Resumen poster 128

THE INFLUENCE OF THE AVERAGE PARTICLE SIZE OF ZIRCON ON ITS OPACIFYING CAPABILITY IN CERAMIC GLAZES

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ABSTRACT

The opacifying capability of the zircon depends on several characteristics such as the chemical and mineralogical composition, the mean particle size and size distribution, etc. Mie’s theory describes the effect of the average particle size of the opacifying phase on the diffuse reflectance in glasses and suggests that, for zircon dispersed in a window glass ($n = 1.5$) the average diameter of 0.7μm should produce the maximum opacity. If this prediction is valid, it would simplify considerably the life of many ceramists all over the world. However, the development of Mie’s theory required many assumptions that may not be always valid and may compromise the general validity of its predictions. Also, it’s important to take into consideration two practical aspects: 1) the costs of producing such a fine particle size are quite high and 2) the decrease of the particle size would increase the probability of the zircon particles dissolving into the glaze.

The main objective of the present work was to evaluate the influence of the average particle size of zircon on its opacifying capability. To achieve this, samples of six commercial zircons, from different sources and countries, were used. After the samples were fully characterized, they were grinded to produce samples with different average particle sizes. The opacifying capability of the different samples was comparatively evaluated, against a standard, through the measurement of the colorimetric coordinate L, by a spectrophotometer, in glazed surfaces produced by the standard procedure. The glazing conditions were studied to avoid the interference of the color of the supports. Through the analysis of the results a standard experimental procedure, mentioned above, was established. The influence of the zircon content and the maximum firing temperature, on the opacifying capability of the samples, also was evaluated. The influence of the variables mentioned above on the other colorimetric coordinates, a and b, were also recorded.

The results have shown the profound influence of the average particle sizes of the zircon samples on their opacifying capability. The general behavior of the curves representing the values of relative L versus average particle size was similar and L increases with the decrease of the average particle size for all samples. However, the position of the curves corresponding to the different samples has varied considerably indicating that it's not a good practice to fix a particle size value for zircons with different characteristics.

The results of the study of the effects of the content and maximum firing temperatures, on the opacifying capability, also have varied considerably from sample to sample. As expected, the increase of the zircon content lead to higher opacities for all samples, however, the amount required to achieve the opacity of the standard zircon varied considerably. The increase of the maximum firing temperature resulted in a decrease of the values of L and, as for the average particle size, the curves presented a similar shape however their positions varied considerably.

In summary, the finds of the present work have shown that it's wise to evaluate properly the opacifying capability of every zircon to determine the appropriate amount and average particle size to optimize it's performance and that the use of fixed values for these parameters could have significant performance and economical implications.