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(54) **METHOD FOR PREPARING GAMMA-C2S-BASED CEMENTING MATERIAL.**

(57) The present disclosure provides a method for preparing a y-C2S-based cementing material, comprising the following steps: 1) performing ball-milling and mixing of a calcium material, a silica material according to a calcium-silicon molar ratio of 2.0-2.3, to obtain an unprocessed material, wherein the calcium material is one or more of limestone, marl, steel slag, the silica material is one or more of sandstone and silica; 2) mixing the sintered raw material with absolute ethanol with a mass fraction of 10%, pressing into a green body, after drying, sintering, naturally cooling, to obtain a y-C2S-based cementing material. In the present disclosure, the y-C2S-based cementing material is prepared from industrial raw materials, the prepared y-C2S-based cementing material has a self-pulverization characteristic, the grinding energy consumption of clinker can be reduced, and a carbonized product of the y-C2S-based cementing material has the characteristics of quick hardening and high strength of a y-C2S carbonized product. Besides, the y-C2S-based cementing material is prepared from the industrial raw materials through sintering so that the production cost of y-C2S is greatly reduced, and it has very important practical significance in industrial production and application of the carbonized and hardened cementing material.

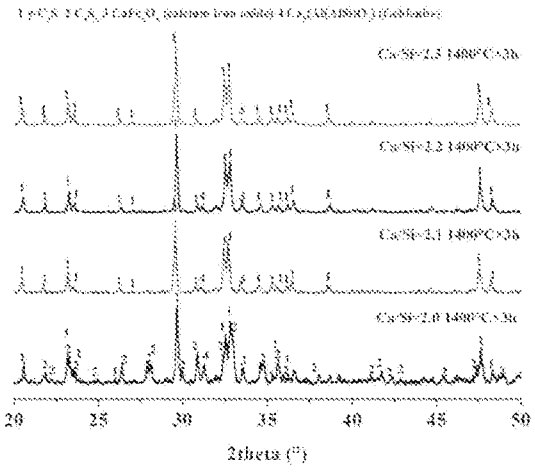

FIG. 1

METHOD FOR PREPARING γ-C2S-BASED CEMENTING MATERIAL

TECHNICAL FIELD

[01] The present disclosure relates to the technical field of building materials, and particularly relates to a method for preparing a γ-C2S-based cementing material.

BACKGROUND ART

[02] With the continuous global warming, the massive emission of carbon dioxide has attracted widespread attention worldwide. In order to promote the transformation of the cement industry to the direction of energy conservation and pollution reduction, carbonized and hardened calcium silicate products have been produced. Studies have shown that most of the calcium silicate minerals in the cement have a high carbonization reaction, of which, γ-C2S is a calcium silicate mineral with high carbonization activity, and has the self-pulverizing properties in the sintering process, which can significantly reduce the energy consumption of grinding, therefore, it is an ideal raw material for the development of carbonized and hardened low-carbon cementing materials.

[03] As a new type of structural material, the carbonized and hardened γ-C2S products have broad application prospects, but there are still many problems to be solved for the preparation of γ-C2S. At present, in the study on the carbonization characteristics of γ-C2S, analytically pure chemical reagents are used to prepare γ-C2S, which has a high cost and is unable to be realized in large-scale industrial production applications in the future. Therefore, it is of great significance to use industrial-grade raw materials to prepare self-pulverizing carbonized cementing clinker that is mainly composed of γ-C2S.

SUMMARY

[04] In view of this, the present disclosure aims to provide a method for preparing a γ-C2S-based cementing material to solve the problems that existing γ-C2S is high in preparation cost and cannot be industrially produced and applied.

[05] In order to achieve the above object, the present disclosure adopts the following technical solutions:

[06] A method for preparing a γ-C2S-based cementing material comprises the following steps:

[07] 1) proportioning a calcium material, a silica material and a corrective addition, and then performing ball-milling and mixing to obtain an unprocessed material, wherein the calcium material is one or more of slaked lime, limestone, marl, steel slag and calcium solid waste, the silica material is one or more of quartz powder, sandstone, silica and siliceous solid waste, and the corrective addition is one or more of bauxite, steel slag and high-aluminum or high-iron solid waste.

