INFLUENCE OF PARTICLE SIZE REDUCTION ON THE MICROSTRUCTURE AND CHARACTERISTICS OF SOME GLAZES

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1. ABSTRACT

This study examines the effect of the particle size distribution of three glazes used in industry on their microstructural characteristics. To do so, three frits were selected: a calcium and zinc transparent frit, a zirconium opaque frit, and a calcium matt frit. The particle size distributions obtained exhibited a mean diameter of about 10µm, 5µm, and 0.7µm. The microstructure of each fired glaze was observed by SEM–EDX and glaze pore size distribution was determined by image analysis. It was verified that glaze particle size had a pronounced effect on pore size and on crystalline phase size.

2. EXPERIMENTAL PROCEDURE

Three glazes were prepared by adding 8 wt% kaolin to each of the selected frits. Three suspensions of different particle size were prepared for each glaze. The distributions with a mean diameter of about 10µm (T1) and 5µm (T2) were obtained by conventional milling. The finest distribution, with a mean diameter of 0.7µm (T3), was obtained by milling T2 in a high-speed grinding mill, using an organic suspending agent. The suspensions were applied onto conventional unfired ceramic bodies and fired in a laboratory kiln according to a standard cycle at the most appropriate temperature. After firing, their microstructural characteristics were determined by SEM–EDX and their pore size distributions were determined by image analysis.

3. RESULTS AND DISCUSSION

The most appropriate microstructural characteristics for all test glazes were obtained on reducing peak firing temperature of the T1 and T2 particle sizes by 50ºC for the T3 particle size. T3 closed porosity was slightly higher than that of T1 and T2. In contrast, the pore size distribution (PSD) (Figure 1) of the glaze obtained with T3 particle size was finer than those of the T1 and T2 glazes. It was further noted that the PSDs corresponding to the T3 glazes were practically identical, even though their physico-chemical nature was very different.

Comparison of the size of the crystals that formed on firing the zirconium (zircon) opaque glaze and the calcium and zinc (plagioclase) matt glaze (Figure 2) revealed that the smallest crystals corresponded to the glazes obtained from the finest particle size (T3). Phase separation in the glass matrix of the zirconium glaze obtained with T1 was larger than that corresponding to T3. The presence of small zirconia grains from the milling operation was also observed in T3. No differences were detected in the transparent glaze on varying particle size, except for the presence of zirconia contamination from milling.

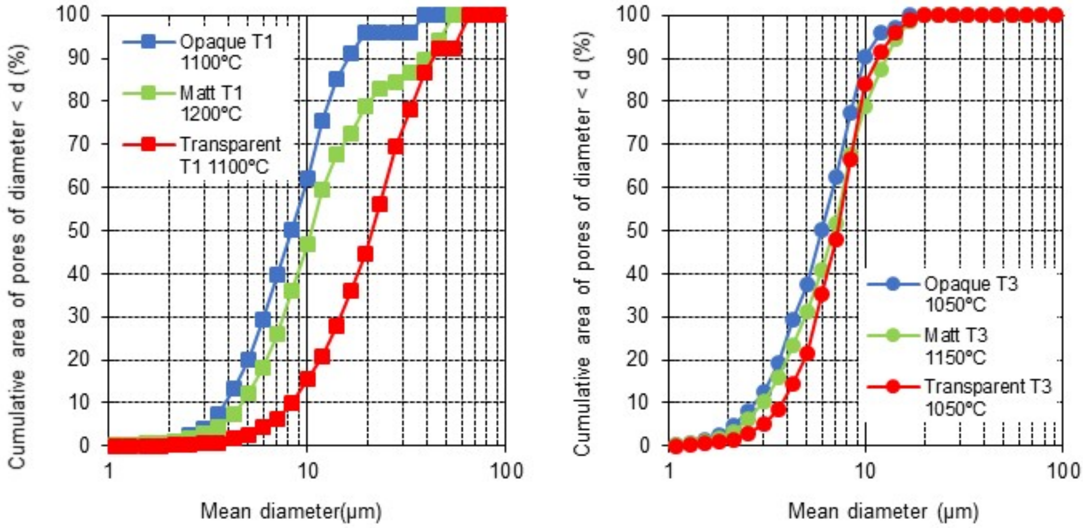

Figure 1. *Pore size distribution of the opaque, matt, and crystalline glazes obtained with particle sizes T1 and T3.*

