ABRASION RESISTANCE OF CERAMIC FLOORING IN ACTUAL HEAVY TRAFFIC CONDITIONS(*)

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INTRODUCTION

The progressive improvement of the technical characteristics of ceramic floorings currently enables having products that perform appropriately under intended conditions of use in most types of domains, including heavily trafficked public areas. However, the available standard methods for evaluating abrasion resistance (UNE EN-ISO 10545 Parts 6 and 7) are inadequate for predicting the durability of these materials[1], because they do not reproduce the real wear mechanisms associated with pedestrian traffic. A study is at present in progress designed to develop a simplified test method, which allows evaluating ceramic floor tile durability under actual service conditions, by in-situ installation of panels of ceramic tiles. On ending the project, the method developed will be submitted to the Technical Committee for Standardization AEN/CTN 138, as a proposed standard to replace present test methods.

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[1] ENRIQUE, J.E.; SILVA, G.; FELÍU, C.; BARBERÁ, J.; USÓ, J. Durability prediction of ceramic tile subject to abrasion processes from pedestrian traffic. In: QUALICER 96. Castellón (Spain). p.453-468.

EXPERIMENTAL

The access lanes to the self-service area of two public dining rooms at Universitat Jaume I were selected as test areas. These carry a heavy volume of traffic in a single direction (Figure 1). The materials used in the study were expressly designed with certain minimum abrasion resistance performance characteristics, so that they would exhibit significant alterations during the planned two-year period of exposure to traffic.

Figure 1. Location of the ceramic flooring in the self-service area.

The adhesive-free installation system allows withdrawing and relocating the tiles, with a view to periodically evaluating the arising changes in surface colour and gloss produced by pedestrian traffic. Photoelectric sensors are also fitted to monitor the total number of people crossing the flooring. Since durability studies under actual conditions require very lengthy periods of time in order to obtain reliable results, the study will be accelerated by using the Tribopod apparatus as a reference (Figure 2). The apparatus simulates a walker's foot movement, and its suitability for reproducing wear under light residential service conditions has been demonstrated in previous studies.

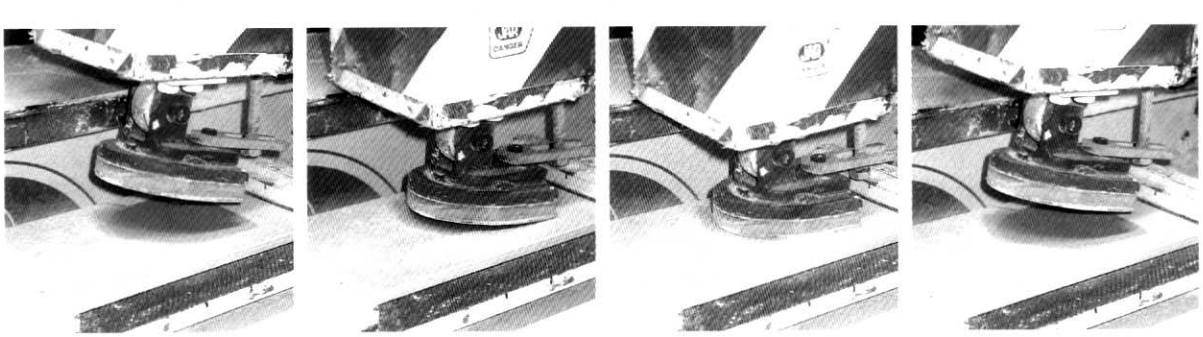

Figure 2. Tribopod apparatus movement sequence.

The results of two year's service under actual conditions of use will be used as a reference to adjust the Tribopod test parameters. This will enable reproducing the conditions of public use, and allow simulating periods equivalent to 10 years of exposure under heavy traffic conditions in an accelerated form. Both references will be used to define the test conditions of the new proposed standard for evaluating abrasion resistance.

RESULTS

Analysis of the changes occurring in the surface of the flooring during the period that has elapsed after its installation (approximate traffic of 80,000 people) confirms that specular gloss is the surface parameter modified most significantly as a result of the abrasion process in the models with a glossy as well as those with a matt surface. On the other hand, significant alterations have not been observed in the colour of the samples ($\Delta E<0.5$). Colour variation over the period of exposure was found to occur considerably more slowly. Analysis of the difference between initial gloss and gloss in different abrasion stages (Figure 3) in each type of ceramic tile installed in the panels has shown that most of the samples exhibit a rise in surface gloss, even in the case of models with high initial gloss (>70). To date, this tendency has continued to increase in every case, with the exception of a few glossy models that have started losing surface gloss.