[08] The unprocessed material is measured by XRF and comprises the following main chemical components: 58-64% of CaO, 30-34% of SiO_2, less than 22% of Al_2O_3 and less than 10% of Fe_2O_3, wherein the molar ratio of calcium to silicon is 1.5-2.4.

[09] 2) drying the unprocessed material obtained in the step 1), sintering at high

temperature, and naturally cooling to obtain the powdery γ-C2S-based cementing material.

[10] Optionally, the calcium oxide content in the chemical composition of the calcium material in the step 1) is greater than or equal to 50%.

[11] Optionally, the silicon dioxide content in the chemical composition of the silicon material in the step 1) is greater than or equal to 85%.

[12] Optionally, the sum of aluminum oxide and iron oxide in the chemical composition of the corrective addition in the step 1) is greater than or equal to 50%.

[13] Optionally, for the unprocessed material containing less than 5% of Al_2O_3 and less than 5% of Fe_2O_3 in the chemical composition, the unprocessed material can be subjected to molding treatment before entering the step 2) to obtain the γ-C2S-based cementing material with high γ-C2S content. The molding mode is an extrusion granulation mode or a double-roller granulation mode. The water content of the unprocessed material needs to be controlled at 10-30% before molding.

[14] Optionally, the sintering technique in the step 2) comprises the following step: calcining for 0.5-3 h at 1,300-1,500°C.

[15] Optionally, for the unprocessed material using calcium carbonate as the main calcium material, the raw material needs to be pre-calcined at 700-950°C before high-temperature calcination to decompose the calcium carbonate.

[16] Optionally, the strength of the γ-C2S-based cementing material should be greater than or equal to 150 MPa after being cured for 24 h at room temperature under the conditions of carbon dioxide with concentration of 99% and 30% of humidity.

[17] Compared with the prior art, the method for preparing the γ-C2S-based cementing material has the following advantages:

[18] The γ-C2S-based cementing material is prepared from industrial raw materials, the prepared γ-C2S-based cementing material takes γ-C2S as a main component and further comprises a small quantity of byproducts such as β-C2S, C3S2 and C2AS, the γ-C2S-based cementing material has a self-pulverization characteristic, the grinding energy consumption of clinker can be reduced, and a carbonized product of the γ-C2S-based cementing material has the characteristics of quick hardening and high strength of a γ-C2S carbonized product. Besides, the γ-C2S-based cementing material is prepared from the industrial raw materials through sintering so that the production cost of γ-C2S is greatly reduced, and it has very important practical significance in industrial production and application of the carbonized and hardened cementing material.

BRIEF DESCRIPTION OF THE DRAWINGS

[19] The accompanying drawings constituting a part of the present disclosure are intended to provide further understanding of the present disclosure, and the exemplary embodiments of the present disclosure and their descriptions are intended to explain the present disclosure and do not constitute an improper limitation of the present disclosure. In the figures:

[20] FIG. 1 is an XRD pattern of a γ-C2S-based cementing material in the Examples 1 to 4 of the present disclosure; and

[21] FIG. 2 is an SEM image of a γ-C2S-based cementing material in the Examples

1 to 4 of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[22] It should be noted that the embodiments of the present invention and the features of the embodiments may be combined with each other under the condition of no conflict.

[23] The present invention will be described in detail below with reference to the accompanying drawings and embodiments.

[24] Examples 1 to 4

[25] A method for preparing a γ-C2S-based cementing material comprised the following steps:

[26] 1) putting limestone and sandstone into a ball mill according to the calcium-silicon molar ratio of 2.0, 2.1, 2.2 and 2.3, and performing ball milling and mixing for 2 h to obtain an unprocessed material, wherein the limestone contained greater than or equal to 50% of calcium oxide, and the sandstone contained greater than or equal to 85% of silicon dioxide; and

[27] 2) pre-calcining the unprocesed material at 850°C, then feeding into a rotary kiln, calcining at 1,350°C for 40 min, and naturally cooling after calcining to obtain a self-powdered γ-C2S-based cementing material.

