measure. Palliative, because with this volume, it has a very great area occupation and costs of maintenance. Harmful, because these materials have in their coatings, constituents that are soluble in water, and which represent great health dangers to human beings, as the case of the lead, cadmium and other heavy metals.

With this in view, the Eliane Ceramic Tiles Group, aiming to treat the residues generated by its manufacture processes, has implemented two Effluent Treatment Stations, ETE 1, located in the city of Cocal of the South, and ETE 2, located in the city of Criciúma, which deal with their effluents. In the two stations, the clarified water, that is to say, one of the products of this treatment, returns for the production process or to the rivers of the region. Therefore, other products of the treatments, are the solid residues in question in the work, that possess a total generation of 1.600 ton./month of sludge (ETE 1 with 600 ton./month and ETE 2 with 1.000 ton./month), both with humidity of 30-40%.

In accordance with the philosophy of recycling and use of wastes, based on the possibility of the maximum use of these, the objective of the present work is to enable the reuse of the residues generated by the decoration sector and the equipment laundering (silts), as well as the residues generated for porcelain technical polishing in set with a clay that is treated as wastes, in a formulation of a new ceramic composition, which will serve as base for development of a new product with characteristics of rustic floor, formed by the method of extrusion and with water absorption below 10%. This initiative is valid, since it can decide a problem of technical/economic and environmental order.

2. MATERIALS AND METHODS

First, the physical and chemical characterizations of raw materials involved in the work have been effected: Clay Porto Seco, Silt of ETE 2 (called Silt A) and Silt of ETE 1 (called Silt B), to better know them and to have conditions of through its results, formulate the composition proposals.

The results of the characterizations were transferred then to the formulation of the compositions, which had been formulated taking in consideration the effected characterizations previously and the demand of raw materials.

RAW MATERIALS	COMPOSITIONS (% IN WEIGHT)					
	F1	F2	F32	F4	F5	F6
Clay Porto Seco	34	25	45	35	40	20
Silt B	33	25	25	25	20	30
Silt A	33	50	30	40	40	50

Table 1. Formulations

Test bodies were then prepared in the laboratory through the extruded process, with dimensions of 30 x 70 mm, formed with vacuum pressure (- 0,78 ± 0,02 kgf/cm^2) and frequency of 25 Hz of rotation, with 23% humidity. These were dried in the

laboratory and were then subjected to thermal treatment, at a temperature of 1050 and 1100ºC, in a cycle of 60 minutes, to be effected the characterizations.

After analyzing the qualitative results (extrudability) and quantitative results of the processed formulations in the laboratory; the F5 formulation was selected for the industrial test of 100 m^2 of each size of considered product (pieces with dimensions of 300 x 300mm and cotto with dimensions of 240 x 115 mm). For the conformation was used a pressure of vacuum of (- 0,68 ± 0,05 kgf/cm^2), with frequency of rotation of 20 Hz and humidity of 25%. After gotten the test bodies, these had been dried in industrial drier and thermal treatment the temperature of 950ºC for 36 hours in a "flagon" kiln, and 1060 and 1080ºC in cycle of 17 hours in static oven to the gas, later to be characterized.

After finding the formulation and the curve of thermal treatment more adjusted to take care of the objectives of the work, we effected the tests of the finished product, which had more directed the product to local its better and adjusted of use, being that all the tests carried through in this work, had followed norms ISO 13006 or NBR 13818.

3. RESULTS AND DISCUSSION

Of the formulations thermal treatment in the temperature of 1050ºC, the F1 only took care of to the basic requirement of water absorption (9,6%) for the considered work, that is of in maximum 10%. And the F6 did not only take care of to the resistance minimum mechanics (18 MPa), being with 16,84 MPa. In the other factors, all had been inside of the specifications. Summarizing the results, it could say that in the laboratory tests, of the samples made for extruded in this work, the F1 formulation would only take care of to the specifications. Already for the samples thermal treatment in the temperature of 1100ºC, all the formulations had taken care of to the basic requirements.

After to analyze all the values acquired with the tests of characterization and also for the qualitative aspect of the formulations in elapsing of the involved processes for these characterizations, the formulation that took care of to prerequirement the basic ones was the F5 formulation, as much for the obtained results, how much for the demand of wastes it generated. One evidenced then that for the pursuing of the work, this formulation would be used to analyze its behavior in industrial test.

The processed samples in the industrial test, which had been treated thermally 950ºC, had not presented good characteristics final techniques, getting one high water absorption and low a resistance mechanics after thermal treatment, in relation the proposal of this work. These facts had been caused by low temperature of the burning, that did not allow the formation of amount enough of liquid phase to close more the porosity. However, for structural use as ceramic, the product takes care of to the market requirements, an excellent option also, for the use of this formulation. In the temperature of 1080ºC they had formed great amount of liquid phase, what it took its deformation, thus not allowing the characterization tests. Already the samples that had been treated 1060ºC had presented the best characteristics techniques with an apparent density of 2,23 g/cm^3, resistance mechanics of 32,28 MPa, and 2,25% water absorption.

In the tests of finished product, the product presented a high chemical resistance to acid ones and alkalis in low concentration (LA), resistance to the stains Class 4,

presented resistance 166,8 mm^3 the deep abrasion, hardness to risk 5, coefficient of dynamic attrition dry Class 2 (> 0,4) and humid, Class II (between 0,4 and 0,75).

Then, by means of the described analysis previously, one evidences that the end item of this work could in such a way be used for coverings of walls as for floor in internal environments, including stairs or slopes, or in external environments, since that is in plain surfaces.

4. CONCLUSION

With the ending of this work and the analysis of all the involved factors and results, it can be said that the objectives had been reached. Under this approach, the carried through study sample allowed deciding an ambient problem first, and what the main objective of this study would be, either totally manufacture a product through wastes, as well as manufacture a product with "correct ecology", which would bring respect to the ceramic community and to the environment, and would have the reduction of the costs that the company comes to having to keep these on land.

In the second place, the formulation proposal can be used to manufacture ceramic pieces and to valorize raw materials that before had added costs for the company and were being removed, returning in profits, through the commercialization of these products.

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