(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 266 769 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.12.2010 Bulletin 2010/52

(51) Int Cl.:
B28B 11/24 *(2006.01)*

(21) Application number: **09425244.2**

(22) Date of filing: **25.06.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA RS

(71) Applicant: **Iniziativa Otto S.r.l.**
41124 Modena (IT)

(72) Inventor: **Bonezzi, Massimo**
41049 Sassuolo, Modena (IT)

(74) Representative: **Colò, Chiara**
Bugnion S.p.A.
Via Vellani Marchi, 20
41124 Modena (IT)

(54) A process for manufacturing very slim ceramic tiles

(57) The invention relates to a process for manufacturing very slim ceramic tiles. The process comprises stages of: pressing a mixture in a die, the mixture comprising plastic clayey components having a green modulus of breakage of at least 11 Kg/cm2 and a dry modulus of breakage of at least 40 11 Kg/cm2. A first firing of the tiles is done at a temperature comprised between 800°C and 1000°C. Glazing the tile, using known means, is done after the first firing, and a second firing of the tile is performed at a temperature comprised between 1150°C and 1200°C.

EP 2 266 769 A1

Description

[0001] The invention relates to a process for manufacturing very slim ceramic ceramic tiles.

[0002] In the field of industrial ceramics normal presses are often used for producing glazed tiles, either which a smooth glazed surface or with an "irregular" surface, i.e. with some parts in relief and others recessed, normally known as structured tiles, which have a thickness of one centimetre or more. With smooth-surfaced glazed tiles, used in particular for cladding, tiles having a thickness of 6-7 millimetres are obtained. Below this thickness the working of the tiles becomes very complicated as clay pressed into small thicknesses produces an unfired tile which is very difficult to transport and to glaze. Neither does the double-firing technique provide satisfactory results as the fired support, having already been difficult to transport when unfired, becomes so fragile as to be hard to send on the following work stages.

[0003] In order to obtain very slim tiles, i.e. of about up to 2-3 millimetres, a process is known that uses special clays which are laminated in large slabs, possibly silk-screened before being fired up to gresification; thus a slab is obtained having a glassy consistency, which is then cut into tiles of the desired dimensions. The process requires special machines and plants and is therefore particularly expensive; further, though it provides high-resistance tiles, it provides tiles which, given their glass consistency, are difficult to work mechanically for cutting and holing operations that have to be done during and after laying. Further, the tiles obtained using this method are smooth-surfaced, typical of working by lamination and firing at high temperatures, which brings the clays to a plastic stage and which tends to render the surface plane of the slab uniform.

[0004] The aim of the present invention is to obviate the drawbacks encountered in the prior art, by providing a process which enables very slim tiles to be obtained, of up to 2-3 millimetres, utilising normal presses as used in the ceramic industry for pressing clays.

[0005] A further aim of the present invention is to obtain very slim glazed ceramic tiles which are resistant and easily workable with mechanical processes using traditional tools.

[0006] An advantage of the present invention is to provide a process which enables production of very slim tiles the surface of which can be worked, i.e. provided with parts in relief and parts in recess (known as "structured" tiles).

[0007] These aims and advantages are all attained by the present invention, as it is characterised in the appended claims.

[0008] Further characteristics and advantages of the invention will better emerge from the detailed description that follows of possible ways of realises the stages of the process of the invention.

[0009] The process provides very slim ceramic tiles; the process described enables very slim tiles of 2-3 millimetre thickness to be obtained.

[0010] The process comprises a stage of pressing a mixture in a die, which mixture comprises plastic clayey components, of a type normally used for forming by extrusion, up to obtaining an unfired tiled having the desired thickness. Normal ceramic presses are used for this stage, which are prepared with dies, obviously in a suitable way for realising an unfired support of the desired thickness, which are carefully and uniformly filled with the mixture; the filling of the die must be particularly carefully done, as given the very modest thickness of the pressed mixture, even small differences in density in the various points of the die would be difficult to compensate for even with the use of isostatic dies. The mixture used must be highly resistant to unfired flexion such as to be able to guarantee an even tiny movement of the pieces from the press to the firing process without the piece breaking or cracking in consequence of vibrations or impacts; the mixture must also have a gresification curve (naturally when the gresification of the mixture is obtained as will be better described herein below) such as to maintain the stability of shrinkage during firing and a dilatometric curve perfectly matched to that of the glazes used in order to reduce the effects of planarity deformations to a minimum. These characteristics are obtained using a mixture having special plasticity characteristics; clays of this type are known and normally used for forming processes via extrusion. The characteristic of these clays is that they have a green breakage modulus of at least 11 Kg/cm^2 and a dry breakage modulus of at least 40 Kg/cm^2.

