PORCELAIN TILE FORMULATIONS WITH CLAY RAW MATERIALS OF NATIONAL ORIGIN

García Portillo, C[(1)]; Milián, V[(1)]; Lázaro, A[(2)]; De la Torre, J[(3)]; Bastida, J[(2)].

[(1)]Escuela Superior Cerámica de Manises (Spain),
[(2)]Geology Department of the University of Valencia (Spain) and
[(2)]Chemical Engineering Department of the University of Valencia (Spain).

White-firing plastic or so-called ball clays are mainly intended for ceramic bodies of white stoneware, porcelain tile and porous white-body tile and in smaller quantities for glazes, engobes, and bodies for earthenware, porcelain, and sanitary ware. The clays used in the national ceramic sector are mainly of Spanish origin (67%) although the imported quantity (33%) from Great Britain, Germany, France and Ukraine is increasing. The total consumption has reached a volume of 1,500,000 t/year, with a value of 36 M€.

The proportioning of the usual ball clays in unglazed porcelain tile bodies is 35-50% import and up to 25% of kaolin[1]. When great whiteness is not needed, the national clay contribution is increased. An example follows of the application of a ball clay from Teruel for this purpose.

The formulations given in Table 1 have been prepared using the materials referenced: clay and/or kaolins (42-CAV, 70-GL, A-21, CB) and feldspars (FC and FS), whose chemical composition is given in Table 2 and whose mineralogical characterisation is set out in the diffractograms of Figure 1.

With the formulated bodies, firings were conducted at peak temperatures between 1125 ºC and 1220 ºC with a total duration of 61 minutes. The obtained scraps were characterised in terms of water absorption, linear shrinkage, bending strength (Standard UNE-EN 14411). Additionally their mineralogical composition was analysed by X-ray diffraction and their CIELAB (L*a*b*) coordinates were determined.

MP/BODIES	A1	A1+FC	A1+FS	A2	A2+FC	A2+FS
42-CAV (%)	60	30	30	50	30	30
70-GL %)	20	10	10	33.33	20	20
A-21 (%)	20	10	10	8.33	5	5
CB (%)				8.33	5	5
FS (%)			50			40
FC (%)		50			40	

Table 1. Formulations of the tested ceramic bodies

	42-CAV	70-GL	A-21	CB	FC	FS
SiO_2	63.9	59.2	81.1	55.3	64	64
Al_2O_3	20.7	24	12.5	26.5	13	13
Fe_2O_3	2.49	2.7	0	1.91	0.9	0
CaO	0.6	0.2	0.23	1.12	2.05	1.44
MgO	0.4	0.65	0.85	0.38	2.72	0.13
Na_2O	0.15	0.19	0.05	0.09	3.22	4.26
K_2O	2.28	3.14	1.91	1.9	0.2	0.15
TiO_2	0.9	0.99	0.23	0.39	0.42	0.43
MnO	0.03	0.01	0.04	0.05	0.01	0
P_2O_5	0.1	0.07	0.06	0.08	0.12	0.08
PPC	6,7	6,6	4,4	9,2	13	13

Table 2. Chemical composition of the raw materials.

