THE RELATIONSHIP BETWEEN THE CHARACTERISTICS OF CERAMIC TILES, BEFORE AND AFTER FIRING, AND THE WATER CONTENT OF GRANULATED POWDER AND THE COMPACTATION PRESSURE

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Even in the best ceramic tile industries the moisture of the powder and the compaction pressure change with time and from place to place inside the plant. These variations are inevitable. In this context the objective of the present work is to determine the consequences of these variations on the characteristics of the ceramic tiles before, during and after firing. With this knowledge it will be possible to establish the acceptable limits for the variation of the moisture of the powder and compaction pressure and look for practical means of achieving the required degree of processing control to produce tiles with the desired characteristics.

An industrial granulated powder typically used for "monoporosa", produced by the wet route, was used. The moisture of the powder (U) and compaction pressure (P) were adjusted to prefixed values. The green compacts were dried and sintered at fixed conditions and the dried density (Ds), flexural modulus of rupture after drying (MRFs), firing shrinkage (RLq), water absorption (AA) and flexural modulus of rupture in three points after firing (MRFq) were evaluated.

Figure 1 shows the variation of Ds as a consequence of the variation of the moisture of the powder for various compaction pressures. For each compaction pressure Ds increases linearly with P, except for the highest values of P and U. From a practical point of view, Figure 1 shows that the same values of Ds can be obtained using several different combinations of U and P.

The increase of Ds with U, for the same P, shown in Figure 1, is due mainly to the decrease of the volume of the pores between the granules (intergranular). The lubrication

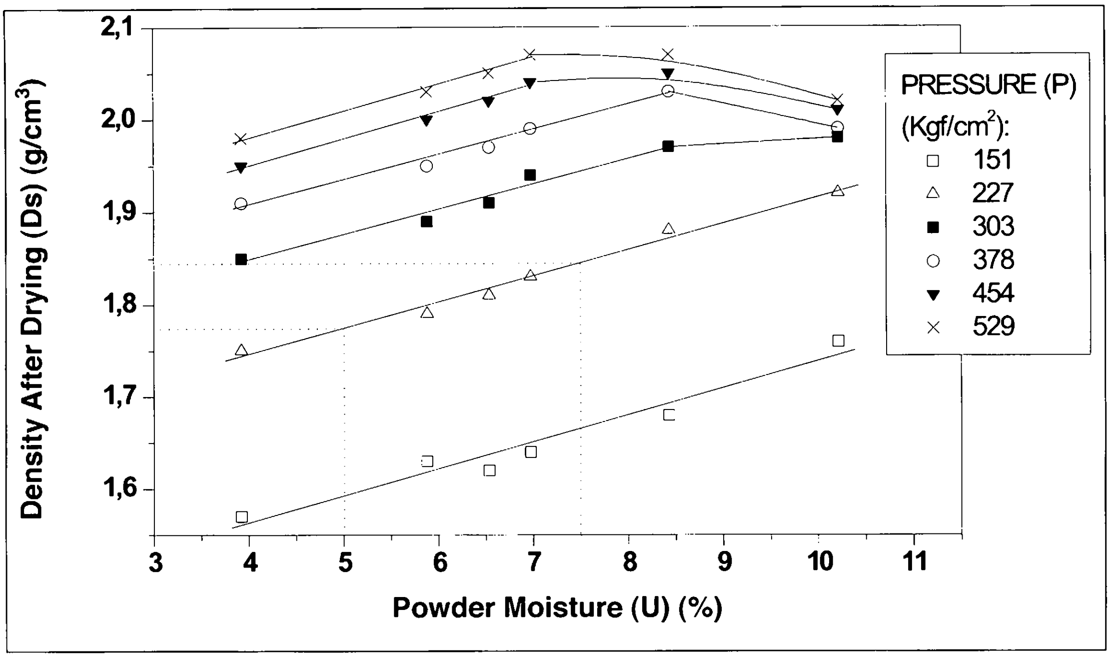

Figure 1: Variation of the dried density (Ds) with the moisture of the powder and the compaction pressure.

effect of water on clay leads to the decrease of the yield stress and, in doing so, increase the degree of deformation of the granules, for the same P, when U is increased. The deformation of the granules, due to the local stress distribution and the sliding of the clay particles inside the granules, is directed towards the pores between granules (intergranular) and leads to the observed increase of Ds. For the highest values of Ds and U in Figure 1, the intergranular pores have almost disappeared and the volume and size of the pores between the particles inside the granules (intragranular) have decreased below the volume of water added. This new configuration of the system probably is responsible for the deviation from linearity of this part of the results. The MRFs increases with the increase of Ds, regardless of the P and U used to produce the compact.

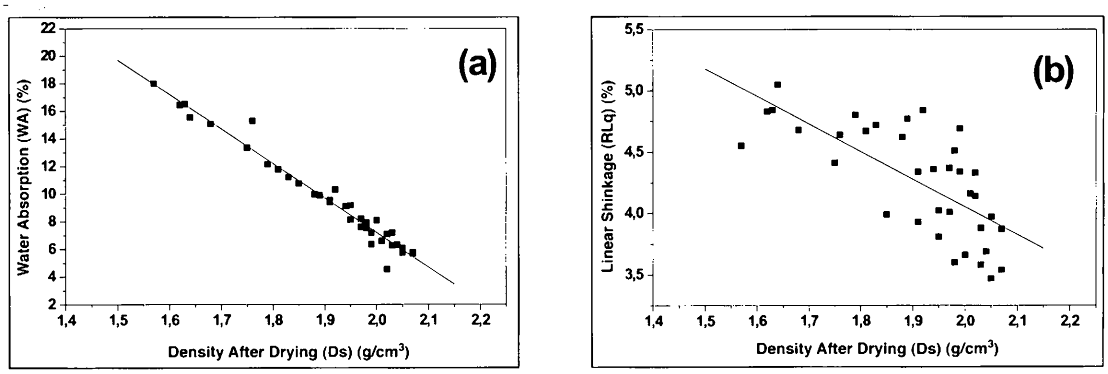

Figure 2: Variation of AA (a) and RLq (b) with the dried density.

Figure 2 show the effect of Ds on the water absorption (AA) and linear shrinkage (RLq) of the fired samples. The relatively high dispersion of RLq was probably due to the bending of the samples. The results have shown that there is a linear dependence of AA and RLq with Ds, regardless of the values of U and P used to produce the compact. The relationship between AA and the MRFq is also linear, therefore there is a linear relationship between MRFq and Ds.

CONCLUSIONS

The results obtained have shown that the density of the dried compact is one of the most fundamental parameters to be kept under strict control if one wants to maintain the flexural modulus of rupture of the dried compacts, water absorption, linear shrinkage and the flexural modulus of rupture after firing of the products close to the desired values.

For a given composition the dried density can be adjusted by adjusting the moisture of the powder and the compaction pressure.

Within usual working conditions there is a linear relationship between the dried density and the moisture of the powder, for a given compaction pressure.

There is a linear relationship between the density of the dried compact and the flexural modulus of rupture of the dried compact, the water absorption, linear shrinkage on firing and the flexural modulus of rupture after firing.

The linearity of all these relationships makes it easier to work out the effects of one variable upon another and allows the establishment of the ideal working conditions

REFERENCE

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