**An Investigation into the Problem of “Delayed curvature” in Glazed and Unglazed Porcelain Tiles**

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The concept of fast firing is now the dominating technology in the ceramic tile sector and the time available to reach an optimal stabilization of the ceramic body is reduced to few minutes. The change in tile curvature after the tiles leave the kiln is a big problem in porcelain tiles after industrial fast firing and becomes more problematic as the tile size increases. The rapid cooling of ceramic tiles in an industrial kiln produces temperature gradients inside the tiles that cause residual stresses and also curvature of the tile. In this study, the variation of curvature after fast firing have been quantified with time in commercial glazed and unglazed porcelain tile products. In addition to the experimental effort, the temperature profile based on temperature difference between surface and bottom of the tile and the residual stresses during cooling were evaluated by a simulating model. Tiles were investigated by solving the coupled thermal displacement equation with finite element method as implemented in ABAQUS program. The tiles with 45x90, 60x90 and 15x90 sizes were considered in the simulations. Critical effect of temperature difference on the displacement was predicted. The effect of thermal expansion coefficient difference between tile and glaze on displacement was also determined but it was found to be not as critical as temperature difference. The delayed curvature problem can be successfully tackled by studying the critical cooling zones in which the maximum temperature difference occurred.

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