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HIGH TEMPERATURE VISCOSITY OF PORCELAIN STONEWARE BODIES

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The viscosity of a porcelain stoneware at high temperatures is crucial to understand the vitrification path, the viscous flow sintering kinetics and the pyroplastic deformation of this material. The final viscosity of a porcelain stoneware has to be determined considering both the viscosity of the liquid phase formed by the melting of feldspars – and other minerals – and the viscosity of the body made up of a suspension of crystals dispersed in the melt. A fundamental theoretical background along with semi-empirical constitutive laws on the viscous flow sintering, the glass densification, as well as on the high viscosity of liquids and melts already exists [1]. Since different approaches are needed to measure/estimate the two viscosities, the best model for ceramic tiles has been defined by contrasting experimental data with calculated viscosities within the IPERCER project [2]. It should be noted that the parameterization depends on both chemical composition of the liquid phase and persistence of crystal phases in the melt. Further variables, such as porosity, particles size, and shape, play a significant role and some attempts of modelling are available [3]. Existing models for high temperature viscosities of glasses and melts present some limits that will be overviewed. In particular, the well-known model proposed by Fluegel [4], which takes into account a large number of oxides, can be applied to melts characterized by wide ranges of composition. On the other hand, the maximum concentration of alumina expected by the model is too low compared with that of the systems here investigated, thus generating a significant error between the calculated and the measured viscosities. Although based on a lower number of oxides, the more recent model proposed by Giordano et al. [5], takes into account for alumina levels closer to those of the systems of interest. In this contribution is demonstrated that the latter model can be used to predict the viscosity at high temperature of porcelain like bodies. Examples are provided for porcelain stoneware tiles, compared with vitreous china and porcelain bodies.

References

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