ANALYSIS OF THE TECHNICAL AND MICROSTRUCTURAL CHARACTERISTICS OF CERAMIC FLOORINGS MODIFIED BY WEAR

A. Muñoz, E. Bou, R. Domínguez, J. Gilabert

Instituto de Tecnología Cerámica (ITC). Asociación de Investigación de las Industrias Cerámicas (AICE)

Universitat Jaume I. Castellón. Spain.

1. INTRODUCTION

A key technical property to be taken into account in designing and developing flooring is abrasion resistance, owing to its importance in defining the material's possible uses. The choice of a particular product as floor covering in a building does not only require the flooring to exhibit a set of appropriate characteristics for service conditions, but also to assure that these characteristics will remain unaltered for a reasonable period of time.

The test methods set out in the standards applicable to ceramic tiles for determining tile abrasion resistance do not allow flooring life span to be evaluated, as they do not reproduce actual service conditions. Consequently, in this study, a method was used that simulates the wear occurring under real conditions owing to pedestrian traffic across the flooring. The method was validated elsewhere[1] with different in situ studies.

2. WEAR METHOD USED

The apparatus used was a semi-industrial polishing head that operated such that the flooring sample was conveyed on a belt under the simultaneously rotating head. The head had 6 abrasive pad holders that held commercial scouring pads.

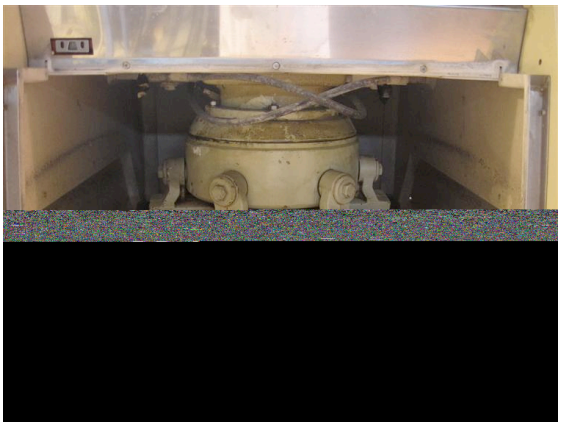

Figure 1. *Abrasive pad holders of the polishing head.*

Figure 2. *Detail of the abrasive pad.*

3. TECHNICAL CHARACTERISTICS EVALUATED

Different types of commercial ceramic floorings designed for areas with high pedestrian traffic were selected, as these types of tiles need to withstand the greatest wear under normal service conditions.

The following technical characteristics, deemed most important in verifying tile fitness for use, were determined before and after various wear stages:

- Aesthetic characteristics: visual appearance, colour, and gloss
- Stain resistance
- Slip resistance

Similarly, the following tile surface and microstructural characteristics were measured to evaluate the arising changes on a microscopic level:

- Topography
- Roughness
- SEM observation and analysis

4. RESULTS AND DISCUSSION

The results obtained are presented by means of a typical sample of a non-slip ceramic floor tile with a high slip resistance value, a rough finish, and no relief.

The evolution of slip resistance with wear is shown below. The unpolished slip resistance value (USRV) measured by the pendulum method according to UNE-ENV 12633[2] is plotted against the level of traffic represented by each wear stage. As may be observed, there was a very pronounced decrease in slip resistance in the first wear stages, tending towards a stabilisation value that depended on tile surface topography.

