CHARACTERISATION OF GRINDING TOOLS USED IN THE PORCELAIN TILE POLISHING STAGE

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1. INTRODUCTION

Polishing is a very important part of the porcelain tile manufacturing process because of its cost, and the aesthetic and technical characteristics it gives the end product.

During this polishing stage, grinding tools are used that are primarily made up of SiC, corundum, and quartz in a magnesium oxychloride and/or phenol resin matrix [1,2].

These materials are very difficult to analyse because of the presence of components of different nature. The methods described in the literature on the characterisation of SiC-based materials are few and only address materials with high SiC concentrations [3,4], while it is important to have a rapid, reliable control method that enables consistent quality of these materials to be assured.

Therefore, the purpose of this study has been to establish a system for characterising grinding tools that contain SiC through use of element analysis techniques, wave-length dispersive X-ray fluorescence spectrometry (WD-XRF) and X-ray diffraction (XRD), in order to have a rapid, simple, reliable control method that allows their composition to be established.

2. EXPERIMENTAL PART

To carry out the study, five types of silicon carbide-based grinding tools used in different phases of the polishing process were chosen, i.e. with differently sized silicone carbide particles.

A method has been developed for comprehensive chemical characterisation of these materials, from sample preparation (milling) for subsequent analysis, an essential step because these materials are difficult to mill and can become contaminated during the process, to the choice of most suitable analytical technique for determining each component.

Thus, milling was performed in a tungsten carbide ring mill, taking into account sample contamination by milling equipment material in subsequent analysis, because silicon carbide is a harder material than tungsten carbide. Before chemical characterisation, the phases were identified by XRD with a view to identifying the phases making up each studied grinding tool, which was necessary for chemical analysis. Si, Al, Fe, Ca, Mg, Na, K, Ti, Mn, P, Cl, and S were determined using WD-XRF, preparing the sample in the form of fused beads and pressed pellets. Finally, silicon carbide was determined indirectly from the determination of the different forms of carbon present in each analysed grinding tool. Element analysis was thus used to analyse the organic carbon (at a temperature of 490ºC) originating from the resin, the carbon at 950ºC, which includes organic carbon and the carbon

from the carbonates in the sample, and total carbon, analysed at a temperature of about 2000ºC. The silicon carbide concentration was determined from the results obtained on subtracting the carbon analysed at 950ºC from the total carbon [5].

To validate the measurement by WD-XRF, mixtures of the following certified reference materials were prepared: BCS Nº 389 High-purity Magnesite, BCS Nº 394 Calcined Bauxite, EURONORM-ZRM Nr. 777-1 silikastein, EURONORM-CRM Nº 782/1 Dolomite, GBW03122 Kaolin, IPT-72 Sodium Feldspar, NaCl supplied by Merck, and MgCl2 supplied by Merck, with a view to obtaining similar compositions to those of the samples analysed. To validate the measurement of the different forms of carbon, the following reference materials with known concentrations of total carbon, carbon at 950º, and total carbon were used: SRM 112b Silicon Carbide, BCS-CRM 359 Nitrogen Bearing Silicon Carbide, GBW07402 Soil, GBW07403 Soil, GBW07404 Soil.

With the information obtained in phase analysis and chemical analysis, the phases were quantified and it was observed that the studied grinding tools were basically made up of silicon carbide and corundum as abrasive agents and magnesium oxychloride as binder, in addition to minor components such as: halite, bassanite, dolomite, calcite, periclase, talc, brucite, and quartz.

3. CONCLUSIONS

A method of complete chemical characterisation of a silicon carbide-based grinding tool has been developed that can be used for quality control of these products.

XRD analysis was used to identify the phases present in the studied grinding tools and to enable chemical analysis to be more satisfactorily addressed.

WD-XRF analysis was used to determine the elements making up a grinding tool, except carbon, the samples being prepared either as beads or pellets, depending on the element to be analysed.

Carbon element analysers with variable operating temperature were used to analyse organic carbon, carbon at 950ºC (sum of organic carbon and carbon from the carbonates), and total carbon. This information was used to calculate the SiC concentration.

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