This tendency to develop higher gloss is clearly opposed to that exhibited by every type of ceramic tile when tested using the method set out in standard ISO 10545-7, which typically produces a pronounced loss of gloss and colour. Bearing in mind furthermore, that the visual classification system used in this method does not allow perceiving changes of surface gloss, it can be concluded that the method is inadequate for estimating durability under actual conditions of use.

On the other hand, it has been confirmed that the tendency to develop greater surface gloss can be reproduced by adjusting the Tribopod test parameters. Parallel to monitoring the evolution of the panels installed under actual conditions, a study is being carried out on the effect of test conditions (type of abrasive, grain size, saturation level, sole displacement) in the surface abrasion process with the Tribopod. Figure 4 plots the evolution of gloss produced with the Tribopod in the unglazed flooring with a smooth matt surface, using different size quartz grain as abrasive and modifying sole displacement on the surface. The results are observed to vary in a very significant manner, so that test conditions can be adjusted to reproduce behaviour under actual service conditions.

Based on the tendencies of gloss and colour evolution of the different types of materials used in the study, optimum test variables will be defined with the Tribopod to reproduce heavy traffic conditions, establishing a correlation between the number of steps taken by the apparatus and the equivalent traffic under actual conditions.

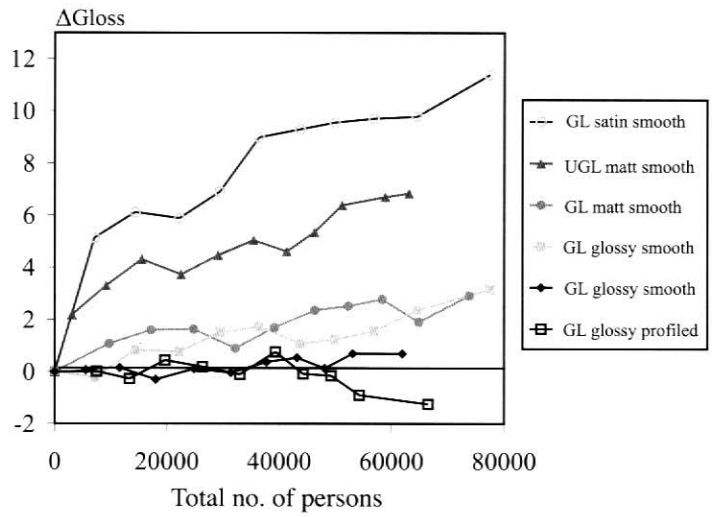

Figure 3. Evolution of gloss under actual conditions.

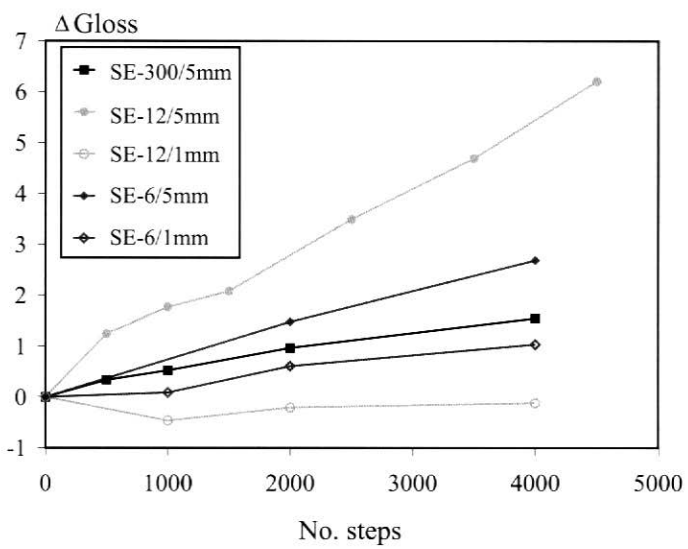

Figure 4. Evolution of gloss with the Tribopod (UGL matt smooth).

Based on this correlation it will be possible to estimate the durability under these conditions of any type of surface and develop equivalent periods of use under real conditions in an accelerated way. These results will serve as a reference for the adjustment of the new simplified test method, currently in the development stage.