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Porcelain stoneware is a product in which the synergy between manufacturing technology and physical-mechanical properties is particularly well developed with excellent results. Since this product has excellent technical characteristics, such as good flexural strength, resistance to surface abrasion and stains, surface hardness and, in comparison with other classes of tiles, a high fracture toughness, it can be used in those environments where high performance and reliability are required. For these reasons, porcelain stoneware tile production is still rather high. In example in Italy, in 2010, on a whole tiles production of about 387 million of m², more than 285 million of m² was porcelain stoneware (181 million of m² glazed and 104 million of m² unglazed).

With the aim to reduce the risk of slipping on ceramic tiles, several of treatment have been introduced to the market. These treatments consist of acid based applications on the ceramic surfaces (hydrofluoric acid, ammonium bifluoride), able to produce a chemical etching causing microstructural changes, diminishing glossiness, color variations and sometimes lowering the cleanability of the products. In literature, some works about chemical etching as anti-slip treatment are available only for glazed ceramic tiles. Nevertheless, studies to assess the effectiveness of the treatment in accordance to standardized methods for slip resistance, are still missing.

A deep knowledge of the tile characteristics, in terms of composition and microstructure, plays a key role to assess if the acid treatment will give rise to an anti-slip surface without damage the ceramic product. In the present work different kind of commercial porcelain stoneware tiles (glazed, as fired, polished) were considered and analyzed before and after the anti-slip treatment, in order to correlate their performance (slip resistance, wear resistance, stain resistance) to their mineralogical composition and microstructural characteristics.

To evaluate the treatment effectiveness, on the surfaces both treated and untreated, slip resistance was determined according to several standardized methods: pendulum (EN 13036-4), dynamometer (ASTM C1028) and Tortus (B.C.R.). The effects caused by the treatment on the surface was studied in terms of stain resistance (ISO 10545-14), chemical resistance (ISO 10545-13), wettability (measurements of contact angle) and gloss variations (ASTM C346).

Mineralogical composition and microstructural characteristics of the tile surfaces have been deeply investigated by X-ray diffraction and scanning electron microscope. Surface metrology of the tiles has been studied by a confocal profiler. Furthermore, for the polished porcelain stoneware tiles, image analyses were carried out on the tile surfaces before and after the anti-slip treatment, to evaluate the pores dimension, shape and distribution.

By the comparison of the treated and untreated surfaces of the same product, it will be possible to analyze the effects in terms of visual appearance, cleanability and anti-slip performance. Moreover, by the comparison of all the treated surfaces, it will be possible to evaluate which products achieve the best anti-slip performance.