REHYDROXYLATION OF CERAMIC TILES AND ITS INFLUENCE ON CURVATURE EFFECTS AFTER FIRING

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In the 1980s, rapid firing technology enabled a significant step forward in the development of tile production in roller kilns. The firing times as well as the energy consumption could be reduced to a fraction of those of the tunnel firing process in a very short time. However, a sintering time of only a few minutes does not enable a complete thermal conversion of clay minerals, resulting in disequilibrium of sinterphases and thus leads to a limited sintering activity. Thus, time-dependent rehydroxilation of transition phases (X-ray amorphous clay minerals) by water absorption from the ambient takes places, resulting in deformation of the ceramic product. Deformations are more noticeable with increasing product dimension; hence large-format products like tiles or laboratory benchtops are affected. Standard specifications, measured at kiln exit do not assure that these are being kept on a long term basis. In order to counter this problem, a process-controlled convex pre-curvature has been established, which is eliminated by concave delayed deformation effects after firing. However, this is accompanied by process uncertainty and high storage costs.

Rehydroxilation reactions of ceramics and the associated mass gain occur in two distinct steps. Stage I is characterized by transient equilibration, whereas Stage II reactions refer to rehydroxylation. RHX reactions in stage II are linear with $time^{1/4}$ – Power-law model (INCE & DEROGAR, 2014; WILSON et al. 2014). In order to gain more detailed information about the influence of raw materials and ceramic mixes on the curvature effects after firing, RHX-Process, several experiments (DTA-IR, FTIR, mass gain after autoclave treatment) have been performed.

It has been observed that the mass gain is directly related to temperature, sinterkinetics and phase composition, with a completed conversion at temperatures above 1000 °C (no Stage II reactions after autoclave treatment). Furthermore clays from different deposits with no relevant differences in mineralogical composition show a different behavior under firing and RHX. These effects are still not yet fully understood and are a matter of an ongoing research project.

INCE, C., DEROGAR, S. (2014): Journal of the Australian Ceramics Society, 50, 59-67.
WILSON, M.A., CLELLAND, S., CARTER, M.A., INCE, C., HALL, C., HAMILTON, A., BARR, C.M. (2014): Archaeometry, 56, 689-702.