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EFFECTS OF NANO-OXIDES ON THE SURFACE PROPERTIES OF CERAMIC TILES

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Nowadays nanopowders are of extreme interest in many fields of application for their peculiar physical and chemical properties, mainly due to their dimensions. In material science, nanopowders are often used to prepare functionalised coatings by using quite complex and/or expensive application methodologies, such as sol-gel, physical or chemical vapour depositions. Moreover the risk for the human health, principally related to the inhalation and skin contact with the nanoparticles, can not be neglected.

The peculiar characteristics of nano-sized materials, in particular enhanced diffusivity and chemical reactivity, might been exploited to develop silicatic based ceramics with new and superior surface properties. The presence of nanoparticles on the working surface of ceramic tiles should be able to confer a higher added value to this class of product, due to their improved surface properties, further broadening the application spectrum.

In the present work, porcelain stoneware tile samples, with superior surface physical-mechanical characteristics were obtained by the use of nanoparticles oxides, such as zirconia and alumina.

To avoid any dangerousness, the nanoparticles of zirconia and alumina, having an average diameter of 80 and 70 nm, respectively, have been used in form of aqueous suspension and sprayed, by airbrush, directly on the green ceramic body. Moreover, to promote the crystallisation of mullite, a well balanced mixture of nano-allumina and kaolin, was also considered.

The use of the air-brushing system, even if it does not promote a continuous surface coatings, favours the penetration of the nanoparticles through the green material, favouring the interaction with the ceramic body during the firing step. After the sintering treatment at 1180°C, the penetration depth of the nanoparticles was thoroughly investigated by SEM-EDS analyses on the cross section of the samples. In order to qualitatively examine the crystalline phases developed on the ceramic surfaces, with and without the nanoparticles, X-ray diffraction analyses were carried out.

Micro-hardness tests were performed on the as fired surfaces, at different indentation loads (0.5-2.0 N), allowing to determine changes in the mechanical behaviour for the presence of the nanoparticles. The chemical resistance of the ceramic surfaces was evaluated by microstructural observation and colour shifting, by using UV-Vis spectrometer.

The added nano-oxides particles largely covered the ceramic surfaces, showing a good interaction and reaction with the substrate, that is responsible of the positive obtained results. Furthermore, the combined use of the nano-suspension and air-brushing, to functionalise the ceramic surfaces, resulted to be strictly compatible within the traditional ceramic processes.