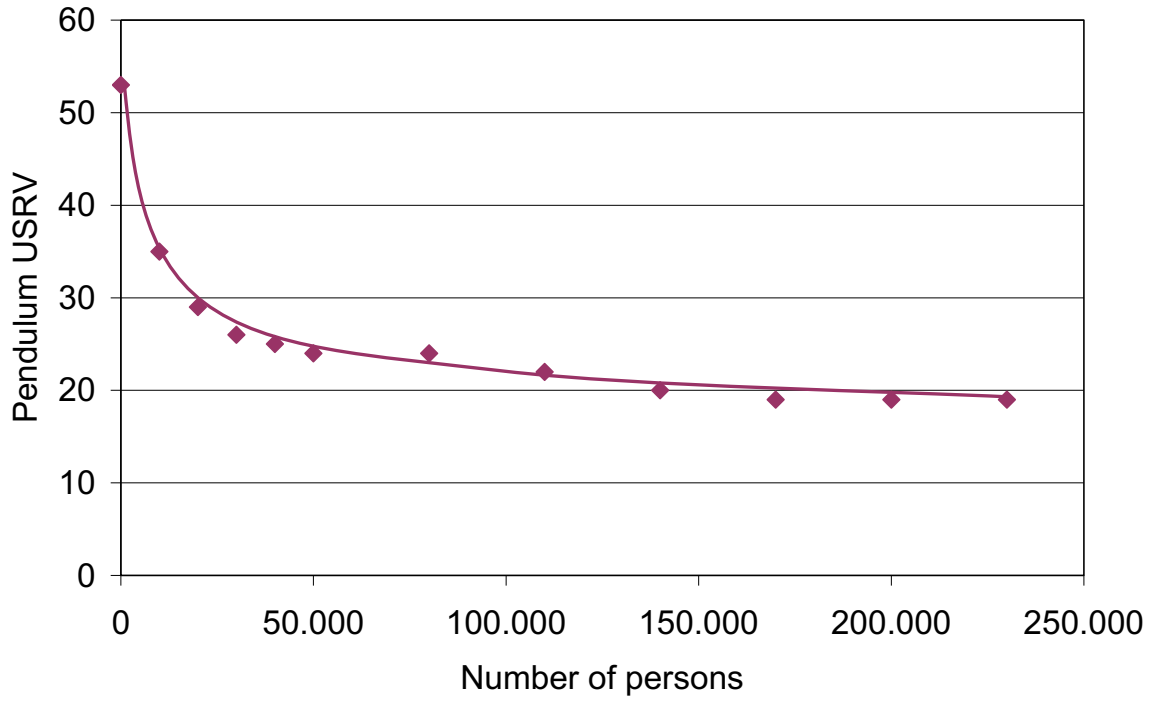

Figure 3. *Evolution of slip resistance as a function of pedestrian traffic.*

Despite the pronounced decrease in slip resistance, there was no apparent modification in tile appearance and tile performance with regard to stain resistance was maintained.

To evaluate the changes that occurred in the tile surface, which had led to a considerable drop in the coefficient of friction, the topography and roughness of the original sample and of the test pieces were characterised, corresponding to the first two wear stages, in which the most pronounced decrease in slip resistance (USRV) was observed.

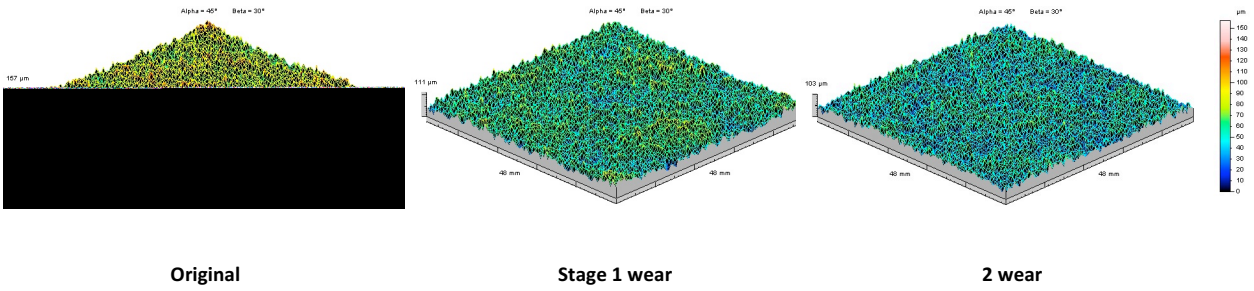

Figure 4. *Topographies of the studied samples.*

All the parameters obtained in the topographic measurements were analysed. The values of the roughness parameters that exhibited the greatest change are detailed in Table 1. The table also includes the slip resistance values for each sample.

5. CONCLUSIONS

- In most of the floorings used for heavily trafficked areas, flooring aesthetic characteristics do not alter with wear. However, some types of surfaces can modify their performance significantly in the course of their service life.
- With respect to the technical characteristics studied here, stain resistance was only observed to decrease in a very small percentage of the materials. However, slip resistance decreased in most of the tested tile samples in a more or less pronounced way, depending on tile starting topography.
- The topographic parameters that exhibited the most important change with surface wear were determined. These were consequently related to the material's loss of slip resistance performance.

ACKNOWLEDGEMENTS

This study was conducted with the support of the Valencian Institute of Business Competitiveness (IVACE) and the European Regional Development Fund (ERDF).

REFERENCE

[1] A. MUÑOZ, G. SILVA, R. DOMÍNGUEZ, J. GILABERT, M. LÓPEZ, M.C. SEGURA. Análisis de la durabilidad de las prestaciones antideslizantes de pavimentos. Qualicer 2014: XIII World Congress on Ceramic Tile Quality. Castellón: Cámara Oficial de Comercio, Industria y Navegación, 2014. (ISBN: 978-84-95931-25-2)

[2] UNE-ENV 12633: 2003. Método de la determinación del valor de la resistencia al deslizamiento/resbalamiento de los pavimentos pulidos y sin pulir