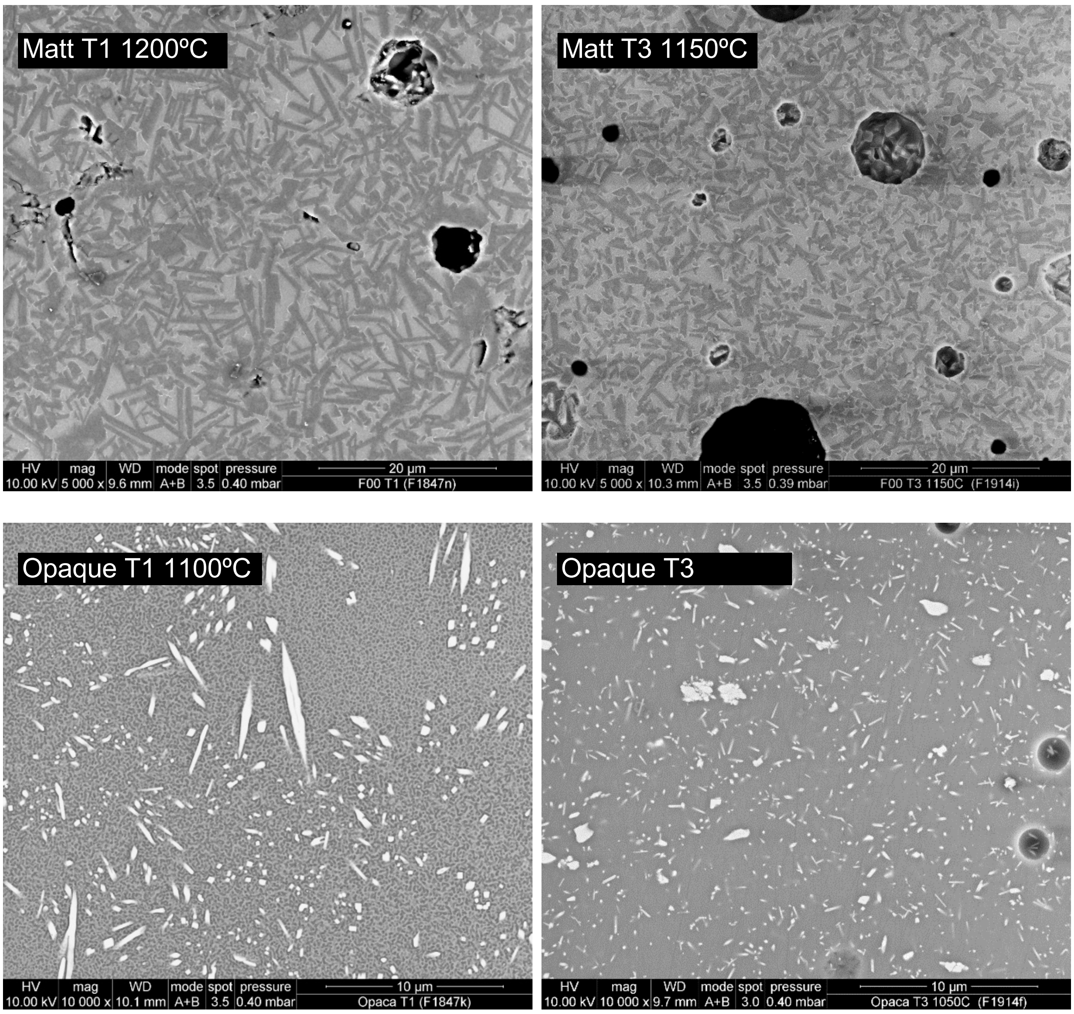

Figure 2. *Microstructure of the matt and opaque glazes obtained with particle sizes T1 and T3.*