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Delayed curvature of silicate ceramics

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The development of fast firing technology using roller kilns in the 1980s enabled significant progress in tile production technology. Besides the reduction of firing times as well as energy costs the increase of tile sizes became possible. The technology however implies that the required conversion of clay minerals be achieved within only a few minutes at high temperature exposure, causing incomplete phase transitions, leading to delayed effects.

The lecture presents the research, funded by the „Collective Industrial Research" (IGF) program of the German Federal Ministry for Economic Affairs and Energy (BMWi) in which the causes of time-dependent deformation effects, which are attributed to different mechanisms of water intake in then product, from the effect of hysical incorporation of water up to the rehydroxilation of X-ray amorphous transition phases from clay minerals by absorption of atmospheric water are investigated. These effects are mainly observed in large-format products such as large-sized tiles or laboratory benchtops, leading to special provision regarding storing of the products up to non-conformity to required product standards specifications, as well as storage effects. A possible and established solution by using pre-deformed dies or controlled correction of the estimated delayed curvature during the firing process with subsequent storage is associated with a degree of uncertainty in the production stability. In the lecture, individual aspects of delayed curvature of silicate ceramics caused by intrinsic thermally and mechanically induced material stresses, due to processing and inhomogeneity of the material, as well as the research into the detection and role of rehydroxilation, indicating he possibility of delayed reactions and meta-stable phases in the modern fast firing technology will be discussed. Special focus will be on the use of Infrared spectroscopy to identify the mechanisms at work.