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Evolution of the pyroplastic deformation of porcelain tiles during firing

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Keywords: pyroplastic deformation, optical fleximeter, firing cycle, porcelain tiles.

Pyroplastic deformations are defined as permanent changes of shape that occur in high temperatures, associated to the flow of liquid phases in the firing of vitrified ceramic materials, such as porcelain tiles. The pyroplastic deformations presented by pieces of large dimensions are crucial to the dimensional precision of ceramic tiles and the fabrication of this sort of products increased expressively, in the last years. The susceptibility to present deformations during firing can be measured in laboratory tests by the pyroplastic index, which is generally determined in samples fired under specific conditions to enhance the deformations. However, this procedure just allows the quantification of the pyroplastic deformation in the fired specimens and it does not offer the possibility to identify the evolution of the deformations during the sintering process. The objective of this work was to study the kinetics of the pyroplastic deformations during firing, considering the effects of the main variables that act during this process. An Optical Platform (ODP 868 - TA Instruments) was used to evaluate the kinetics of deformation of typical bodies destined to the production of porcelain tiles. The consequences of planned variations in the firing cycle, residue content after milling, apparent density and body composition were investigated. The results showed that the most expressive deformations occur in the final steps of the firing cycles, when the bodies are near of their maximum densifications. Thus, it was possible to detect that the soak time at the maximum temperature of the thermal cycle is an important variable to control the pyroplastic deformations. Furthermore, the variables that determine the amount and the viscosity of the liquid phases formed during the vitrification process are also very significant. The results generated a better understanding about the mechanisms of pyroplastic deformations during firing and can be useful to identify the better conditions to produce porcelain tiles of large sizes with high dimensional precision.