DEVELOPMENT OF A COLOUR MODIFYING FLUX FOR THE CERAMIC TILE BODY

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1. INTRODUCTION

The presence of iron oxide in the ceramic tile body contributes to obtaining products with a reddish firing colour, leading to lower added value, on not being considered "noble" products such as porcelain stoneware tiles. Porcelain stoneware bodies have a characteristic clear firing colour, which restricts the use of raw materials with high levels of chromophore oxides (mainly Fe_2O_3 and TiO_2) [1]. However, most of the Brazilian deposits have an iron element as a contaminant.

Therefore, there is a continuous search for new materials that can replace or be used as auxiliary raw materials in ceramic body compositions, promoting the clear firing colour of the products. In view of this, the present study proposes a synthetic flux with the characteristics of a colour modifier during the sintering, from the red to the clear firing colour [2].

The use of a synthetic flux in ceramic tile bodies depends on the knowledge of the reactions that occur at high temperature, in order to be able to use it as a modifier of the firing colour and to determine its influence on the technical characteristics of the end products.

2. MATERIALS AND METHODS

Several compositions were proposed for the synthetic flux (synthetic glassy phase) and ceramic body with a red firing colour, which has a high iron oxide content, and is typically used in the ceramic tile industries of Santa Gertrudes, São Paulo – Brazil. The compositions ranged from 0 to 55 wt% synthetic flux and 100 to 45 wt% ceramic body.

These compositions were wet-milled, adding water and deflocculant, dried in an electric oven and disaggregated for the powder to pass a 425μm mesh. The resulting powder was humidified to the plastic state and formed in metallic mould, obtaining cone-shaped samples.

After forming, the samples were fired with a heating rate of 10°C/min to 1100°C with a 5 min hold at this temperature. Some of the sintered samples were selected and subject to X-ray diffraction and scanning electron microscopy (SEM).

3. RESULTS AND CONCLUSION

Figure 1 shows the results for the compositions proposed, in which E0 is composed only of the ceramic body from the Santa Gertrudes deposit and E7 is composed of 45 wt% ceramic body and 55 wt% synthetic flux.

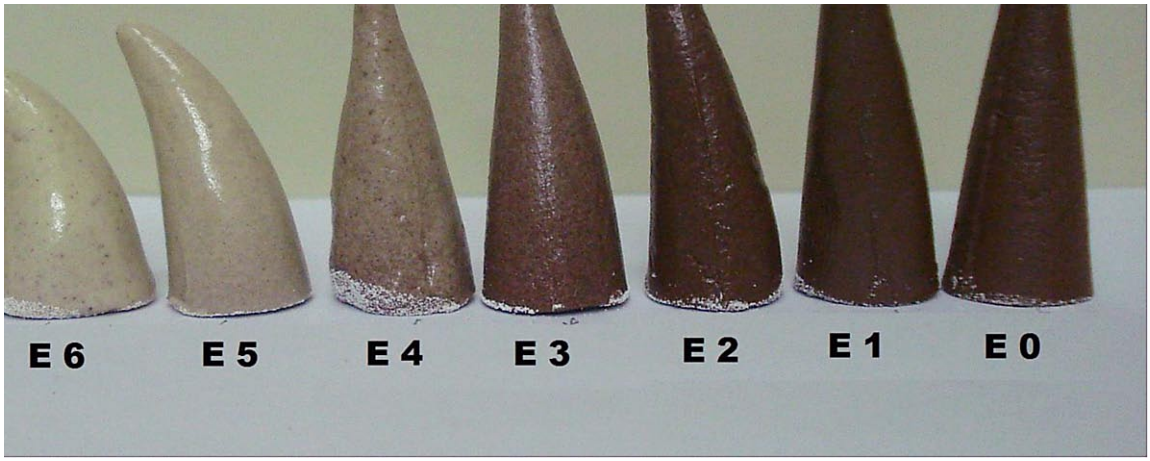

Figure 1 – Digital image of samples of different compositions after firing at 1100°C.