[28] The γ-C2S-based cementing material in the example was subjected to carbonizing curing to obtain a γ-C2S carbonized product, the mechanical properties of the γ-C2S carbonized product were tested according to GB/T50081-2002 “Standard for test method of mechanical properties on ordinary concrete”, and the carbonization degree of the product was evaluated by adopting a calcium carbonate burning-out method.

[29] Through testing, the γ-C2S-based cementing materials in the examples 1 to 4 had good self-powdering characteristics, the compressive strength of the γ-C2S-based cementing material carbonized product after being carbonized for 24 h was greater than 150 MPa, and the carbonization degree was greater than 48%.

[30] Example 5

[31] A method for preparing a γ-C2S-based cementing material comprised the following steps:

[32] 1) putting slaked lime and quartz powder into a ball mill according to the calcium-silicon molar ratio of 2.3, and performing ball milling and mixing for 2 h to obtain a mixture, wherein the slaked lime contained greater than or equal to 72% of calcium oxide, the quartz powder contained greater than or equal to 90% of silicon dioxide, and at the moment, the chemical components of an unprocessed material contained 2.2% of aluminum oxide and 0.8% of iron oxide.

[33] 2) stirring the mixed unprocessed material and water according to the mass ratio of 100: 20 to obtain a mixture, pouring the mixture into a double-roller granulator, and molding to obtain the unprocessed material.

[34] 3) pre-calcining the unprocesed material at 850°C, then feeding into a rotary kiln, calcining at 1,400°C for 45 min, and naturally cooling after calcining to obtain a self-powdered γ-C2S-based cementing material.

[35] The γ-C2S-based cementing material in the example was subjected to carbonizing curing to obtain a γ-C2S carbonized product, the mechanical properties of the γ-C2S carbonized product were tested according to GB/T50081-2002 "Standard for test method of mechanical properties on ordinary concrete", and the carbonization degree of the product was evaluated by adopting a calcium carbonate burning-out method.

[36] Through testing, the γ-C2S-based cementing materials in this example had good self-powdering characteristics, the compressive strength of the γ-C2S-based cementing material carbonized product after being carbonized for 24 h was 162 MPa, and the carbonization degree was 52.1%.

[37] Example 6

[38] A method for preparing a γ-C2S-based cementing material comprised the following steps:

[39] 1) putting limestone, sandstone and corrective addition bauxite into a ball mill according to the calcium-silicon molar ratio of 1.9, and performing ball milling and mixing for 2 h to obtain an unprocessed material, wherein the limestone contained greater than or equal to 72% of calcium oxide, and the quartz powder contained greater than or equal to 90% of silicon dioxide, and bauxite contained greater than or equal to 50% of alumina. The content of alumina in the chemical compositions of the unprocesed material was controlled at 18%.

[40] 2) pre-calcining the unprocesed material at 850°C, then feeding into a rotary kiln, calcining at 1,320°C for 30 min, and naturally cooling after calcining to obtain a self-powdered γ-C2S-based cementing material.

[41] The γ-C2S-based cementing material in the example was subjected to carbonizing curing to obtain a γ-C2S carbonized product, the mechanical properties of the γ-C2S carbonized product were tested according to GB/T50081-2002 "Standard for test method of mechanical properties on ordinary concrete", and the carbonization degree of the product was evaluated by adopting a calcium carbonate burning-out method.

[42] Through testing, the γ-C2S-based cementing materials in this example had good self-powdering characteristics, the compressive strength of the γ-C2S-based cementing material carbonized product after being carbonized for 24 h was 148 MPa, and the carbonization degree was 48.6%.

[43] The above description only describes the preferred embodiments of the present disclosure and is not intended to limit the present disclosure. Any modification, equivalent replacement, improvement, etc. made within the spirit and principle of the present disclosure shall fall within the scope of protection of the present disclosure.

WHAT IS CLAIMED IS:

1. A method for preparing a γ-C2S-based cementing material, comprising the following steps:

1) performing ball-milling and mixing of a calcium material, a silica material according to a calcium-silicon molar ratio of 2.0-2.3, to obtain an unprocessed material, wherein the calcium material is one or more of limestone, marl, steel slag, the silica material is one or more of sandstone and silica;

2) mixing the sintered raw material with absolute ethanol with a mass fraction of 10%, pressing into a green body, after drying, sintering, naturally cooling, to obtain a γ-C2S-based cementing material.

