STUDY OF THE EFFECT OF PYROLUSITE ON EXTRUDED CERAMIC BODIES FOR FAST SINGLE FIRE

Vicente I. Jovaní; Martín Maicas

Pechiney Spain

INTRODUCTION

An industrial trial was recently carried out by Pechiney España, S.A. and Balnul SA, —an extruded floor tile manufacturer from the Castellón tile manufacturing area— with UFM-80 grade (ultra-fine micronised, 80% rich in manganese) pyrolusite.

The aim of Balnul SA was to eliminate black coring in the ceramic bodies, and taking advantage of this effect, reduce the kiln firing cycle.

EXPERIMENTAL

The industrial trial involved firing 1000 m^2 floor tile with different proportions of UFM-80.

Proportioning took place at the extruder entrance prior to mixing, to ensure effective homogenisation of the clay and pyrolusite. Proportions of 0.5%, 1.0% and 1.5% were added to a standard red-firing composition normally used in production.

The tiles were formed by extrusion, working at a die pressure of 18/24 kg/cm^2 with a mixing moisture content of about 16%.

Tile size was 24x24 cm, and the tiles were 10 mm thick.

After forming, the tiles were dried according to the usual working procedure in an industrial dryer, in which they were held for about 15 hours.

CHARACTERISTICS	COMPOSITIONS (%)							
UFM-80			0.5		1.0		1.5	
GLAZED	YES	NO	YES	NO	YES	NO	YES	NO
PRODUCTION (m^2)	(1)	(2)	50	240	(3)	240	50	240
CYCLE (min.)	62	62	44	44		44	44	44
PEAK TEMP (°C)	1160	1160	1160	1160		1160	1160	1160

(1) and (2): Normal daily production. No specific material was fired for the trial.

(3): No glazed material was made with the 1.0% addition, as the most suitable proportion for production was 0.5%. A 1.5% addition was also tested to establish whether high UFM-80 contents affected the glazes.

Table 1. *Characteristics of the industrial trial.*

Most of the trial production was fired without glazing, as the purpose was to establish how the use of UFM-80 affected the body. However, a certain number of tiles were also glazed to study how this product might affect the glaze.

Both the glazed and unglazed tiles were fired in a single-deck roller kiln about 70 m long. The usual firing conditions in this kiln for the standard composition (0% UFM-80) reach a peak temperature of 1160 °C in a 62-min firing cycle. Kiln production under these conditions is around 1050 m^2/día.

The firing conditions of the material used for the trial were strained by shortening the cycle to observe how the material performed. Peak temperature was not modified. Table 1 sums up the firing conditions, proportions and production with each proportion.

RESULTS

The fired test material was used to evaluate tile properties. The results obtained follow.

- **Black core**

To evaluate black core thickness several pieces were fired with each proportion under standard composition conditions (0% UFM-80). The findings indicate that under these conditions, 0.5% UFM-80 was enough to completely eliminate black coring. The tiles without UFM-80 exhibited a 2/3 mm thick black core layer.

In view of these outcomes, the test material was fired shortening the firing cycle to the values given in Table 1. In spite of straining the schedule, no black coring appeared with any of the proportions used.

- **Water absorption and mechanical strength**

The water absorption and mechanical strength of the tiles fired in the trial, and of the tiles made with the standard composition under the conditions set out in Table 1, were measured to study how the presence of UFM-80 affected these properties. The results are detailed in Table 2.

UFM-80 (%)	0	0.5	1.0	1.5
Water Absorption (%)	6.7	3.4	4.5	2.6
Mech. Strength (N/mm^2)	38	46	46	52

Table 2. *Properties of the fired tiles.*

- **Body colour**

On comparing the fired tiles at each of the different proportions used, it was observed that as the percentage of UFM-80 was raised in the body, the body's brown colour became more intense. In the case of the 0.5% addition, the change in body colour was very slight. With the other additions, the body darkened more as the UFM-80 proportion increased.

- **Glazed tiles**

No surface faults were detected in the glazed tiles as a result of using manganese dioxide in either of the two tested proportions. Nor was any change in the colour of the applied glaze found, not even with the 1.5% addition, at which the body colour was more pronounced.

CONCLUSIONS

The results found in the study show that UFM-80 is an effective additive for eliminating black core, and yields tiles with better technical characteristics.

Owing to the arising variation in body colour and the fact that black coring was fully suppressed at a proportion of 0.5%, even when working with short cycles, this proportion was considered to be the most appropriate one in this specific case.

The rise in mechanical strength and drop in water absorption found, despite shortening the firing cycle by 18 minutes (about 33%), confirm the fluxing character of UFM-80 and the great efficiency of this product in ceramic tile manufacture, which it benefits by reducing production costs, improving tile quality and raising kiln production.