VARIATION OF ROUGHNESS AND GLOSS IN GLAZED TILE WITH THE INTENSITY OF THE WEAR PRODUCED WITH A STANDARD ABRASION TESTER

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1. INTRODUCTION

The surface deterioration of ceramic tile glazes as a result of wear is detected as a change in gloss and texture. To study this phenomenon, the evolution has been monitored of gloss and roughness (expressed through the parameter Ra) of the surface of certain homogeneous ceramic glazes, on subjecting these to wear with a standard abrasion tester.

2. EXPERIMENTAL PROCEDURE

The procedure used for producing wear in the glaze surface is based on the PEI method (EN 154). Several test specimens were prepared, which were subjected to wear stages ranging from 0 to 4000 revolutions of a standard abrasion tester [1], applying the method set out in the standard mentioned.

Glaze surface gloss of the test specimens was measured with a reflectometer at a 60° angle of incidence. Ten gloss values were measured at the starting glaze surfaces and their arithmetic mean was calculated. The partially abraded surfaces were scanned with the instrument and the lowest gloss value was recorded, assuming that it corresponded to the most abraded area of the specimen.

A roughnessmeter, fitted with a mechanical pick-up that had a 5 μm diameter diamond stylus tip, with a tip angle of 90°, was used to measure surface roughness [2]. Ten roughness profiles were obtained of each test specimen surface, which were measured at the unabraded specimen surface on a representative area of the surface texture that exhibited no defects which might bias the results. In the case of the test specimens that had been abraded with the abrasion tester, the profiles were obtained by traversing the abraded circle diametrically, and the arithmetic mean was calculated of the resulting values. In order to represent surface roughness, the parameter Ra was chosen in foregoing experiments, which is defined by Equation (1):

$$Ra = \int_0^{l_m} \frac{1}{l_m} |y| \cdot dx \qquad (1)$$

where:
Ra = average roughness (μm)
l_m = measured roughness profile length (μm)
y, x = coordinates of the points making up the profile (μm)

3. RESULTS AND DISCUSSION

On plotting the values of these surface properties versus the number of revolutions of the abrasion tester, with which wear was produced, it was observed that the results obtained for all the tested glazes could be aligned according to two different types of curve.

Fig. 1 shows that gloss decreased in an apparently exponential form, as wear intensity increased through the rising number of revolutions of the abrasion tester. Roughness, however, grew in the form of an S-shaped curve (Fig. 2).

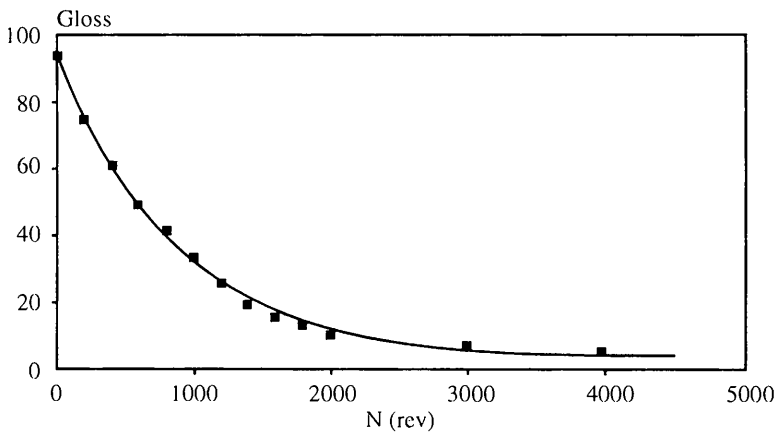

Figure 1. *Evolution of glaze gloss with the number of revolutions of the abrasion tester.*

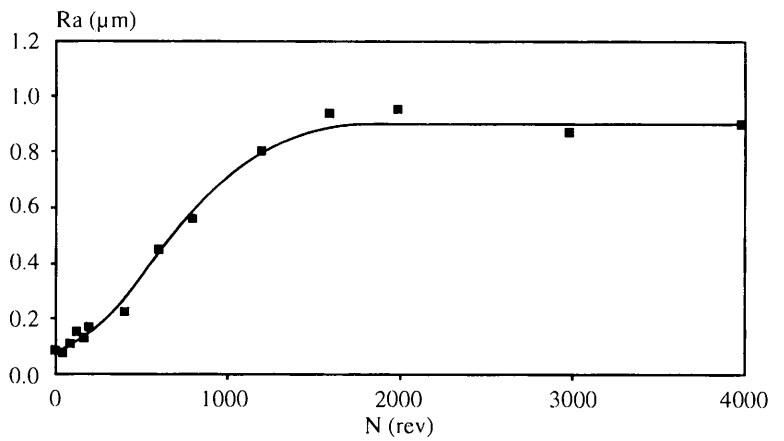

Figure 2. *Evolution of parameter Ra of a glaze with the number of revolutions of the abrasion tester.*

Two equations of an exponential type have been proposed, which relate gloss and roughness to abrasion intensity:

$$\beta = A \cdot e^{-K_B \cdot N} \quad (1)$$

$$Ra = \frac{B}{1 + C \cdot \exp(-K_R \cdot N)} \quad (2)$$

where:
β = gloss; Ra = average roughness (µm); N = number of revolutions of the abrasion tester; A, B, C, K_B and K_R = constants whose values differ for each glaze.

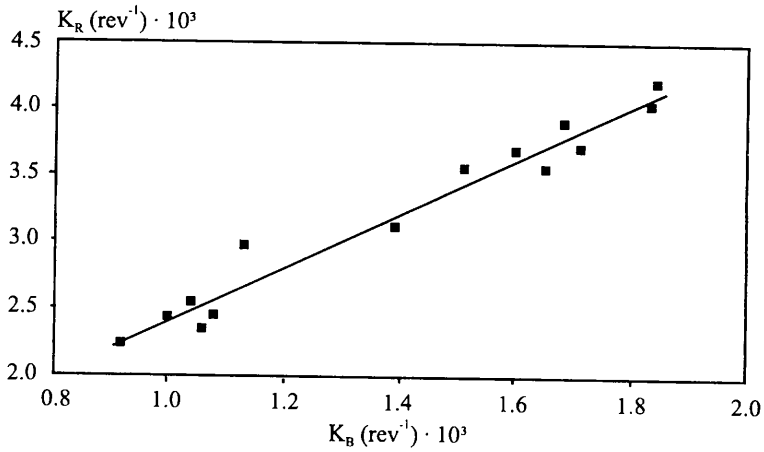

Figure 3. *Relationship between constants K_R and K_B.*

A linear relationship was also found between constants K_B and K_R of Eqs. (2) and (3), calculated for a series of homogeneous glazes of different nature (Fig. 3), which suggests that there is a direct relationship between gloss loss and topographical change of the glaze surface, when it is subjected to wear.

4. REFERENCES

[1] UNE 67-154-85 (EN 154). Ceramic tiles. Determination of abrasion resistance. Glazed tiles.

[2] Mummery, L.; Surface texture analysis. The handbook; Mühlhausen: Hommelwerke 1990

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