[0011] In practice mixtures are used which are suitable for realising single-firing tiles even though, as will be seen herein below, the process is characterised among other things in that it uses single-firing mixtures but subjects them to double-firing.

[0012] This stage of pressing is done with a specific pressing pressure which is comprised between 500 and 650 Kg/cm^2 .

[0013] Once the unfired tile has been obtained, the process comprises a first-firing stage of the tile which is done at a lower temperature than the gresification temperature; this stage of first firing is done by bringing the unfired tile to a temperature comprised between 800 and 100°C, with a firing cycle of 25-40 minutes. In this first-firing stage the tiles are kept at maximum temperature for a period of less than 5 minutes. The first-firing stage produces a biscuit which exhibits a porosity of about 11-16%, i.e. much greater than the mixture would have had if subjected to temperatures reached during single-firing (about 2-3%), though exhibiting the consistency and resistance typical of single-fired mixtures. This makes the following glazing stage possible, as the porosity of the biscuit enables the glaze to anchor down to the support.

[0014] The short time that the firing remains at maximum temperature and the low maximum temperature reached do not cause softening of the tile which therefore

maintains, notwithstanding its limited thickness, the desired irregularities (if indeed desired) of the surface to be glazed and therefore produces structured tiles.

[0015] While it is important, during the pressing stage and the first-firing stage that the unfired tile, not very consistent, should not perform long trajectories, the biscuit has a good level of resistance and can therefore be sent on, via normal working lines, to the following stage of glazing which is done using normal and known glazing techniques. The only special requirement is that the glazes used be compatible with the dilatometric curve of the support such as to reduce to a minimum the effects of deformation in planarity. Glazes specially suitable for the aim are however known and easily sourced in the market.

[0016] The glazing stage does not offer any problems as it is performed on a biscuit which, given its porosity due to the fact that it is not gresified, absorbs glaze, but which, precisely because it is fired, is not subject to any softening caused by the glaze. Further, though the tile support is very slim, large quantities of glaze can be used in order to obtain special and decorative effects, which would not be possible on an unfired support of this slimness. If a large quantity of glaze were applied on a slim support which was as yet unfired, the water contained in the glaze would soak the support itself and soften it to the point of causing it to lose its consistency.

[0017] Once glazed the tile is subjected to a stage of second firing at gresification temperature. This second firing stage is performed at a temperature comprised between 1150°C and 1200°C, with a firing cycle of between 20 and 30 minutes.

[0018] During the second firing stage the tiles are kept at the maximum temperature for less than 5 minutes, in order to prevent excessive softening or deformation of the material.

[0019] In the second firing the tile reaches a porosity level of less than 3%, which is characteristic of glazed vitrified stoneware.

[0020] In the second firing stage excellent resistance characteristics are achieved: by way of example, in tiles of 3 millimetres' thickness, levels of resistance which are normally achieved with tiles of 7-8 millimetres' thickness, obtained by double-firing (cladding tiles).

[0021] To summarise, the described process enables:

obtaining very thin tiles (less than 3 millimetre) having a resistance which, at the said thickness, is not achievable with traditional double-fired tiles;

obviating transport and glazing difficulties which would obtain with very slim unfired tiles destined for single-firing;

enabling use of large quantities of glaze in order to obtain desired technical and decorative effects;

treating the material with all movement applications, glazing and decorations at present known, including on a structured support.