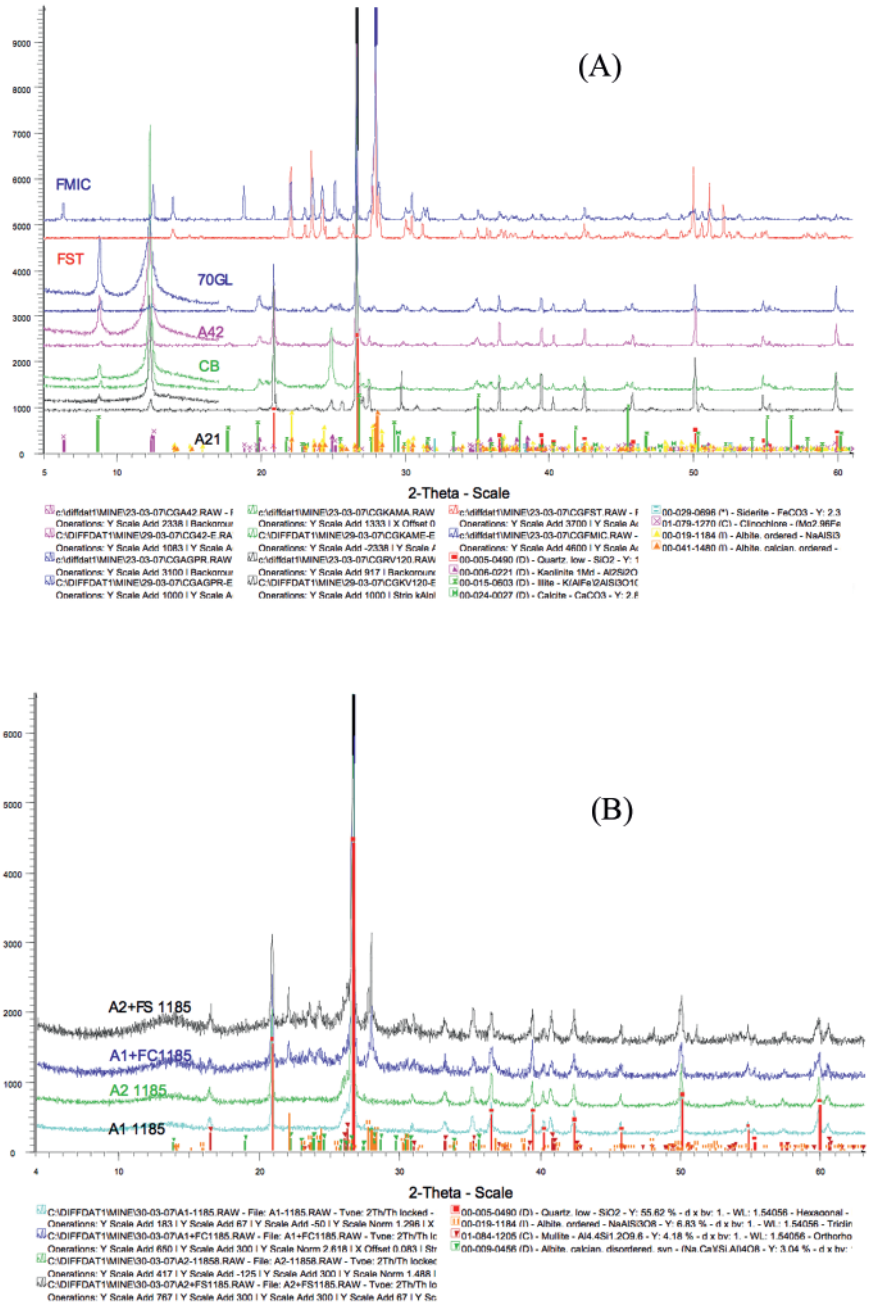

Figure 1. Diffractogram of raw materials (A) and diffractogram of fired bodies (B).

Figure 2 corresponds to the vitrification diagrams of the bodies with better behaviour in regard to firing range and bending strength. Table 3 corresponds to the water absorption data (W.A. %), linear shrinkage (L.S %) and bending strength (B.S.) of the bodies at optimum firing temperature (1185 ºC, in both cases), and the requirements for ceramic tiles of group BI_a (porcelain tile) Standards ISO 13006 and UNE-EN 14411. These bodies allow minimum absorption values to be reached at equal or lower temperatures than those obtained with the different illitic clays reviewed in[3], though using smaller quantities of feldspars.

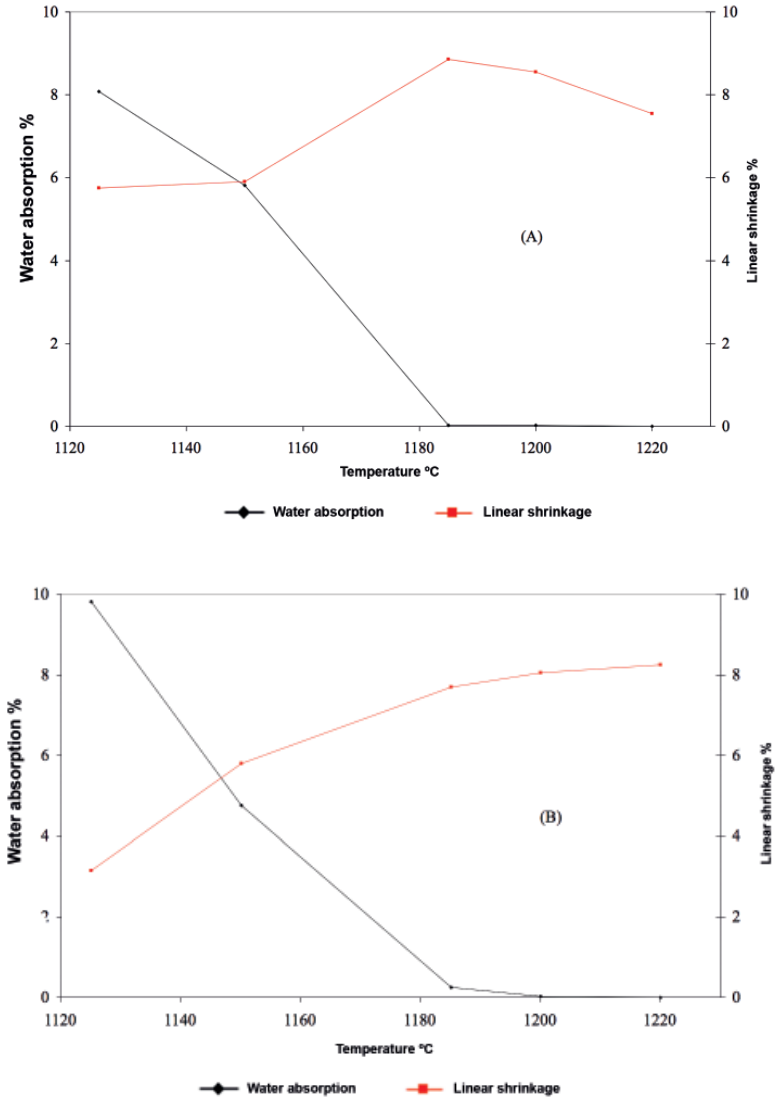

Figure 2. Vitrification diagram of body A1+FC (A) and of body A2+FS (B).

	W.A. %	L.S. %	B.S. (N/mm²)	L	a	b
A1+FC	0,02	8,85	83,385	57,98	3,46	10,62
A2+FS	0,25	7,7	68,67	61,28	5,12	12,32
STANDARD	<0,5	N/A	>35	N/A		

Table 3.

REFERENCES

[1] ICOG (2006) El sector de las arcillas en la provincia de Teruel. Gobierno de Aragón. Servicio de Ordenación Minera. 159 pp.

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[3] S. Ferrari and A.F. Gualtieri. The use of illitic clays in the production of stoneware tile ceramics. Applied Clay Science, Volume 32, Issues 1-2, April 2006, Pages 73-81.