STUDY OF THE WEAR MECHANISM IN GLAZED TILES BY SCRATCHING TESTS

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1 - ABSTRACT

This study presents the basic principles of the scratch technique and shows its potentialities as an aid for studying abrasive wear in ceramic flooring. The use of this technique in the wear process mentioned allows the determination of important parameters, such as: acting strength on the abrasive particles, scratch hardness, specific energy for material removal, a brittleness index, morphology of plastic flow, etc. With these parameters it is possible to make comparisons between the behaviour of different kinds of surfaces and compare them with the results of commonly used test procedures.

2 - THE SCRATCH TECHNIQUE

In the abrasive process, the tribological system is made up of a complex abrasive, the piece that is to be abraded, and an interfacial product. An abrasive is to be understood as the hard asperities or particles that can be free or yet fixed on an antagonistic surface. In a sclerometric experiment, the several existing contacts are assumed to be independent of each other, particularizing one of these contacts and assessing the parameters of the abrasive process found. Because of this, it is necessary to idealize the morphology of the abrasive particle and surface to be worn. Thus an indentor with simple and well-known geometric forms can be considered as an abrasive particle, while the surface that is worn should show a certain planarity. These conditions, although very idealized, efficiently contribute to the

understanding of the fundamental aspects of abrasive wear, without needing very complex modelling. The principal potential of the presented technique can be summarized as follows:

- Determination of the abrasive effort on the abrasive micro event in study
- Criteria establishment for the ductile/brittle abrasiveness transition and evaluation of the contribution of each one on the process;
- Possibility of evaluating the morphological deformation near the indentor and determination of the influence of the position and geometry of the indentor, attack critical angle, etc;
- Physical characteristics determination of the contact such as scratch hardness, specific energy for material removal, brittleness index, etc.

The present work has as its main objective the presentation of this new experimental technique to help investigate the mechanism of abrasive wear in ceramic flooring. We intend to approach the most important potentialities of the sclerometric technique by using some samples with differentiated glaze microstructures, obtained using floor tile prepared with raw materials typically used in industry.

3 - EXPERIMENTAL PROCEDURE

Sample Preparation: Industrial raw materials were processed as commonly occurs at industry labs.

Scratch Test: Each sample was subjected to four scratches with different normal loadings, keeping other variables constant.

Results Evaluation: All the scratches were observed by SEM and their width was measured.

Other parameters (efforts diagram, etc.) were obtained by the sclerometric equipment. Scratch Hardness and Specific Energy for Material Removal were calculated.

4 - RESULTS

For all scratches of each sample, the following data were obtained:
- Tangential and normal forces;(F_t , F_n);
- Apparent Friction Coefficient (μ^*);
- Scratch Hardness (H_r);
- Specific Energy For Material Removal (e);
- Scratch Width (L).
- Micrographs of the surface after the scratch test

The results obtained from experiments run on glazed surfaces with projecting microstructures were consistent with the expected tendencies. Previous results relative to the wear resistance of these materials, using the standard ISO 10545, PEI abrasion test, showed the same tendencies as obtained in this paper. Thus, a comparative study between the two methods, from the point of view of the mechanisms involved in the tribological system studied, can give information regarding the validity for use of the scratch technique in studying the mechanism of abrasive wear in glazed surfaces.

5 - CONCLUSIONS

• The scratch technique permits the quantitative determination of the mechanical parameters relating to the resistance to wear by abrasion of glass surfaces, such as: scratch hardness, specific energy used in the material movement and the acting forces in the abrasive micro event.

• Observation by scanning electron microscopy of the scratch made by the indentor on the glazed surface, using preset mechanical parameters, permits describing the abrasive mechanism and comparing the abrasive behaviour of different materials and microstructures

• The same abrasive behaviour tendencies of different materials are consistent when we compare the results obtained by the scratch technique and the ones obtained by the PEI method.