

STUDY OF BODIES FOR CERAMIC TILE MANUFACTURE BY DRY MILLING IN THE CERAMIC POLE OF SANTA GERTRUDES/BRASIL

**Eduardo Quinteiro, Ana Paula Margarido Menegazzo,
José Octavio Armani Paschoal, Natália Gabriella Silva, Marcelo Dias Caridade;
Thiago Alexandre Deyuri, Tercílio de Almeida Coutinho Jr**

Centro de Inovação Tecnológica em Cerâmica – CITEC/CCB
Santa Gertrudes/SP – Brazil
quinteiro.ccb@terra.com.br

ABSTRACT

A quite singular way of production processing has been adopted, involving dry milling, by the companies of the Ceramic Pole of Santa Gertrudes, which enables using a highly simplified formulation for manufacturing products of water absorption groups BIIb and BIIa, consisting of one to three local raw materials. The ceramic tiles obtained by dry milling processes accounted for around 59% of the total Brazilian production in 2004. In the study a full characterisation has been made of 17 bodies produced by the dry milling process in different ceramic companies from the Santa Gertrudes Pole, while a study has also been conducted of the characteristics of 3 bodies obtained by the traditional wet milling process. The study featured the following characterisations for the masses: analysis of granule size, chemical and mineralogical analysis, behaviour under compaction, physical and chemical transformations in firing, and the characteristics of the masses after the firing. The results indicate that the characteristic of the dry milling process are correlated with the characteristics of the local raw materials, which enables analysing the production limitations of types different from the products being used in dry milling.

1. INTRODUCTION

Studies conducted^[1,2,3] indicate that the dry process has the advantage of lower energy, equipment and operation costs compared with the wet process. From a technological point of view, it is more difficult to reach the low particle size with dry grinding and, consequently also to reach high specific surfaces and the elimination of possible impurities contained in the body. Therefore, its use is inappropriate for highly vitrified products and when it is necessary to grind a body composed of several materials (single-firing white body).

The raw material used in the Santa Gertrudes Ceramic Pole is basically composed of red clays. Milling is conducted using hammer and/or pendulum mills. Wetting and granulation of the body are performed by so-called wetters and granulators. These facilities are equipped with openings and internal blades that wet and granulate the body in a constant flow. In the region of the Santa Gertrudes Ceramic Pole vertical granulators are mainly used, while the bodies are normally formulated with two or, at most, three local clays. After the granulation and wetting process, the body is stored in silos for later use. The drying, glazing, firing, storage and classification process is identical to that found in wet processing.

The dry manufacturing route used in the Santa Gertrudes Ceramic Pole accounts for nearly 40% of Brazilian tile production. The objective of this work has been to conduct a broad comparative study, through the chemical, physical, and mineralogical characterisation and on the firing behaviour of a great number of bodies made by companies in this ceramic Pole, which display peculiarities due to the intrinsic characteristics of the local raw materials used.

2. RESULTS AND CONSIDERATIONS

The results obtained enable assuring that all the tested bodies are appropriate for generating products in accordance with the water absorption classes declared by the manufacturers of the Ceramic Pole of Santa Gertrudes.

The formulations of the bodies in the Ceramic Pole, using few local clays, and displaying a low vitrification temperature compared with that of the bodies processed by the wet method, together with the adaptation to the dry milling/granulation process and fast single-firing cycles of less than 30 minutes, yield products whose technical quality exceeds the specifications of ISO 13006. However, the products are limited to the absorption classes of BIIa and BIIb.

The working particle size distribution of the dry processed bodies in the Ceramic Pole of Santa Gertrudes is substantially different from the dry route practiced in other localities, mainly by the fact of obtaining a milling product with a high proportion of fines. Although that work option leads to a comparatively lower flowability for the masses, it has been more than sufficient to generate products that conform to the national and international standards, besides facilitating a high rate of production. This production technology today enables producing glazed ceramic sheets of up to 50 x 50 cm in the Ceramic Pole of Santa Gertrudes.

A consequence of the low flowability of the dry masses, verified in this study, is the greater scatter of the values for bending strength or modulus of rupture (MOR),

owing to a less uniform ceramic microstructure. However, as highly vitrifiable formulations are involved, the tendency was verified of making products with mean MOR values far exceeding the limits stipulated by a given class (18 N/mm² for class BIIb), thus assuring that even before the scatter in values, the minimum individual MOR value still exceeds that demanded in the standard (16 N/mm² for class BIIb).

Although many of the companies in the Ceramic Pole declare their products as BIIb, these companies are already working near the bottom limit of this product class (6% water absorption). Thus, a tendency in recent years has been verified of the migration of products in this ceramic Pole from class BIIb to class BIIa, as two of the 17 companies that had their bodies characterised in the study, have now already done.

3. ACKNOWLEDGEMENTS

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