Resumen nº 14

Polishing process of ceramic tiles – Influence of tool-wear on gloss

Anatolij Olenburg[1, a], Jan C. Aurich[1, b],
Fabio Jose Pinheiro Sousa[1, c]

FBK - Institute for Manufacturing Technology and Production Systems, University of Kaiserslautern, P.O. Box 3049, D-67653 Kaiserslautern, Germany

[a]olenburg@cpk.uni-kl.de, [b]aurich@cpk.uni-kl.de,
[c]sousa@cpk.uni-kl.de

Keywords: Ceramic, Polishing, Tool-wear, Hertzian pressure

Abstract

The contact pressure is one of the most important parameter in the industrial polishing process of ceramic tiles. It is basically a function of four parameters: the elasticity moduli of both tile and abrasive tool, the applied load, and also the curvature of the abrasive tool. Due to wear, the curvature decreases during the polishing process, from a radius of 130 mm to almost 70 mm, causing an increase in the contact pressure (from 10 MPa to 15 MPa). It is known from literature that for fine abrasive grits (finer than #400) higher tool loads increase the gloss gain. However, there are little researches on the whole sequence of abrasive for different contact pressures and comparing the quality of the final surface.

The purpose of this work is to research the influence of tool-wear on the evolution of gloss and roughness of the polished ceramic tiles and to improve the quality of the generated surface. Polishing tests on a laboratory scale CNC-Tribometer have been used to study the industrial polishing process for unglazed porcelain ceramic tiles. Thereto three different curvatures were used to perform the experiments with a sequence of progressively smaller silicon carbide abrasive particles embedded in a magnesia cement matrix. To achieve and maintain the curvature of the tool during the tests, a new developed tool holder was used. This tool holder was exclusively devised for this purpose, and it is currently under patent request. The radii of the curvature were set to 130 mm, 100 mm and 70 mm. These values correspond to a new, half used and worn tool condition in the industrial polishing process, respectively. The used grit-size was from #400 to Lux.

Tile surface quality was evaluated in terms of roughness and optical gloss. The roughness was measured manually at 11 points to show a cross-section of the machined surface. The gloss was measured at 153 points with a mesh of 3x51 to determine the spatial distribution of gloss.

The topography of the tile and the tool were measured with a coordinate measuring machine. The removed work piece material and the used abrasive were calculated from the changes in the topography. The measurements were done before and during the experiments, until a saturation of gloss for each grit number was achieved.

The used abrasives show a general trend of increasing gloss and decreasing roughness during the process. The used abrasives caused the major gloss enhancement and had only a small effect on surface roughness. The results show the evolution of roughness and gloss for each curvature as a function of abrasive grit number and polishing time, as well as the material removal rate, and the grinding ratio, for each grid number and curvature.