2. The method for preparing a γ-C2S-based cementing material according to claim 1, wherein the calcium oxide content in the calcium material in the step 1) is greater than or equal to 50%.

3. The method for preparing a γ-C2S-based cementing material according to claim 1, wherein the silicon dioxide content in the silicon material in the step 1) is greater than or equal to 85%.

4. The method for preparing a γ-C2S-based cementing material according to claim 1, wherein the drying temperature in the drying in the step 2) is 60 -105°C.

5. The method for preparing a γ-C2S-based cementing material according to claim 1, wherein the molding pressure for pressing into a green body in the step 2) is in the range of 10-50 MPa.

6. The method for preparing a γ-C2S-based cementing material according to claim 1, wherein the sintering process of the sintering in the step 2) comprises: heating to 800°C at a heating rate of 10°C/min, holding the temperature for 0.5-1 h, and then continuing to heat to 1,300-1,500°C at a heating rate of 10°C/min, and holding the temperature for 3-4 h.

ANSPRÜCHE

1. Verfahren zur Herstellung eines Zementmaterials auf γ-C2S-Basis, umfassend die folgenden Schritte:

1) Durchführen von Kugelmahlen und Mischen eines Calciummaterials, eines Silicamaterials, gemäß einem Calcium-Silicium-Molverhältnis von 2,0–2,3, um ein unverarbeitetes Material zu erhalten, wobei das Calciummaterial eines oder mehrere von Kalkstein, Mergel, Stahlschlacke ist, wobei das Silicamaterial eines oder mehrere von Sandstein und Siliciumdioxid ist;

2) Mischen des gesinterten Rohstoffs mit absolutem Ethanol mit einem Massenanteil von 10 %, Pressen zu einem Grünkörper, nach Trocknen Sintern, natürliches Abkühlen, um ein Zementmaterial auf γ-C2S-Basis zu erhalten.

2. Verfahren zur Herstellung eines Zementmaterials auf γ-C2S-Basis nach Anspruch 1, wobei der Calciumoxidgehalt in dem Calciummaterial im Schritt 1) größer als oder gleich 50 % ist.

3. Verfahren zur Herstellung eines Zementmaterials auf γ-C2S-Basis nach Anspruch 1, wobei der Siliciumdioxidgehalt in dem Siliciummaterial im Schritt 1) größer als oder gleich 85 % ist.

4. Verfahren zur Herstellung eines Zementmaterials auf γ-C2S-Basis nach Anspruch 1, wobei die Trocknungstemperatur im Trocknen im Schritt 2) 60–105 °C beträgt.

5. Verfahren zur Herstellung eines Zementmaterials auf γ-C2S-Basis nach Anspruch 1, wobei der Formungsdruck zum Pressen zu einem Grünkörper im Schritt 2) im Bereich von 10–50 MPa liegt.

6. Verfahren zur Herstellung eines Zementmaterials auf γ-C2S-Basis nach Anspruch 1, wobei der Sintervorgang des Sinterns im Schritt 2) umfasst: Erhitzen auf 800 °C mit einer Heizrate von 10 °C/min, Halten der Temperatur für 0,5–1 h und dann Fortsetzen des Erhitzens auf 1300–1500 °C mit einer Heizrate von 10 °C/min und Halten der Temperatur für 3–4 h.