Claims

1. A process for manufacturing very slim ceramic tiles, **characterised in that** it comprises following stages: pressing a mixture in a die, which mixture comprises plastic clayey components of a type normally used for forming by extrusion, in order to obtain an unfired tile having a desired thickness; first-firing the tile at a temperature which is lower than a gresification temperature; glazing the tile after the first-firing; second-firing the glazed tile at a gresification temperature.

2. The process of claim 1, **characterised in that** the stage of pressing is performed with clays having a green breakage modulus of at least 11 Kg/cm^2 and a dry breakage modulus of at least 40 Kg/cm^2.

3. The process of claim 1, **characterised in that** the stage of pressing is performed at a specific pressing pressure of between 500 and 650 Kg/cm^2.

4. The process of claim 1, **characterised in that** the first-firing stage is performed by bringing an unfired tile to a temperature comprised between 800°C and 1000°C, with a firing cycle of 20-35 minutes.

5. The process of claim 4, **characterised in that** during the first-firing stage the tiles are kept at a maximum temperature for less than 5 minutes.

6. The process of claim 1, **characterised in that** the second-firing stage is performed at a temperature comprised between 1150°C and 1200°C, with a firing cycle of between 20 and 30 minutes.

7. The process of claim 6, **characterised in that** during the second-firing stage the tiles remain at a maximum temperature for less than 5 minutes.

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5244

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 405 053 A (HMW FUGENTECHNIK VERTRIEB MARI [DE]) 2 January 1991 (1991-01-02) * column 2, line 35 - line 49; claims 1,2,5 *	1,2	INV. B28B11/24
A	US 5 866 225 A (CROSSLEY JOHN W [US]) 2 February 1999 (1999-02-02) * column 3, line 22 - line 27 * * column 3, line 53 - line 58 *	1	
A	US 5 989 636 A (WINE MICHAEL M [US]) 23 November 1999 (1999-11-23) * column 6, line 41 - line 52 *	1	
A	GB 2 171 402 A (MARAZZI CERAMICA) 28 August 1986 (1986-08-28) * page 1, line 28 - line 31 *	1	
			TECHNICAL FIELDS SEARCHED (IPC) B28B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 February 2010	Boone, John

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 42 5244

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-02-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0405053 A	02-01-1991	DE 8907980 U1	25-10-1990
		ES 2040519 T3	16-10-1993
US 5866225 A	02-02-1999	NONE	
US 5989636 A	23-11-1999	US 5693395 A	02-12-1997
GB 2171402 A	28-08-1986	AT 392266 B	25-02-1991
		AU 595181 B2	29-03-1990
		AU 5347486 A	28-08-1986
		BE 904106 A1	15-05-1986
		BG 47797 A3	14-09-1990
		BR 8600685 A	29-10-1986
		CA 1274070 A1	18-09-1990
		CH 666652 A5	15-08-1988
		CN 86100369 A	24-09-1986
		CS 8601120 A2	16-08-1988
		DD 246536 A5	10-06-1987
		DE 3605127 A1	21-08-1986
		DK 78586 A	22-08-1986
		EG 17474 A	30-09-1989
		ES 8704437 A1	16-06-1987
		FI 860636 A	22-08-1986
		FR 2577547 A1	22-08-1986
		GR 860289 A1	02-06-1986
		HK 78289 A	13-10-1989
		HU 44987 A2	30-05-1988
		IE 57209 B1	03-06-1992
		IN 164647 A1	29-04-1989
		IT 1183389 B	22-10-1987
		JP 1649728 C	30-03-1992
		JP 3010590 B	14-02-1991
		JP 61197462 A	01-09-1986
		LU 86312 A1	10-06-1986
		MA 20634 A1	01-10-1986
		MX 170068 B	06-08-1993
		NL 8600442 A	16-09-1986
		NO 860639 A	22-08-1986
		NZ 215207 A	28-07-1988
		PH 23816 A	23-11-1989
		PL 258041 A1	01-06-1987
		PT 81873 A	01-02-1986
		SE 467096 B	25-05-1992
		SE 8600724 A	22-08-1986
		SG 26789 G	22-09-1989
		US 4805551 A	21-02-1989

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 42 5244

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-02-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2171402 A		YU 25486 A1	30-06-1988
		ZA 8600071 A	24-09-1986

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82