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(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.

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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.

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EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5244

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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

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