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AN INSIGHT INTO PYROPLASTICITY OF PORCELAIN STONEWARE TILES

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The term "pyroplasticity" is commonly referred to deformations occurring during firing of whitewares. This phenomenon is active when sintering acts through viscous flow of an abundant amorphous phase, as typical of porcelain stoneware. Pyroplasticity turned to be increasingly important in ceramic tilemaking with development of large size, rectangular shapes, low thickness, and with use of energic fluxes and micronized fillers, particularly when two or more of these factors are combined in the same production. Pyroplasticity is thought to depend on amount, size, shape and microstructural arrangement of coarse grains (the so-called 'skeleton') as well as on physical properties of amorphous phases at high temperature (especially viscosity). Current models of firing deformations were reappraised in order to get an insight into pyroplasticity of porcelain stoneware tiles. For this purpose, different body compositions and green microstructures were designed and prepared by both dry/wet milling and granulation/spray drying of industrial-like bodies. The effects of the firing settings were evaluated too. The bodies, granules and green compacts were characterized by determining composition (XRF), particles size (PSD), agglomerates size, bulk density, porosity and pore size distribution. Water absorption, bulk density, open and closed porosity, microstructure (SEM), phase composition (XRD-Rietveld) were determined on fired products. Firing deformation was determined by three-points flexural test at temperature of maximum density and expressed as both pyroplasticity index and uniaxial viscosity. Results showed, as expected, that the pyroplasticity is affected by the volume and the viscosity of the vitreous phase developed during firing. Results also suggested that another variable, that is almost absent of the literature related to this subject, the green microstructure, plays an important role in the pyroplastic phenomena establishing the structure that shall accommodate the liquid phase. I this context the green microstructure and pyroplastic deformation of compacts of porcelain tiles, with the same chemical and mineralogical compositions, produced by the wet and dry route, were comparatively evaluated. The results were employed to discuss the current models of firing deformations and to consider new alternatives to produce porcelain stoneware tiles of large sizes, low thickness and low firing deformations.