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POWDER RHEOLOGY AND COMPACTION BEHAVIOUR OF SPRAY-DRIED BODIES FOR PORCELAIN STONEWARE SLABS

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The technological behavior of porcelain stoneware bodies during deposition and pressing of large slabs depends on the rheological properties of spray-dried powders and the way they affect compaction. Although the literature offers some insights into the characteristics of spray-dried powders for ceramic tiles, no data are available on bodies utilized by novel technologies for large slabs (>4 m2). In order to fill this gap, a systematic approach to properties and behavior of spray-dried powders for porcelain stoneware slabs was carried out. For this purpose, 11 industrially-manufactured spray-dried powders were characterized for intrinsic features (particle size and agglomerate size distribution; shape and moisture distribution in function of agglomerate size); rheological properties (mass flow, static and dynamic angles of repose, poured and tapped density); compaction behavior (curves of bulk density, intergranular and intragranular porosity in function of applied load); firing behavior in order to reveal any effect of dry bulk density on shrinkage and bulk density of fired samples. The effect of intrinsic characteristics on the flowability and compressibility of powders was appraised, as the mutual relationships between the rheological parameters. Two broad classes of spray-dried powders occur with a finer and a coarser agglomerate size distribution. Results reveal that ceramic powders are free-flowing, with rheological properties fluctuating in a rather narrow range of values, which makes hard to see strict correlations between the various methods. Flowability mainly depends on the occurrence of coarser aggregates, particularly those irregular in shape, stemming from coalescence of three or more individual agglomerates. The features of green compacts are somehow inherited by the fired bodies, especially in terms of shrinkage and densification kinetics, even though the starting differences are damped during firing. The performance of spray dried bodies during compaction is crucial to control the uniformity, in terms of porosity and bulk density, which has important repercussions on the properties of final slabs, especially considering that residual stresses may be related to differential shrinkages during firing due to density gradients.

References

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