

Innovation in stoneware tile production: the aid of mineralogy to win the raw material challenge

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The technology of porcelain stoneware transformed the ceramic sector bringing innovation, not only in the production process, but also in the final product which become to be employed in for new applications. Today, porcelain stoneware is the best-selling ceramic material in the world. In recent years, with the advent of new technologies and production plants, there has been a huge leap in the range of formats which has led to production of the so called "large slabs". The development of ceramic products with large dimension induced the redefinition of interior architecture. Large porcelain stoneware ceramic slabs are in fact used as coating for doors, wardrobes, kitchen doors, kitchen and bathroom tops. The standard composition of a porcelain stoneware body is usually the following: 45% of feldspars (melting component), 40% of clays and kaolins (plastic component), 12% of quartz sands (structural component) and 3% of complementary raw materials. It is well known that the best clays for ceramic production are those coming from the Donbas region in Ukraine. Unfortunately, after February 2022, the Russian invasion of Ukraine has led to a huge crisis in the import of raw materials from Ukraine. Among these, also the clays and kaolins used by ceramic industries for the production of the porcelain stoneware tiles. Consequently, the Ukrainian crisis has forced the ceramic industries to change the batch formulations and to look for alternative raw materials, able to replace the Ukrainian ones. Thus, the companies of the Sassuolo district have started to produce porcelain stoneware tiles using clays coming from other regions of the world but these clays are not characterized by the same exceptional properties of the Ukrainian ones. In fact, it has been observed that after the changes of the bodies formulations, the large slabs have started to present several problems during the post-firing phases, such as breaking of slabs during the cutting phase. The aim of this PhD project will consist in the comprehension of the changes occurred in the bodies formulations after the Ukrainian crisis and how these changes have affected the technological properties of the porcelain stoneware tiles. In particular, the analytical techniques of X-Ray Fluorescence (XRF) and X-Ray Powder Diffraction (XRPD) will be used to characterize of the old and new bodies formulations with the aim to understand what changes have occurred after the replacement of Ukrainian clays and what changes occur during the firing phase. Subsequently, the large slabs produced before and after the Ukrainian crisis will be characterized with the aim to understand which are the differences between the benchmark and the problematic products. Furthermore, the slabs will be characterized from a microstructural point of view exploiting conventional techniques such as Scanning Electron Microscope (SEM) and non-conventional techniques such as micro-tomography with the aim of evaluating micro-defects inside the slabs.

Finally, statistical methods will be used for the data analysis and once understood which is the origin of the problems, possible eco-sustainable and economic solutions will be search.