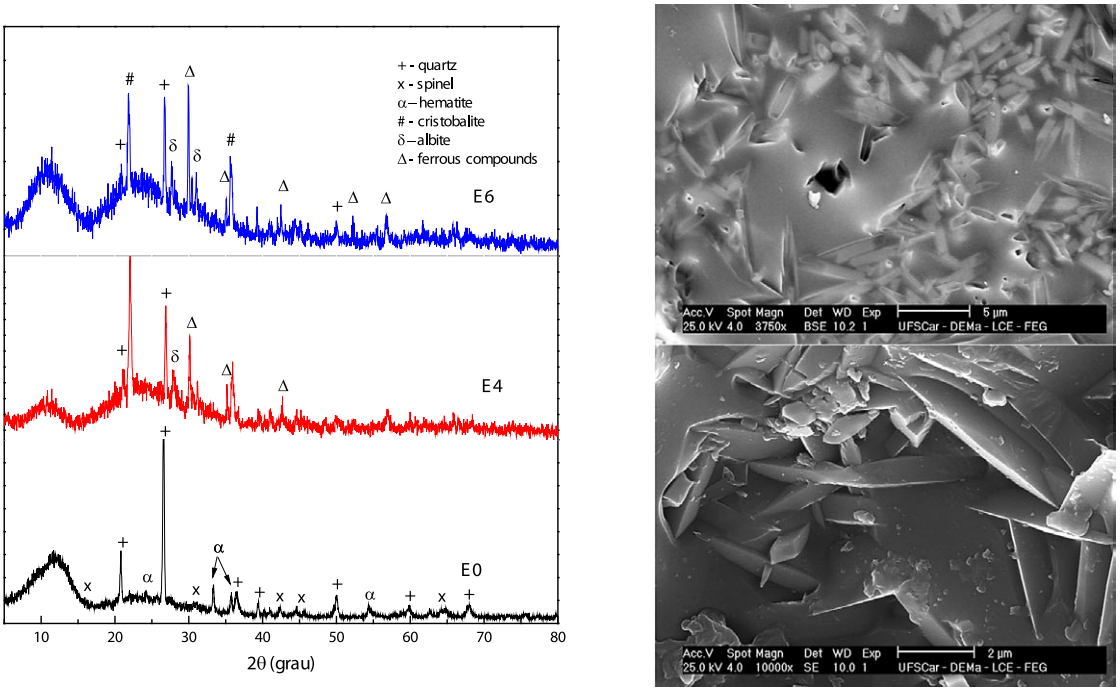

Figure 2 – X-ray diffraction patterns (left) and SEM micrographs (right) of samples with different compositions after firing at 1100ºC.

The change in the firing colour after sintering at 1100ºC occurred when the addition of the synthetic flux in the ceramic body from the Santa Gertrudes deposit was greater than 35 wt%, and a higher content of flux promoted clearer end colours and higher fusibility of the body.

This change in coloration is related to the dissociation of iron oxide (hematite from the ceramic body) at this temperature and that associated with other oxides of the flux composition to form new crystalline phases containing iron in their structure (ferrous compounds), which are observed in X- ray diffraction patterns in Figure 2 [2,4]. The typical general aspect of the microstructures of the samples

in which the firing colour change occurred is shown in Figure 2, in which the high amount of prismatic crystals, ferrous compounds, immersed in the glass matrix, may be noted.

The incorporation of the synthetic flux in bodies with high levels of iron oxides could be an interesting mechanism for modifying the coloration of ceramic tile bodies. It also provides a new alternative for the manufacture of porcelain stoneware tiles with lower-cost compositions. For this, it is still necessary to evaluate the technical characteristics of the end products.

ACKNOWLEDGMENTS

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REFERENCES

[1] BARBA, A. *et al*. Materias primas para la fabricación de soportes de baldosas cerámicas. Castellón, España. 1997.

[2] SANTOS, G. R. *et al*. Influência da adição de um fundente sintético no mecanismo de coloração final de revestimentos cerâmicos. Tese de doutorado. São Carlos, Brasil. 2011.

[3] SANTOS, P. S. Ciência e Tecnologia de argilas. 2ª ed. São Paulo: Editora Edgar Blücher, 1989.

[4] Crystallograph Open Database. Consultado en julio de 2011.