Generation of texture on the surface of porcelain stoneware tiles during the polishing process

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Abstract – This study addresses the spatial distribution of texture over the surface of polished porcelain stoneware tiles. The occurrence of micro-scale scratches having almost the same direction could be quantitatively estimated with the aid of computational simulations, which were developed based on the kinematic parameters adopted for the polishing process. The evolution of texture was found to vary according to the position at the tile surface. The region in the centre of the tile presents a higher tendency of exhibiting preferential textures than lateral regions. However, in both places the direction observed for most scratches seems to follow the same wavelike pattern performed by the polishing heads.

The possibility of having excellent aesthetic effects together with good mechanical performance points out the porcelain stoneware tiles as the best ceramic product ever developed by the floor tile industries [1]. In this context, the texture of the proper surface has a decisive hole. In case of polished tiles, texture defines not only the tribo-mechanical properties but also the glossiness expected for the product. This works investigates the evolution of texture over the surface of porcelain stoneware tiles during the industrial polishing process. Predominance of micro-scale scratches having the same directions is usually noticed even in regions exhibiting considerable glossiness, as consequence of the kinematic adopted at the polishing train. Thus, based on kinematic equations for determining the scratching conditions of a single abrasive particle, which are available in literature [2], a simulation algorithm was developed in order to furnish the angle toward which abrasive particles scratch the surface. The sequence of abrasive contacts undergone by each region over the tile was then quantitatively attained and the corresponding distributions of scratching angle were recorded along the complete polishing process. Histrograms of scratching angle containing average values near to zero and high standard deviations are indicative of regions with a randomized texture rather than having mostly parallel scratches. With the intention of verifying such tendency experimentally, a real porcelain stoneware tile was then submitted to industrial polishing under the same conditions adopted for carrying out the simulations. After the polishing process the texture of the surface was characterized by profilometry, optical microscopy and also white light interferometry. According to the results, a good agreement between measurements and simulated pattern was obtained. The evolution of texture was found to occur in different ways according to the position at the tile surface. The region in the centre of the tile presents a higher tendency of exhibiting preferential textures than the lateral regions. However, in both places the direction of most scratches seems to follow the same wavelike pattern performed by the polishing heads. Such fact highlights the influence of the kinematic parameters adopted by the industries on the polishing quality of porcelain stoneware tiles.
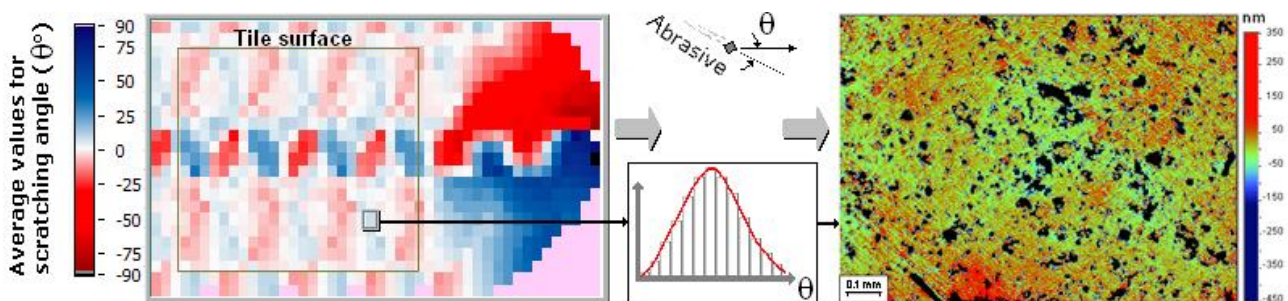

Figure 1: Spatial distribution of texture over the surface of porcelain stoneware tiles as function of the kinematic parameters

References

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