DRAWINGS

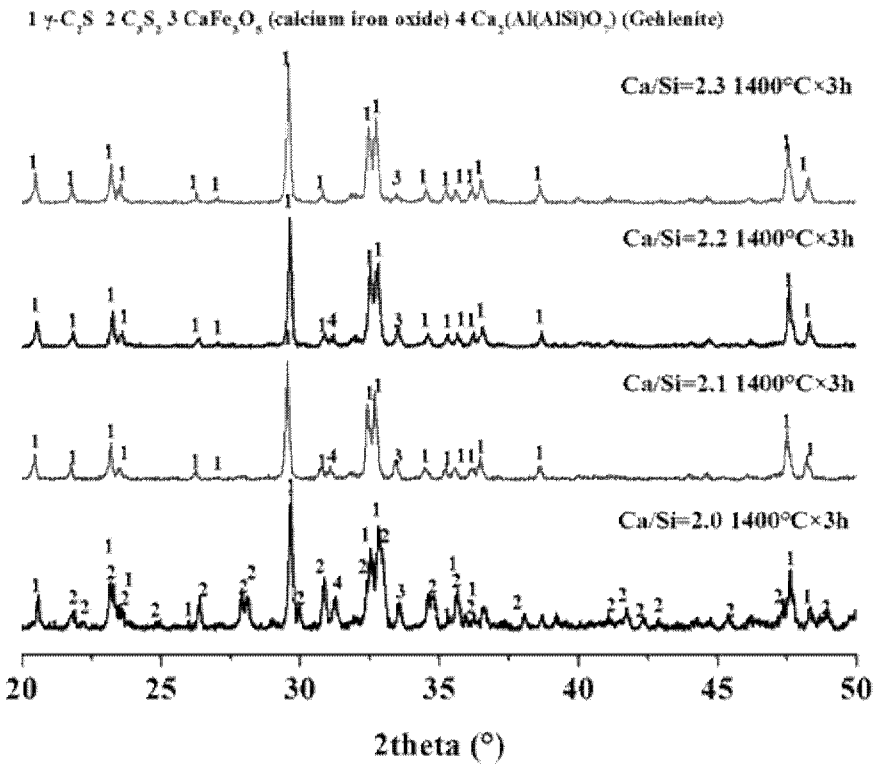

FIG. 1

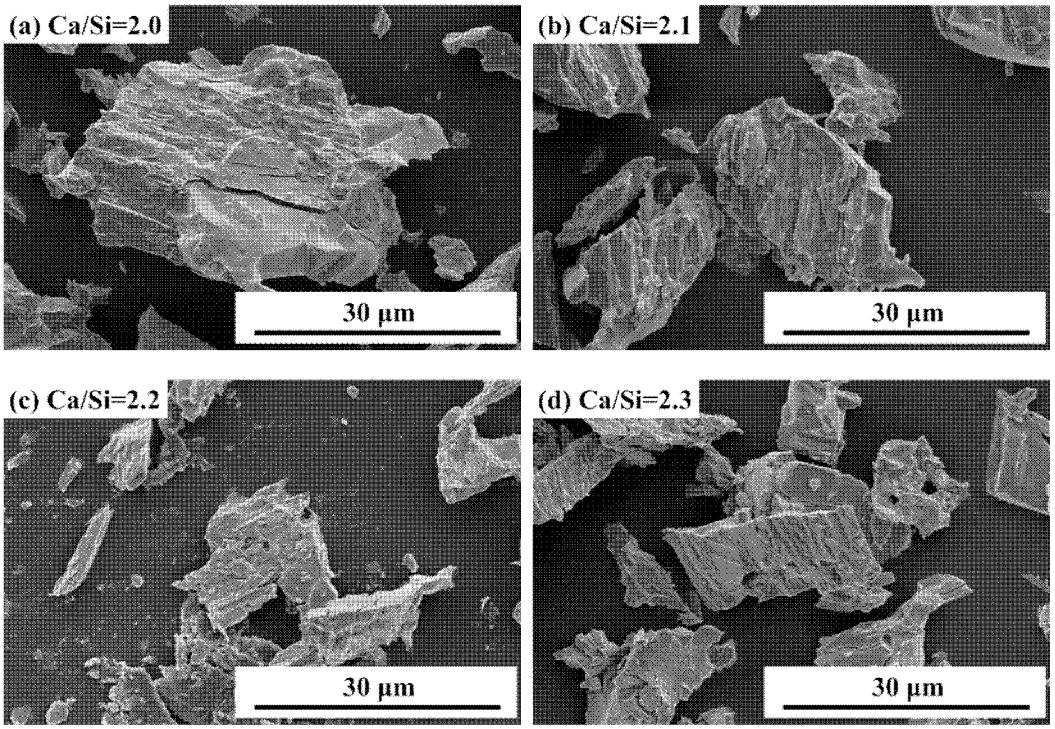

FIG. 2