COMPARATIVE STUDY OF THE PERMEABILITY OF DIFFERENT ENGOBES AS A FUNCTION OF THEIR SPECIFIC SURFACE AREA DETERMINED BY LASER DIFFRACTION

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The importance of the application of an engobe on ceramic bodies is well known. Among all the properties that the engobe provides the tile with, there is that of providing it with impermeability to water, and thus avoiding problems like changes of colour in the finished product, especially when porous wall tiles are involved.

Engobe permeability depends on several factors. One of them is the specific surface area of the particles, since by increasing the specific surface area of the particles in a suspension, the size of the capillaries in the porous bed decreases and, therefore, it becomes more difficult from a fluid to cross it.

The determination of the specific surface area is generally performed by means of N_2 adsorption with the classic BET method, recognized world-wide as the standard method. However, in the present work, it has been attempted to verify whether the data offered by the laser diffraction instruments on specific surface area can be considered valid when it comes to comparing the permeability of different engobes.

In the instrument used, the specific surface area is defined as the total area of the particles with respect to their gross weight. The unit is m^2/g and it is necessary to introduce the density data of the particle for the calculation. When this information is not known, the instrument considers this to be $1 g/cm^3$. The mathematical calculation is based on the assumption that all the particles are simultaneously spherical and non porous and, therefore, is subject to several theoretical considerations. The equation from which the specific surface area is determined is as follows:

$$SSA = \frac{6\Sigma \frac{Vi}{di}}{\rho \Sigma Vi} = \frac{6}{\rho D`[3,2]}$$

Ecuation 1.

Where Vi is the relative volume of the particle, d is its diameter, y ρ is the particle density.

In order to carry out the study two experiments were conducted. In the first, six engobes were prepared, only varying the type of clay used in their composition, it thus being possible to see how each affected the drying time of the engobe and, hence, engobe permeability.

First, the clays were dried in a laboratory oven to 0% humidity. The deflocculation curve was then determined of each engobe with a Brookfield rotational viscometer, with a view to determining their optimum deflocculant content.

The deflocculant content, which provides the minimum suspension viscosity (deflocculated suspension), was determined from the deflocculation curves.

The six engobes were then re-milled, using this deflocculant content, keeping the milling time, solids content, and ball size distribution of the mill constant.

After the milling, the six slurries were allowed to cool and their surface specific area (SSA) was then determined using a laser scattering instrument. The methodology followed to make the measurement is the one indicated in the instruction manual of the laser scattering instrument used.

Next, each one of the engobe slurries was stirred for 5 minutes in a laboratory stirrer and the suspension was then applied on to a green stoneware piece by means of a slide applicator with an opening of 400 μm. A timer was used to determine the surface drying time of the consolidated layer, starting when the slide applicator finished its travel across the piece and stopping when water was no longer observed at the surface. Those areas where there was a greater build-up of material (start and end of the application) were into taken not account. The test was repeated twice to calculate the arithmetic mean of the times. The temperature was the same one during the performance of all tests.

In the second experiment, the same procedure was carried out as in the first, but in this case three completely different engobes were used, both in the type of clay and in the remaining raw materials.

From the results obtained in both experiments, it was observed that as SSA decreased, the drying time (ts) of the engobes decreased.

The drying time indicates the greater or lesser difficulty that the body has to absorb the water, i.e., it contributes information on the permeability of the engobe. Thus, the shorter the drying time, the greater the ease with which it absorbs water, and as a result, the greater the permeability.

Therefore, as the measured specific surface area increases with the laser diffraction instrument, engobe permeability decreases. These results agree with those predicted by the theoretical models of the permeability of a porous bed.