

Method of producing a cement composition

The invention refers to a method of producing a cement composition, which comprises Portland cement and at least one added component.

Further, the invention refers to an installation for carrying out this method.

Today portland cement is the most common type of cement. This cement is made by calcining limestone with other materials, such as clay to 1450 °C in a kiln. The resulting clinker is ground in a cement mill with a small amount of gypsum into a powder to make Ordinary Portland Cement (OPC).

In order to meet special requirements, Portland cement is often blended with various mineral components in order to obtain composite Portland cements or Portland cement blends. Chemical additives or admixtures may be added depending on the application intended.

The following types of mineral components may be added to Portland cement in order to obtain composite cements. Granulated blast-furnace slag (gbfs), fly ash, natural pozzolans, calcined clays or ground limestone are usually added to Portland cement in order to replace a partial amount of Portland cement. By substituting the cited mineral components for Portland cement the specific emission of CO₂ will be reduced in the production of cement, because during the production of Portland cement clinker about 0,9 tons of CO₂ per ton of Portland cement clinker

will be emitted by the calcination of the raw materials and from the oxidation of the fuels in the rotary tubular kiln.

The addition of ultra-fine mineral components, such as microcement or microsilica, to Portland cement is used to enhance the durability and the strength of the resulting concrete.

Chemical additives or admixtures may also be added to said composite cement, such as grinding aids, air entrainers, retarders, activators, expansion agents, coloring agents and/or water repellent additives.

Composite cements are usually produced by mixing clinker and mineral components, in particular granulated blast-furnace slag, fly ash, natural pozzolans and calcined clays, before feeding them to the cement mill. The ground composite cement is then stored in cement silos located at the cement manufacturing plant before being conveyed to a packing installation or to a loading station for loading the composite cement to a transport vehicle. Co-grinding the clinker and the mineral components results in large quantities of composite cement being produced in an efficient way. However, this production process is very inflexible with regard to changing the composition of the composite cement. Further, producing such large amounts of different types of composite cements requires a corresponding number of storage facilities, such as silos.

Another drawback of co-grinding clinker and mineral components or chemical additives is the difficulty of accurately dosing the components, especially the chemical additives. As a consequence, there is usually a variation

in the composition of the resulting composite cement among the production batches. Further, co-grinding clinker and mineral components does not allow to precisely control the particle size distribution of the mineral components.

Therefore, it is an object of the present invention to provide a method of producing cement compositions as well as suitable production facilities that allow to overcome the above drawbacks. In particular, a method shall be developed which increases the flexibility in the composition of the cement composition, in particular with regard to the type and amount of the added components, such as mineral components and/or chemical additives to be added. At the same time, the production shall be cost and time efficient also in case that only a small amount of a specific composite cement composition is needed.

To solve these and other objects, the invention provides for a method of producing a cement composition, which comprises Portland cement and at least one added component, comprising the steps of

- storing Portland cement powder in a container, in particular a silo of a cement manufacturing plant,
- conveying the Portland cement powder to a packing station or a loading installation for loading a cement composition to a transport vehicle,
- measuring the mass flow of Portland cement powder during said conveying step,
- adding the at least one added component to said Portland cement powder during said conveying step so as to obtain a cement composition, the added amount of said at least one added component being controlled as a function of the mass flow of Portland cement powder.

Therefore, the invention is based on the idea to manufacture cement compositions, such as composite cements, by dosing at least one added component, such as a mineral component and/or a chemical additive, to already pre-manufactured Portland cement powder. The at least one added component is added to the Portland cement powder during the conveying step, in which the Portland cement is conveyed from the storing site, such as a silo, to a packing station for packing the product into bags or to a loading installation for loading the product to a transport vehicle, such as a truck. In this way, an on-demand production of cement compositions is achieved, which is efficient as regards costs, logistics and time also with the production of only small amounts. Therefore, the inventive method is of particular benefit for the production of niche-products, such as composite cements intended for special applications.

In order to achieve a precise dosing of the at least one added component, the mass flow of Portland cement powder that is conveyed from the storage container is measured and the feeding of the at least one added component is controlled as a function of the mass flow of Portland cement powder. The measuring of the mass flow of the cement powder can, e.g., be realized by a mass flow meter distributed by Schenck Process GmbH, Darmstadt (Germany), under the trade name Multicor®. This device works according to the principle of the Coriolis force. The cement powder hits a rotating measuring wheel. Due to the centrifugal force, the cement powder on the vane is moved outwards. On the measuring wheel - due to the acceleration in the direction of the circumference - the cement powder is

subject to the Coriolis force. This can be recorded as a measurable variable which is proportional to the gravimetric feed rate, even with changing bulk density or different grain size. Further, the dosed feeding of the at least one added component to the cement powder may, e.g. be realized by means of a feeding unit distributed by Schenck Process GmbH, Darmstadt (Germany), under the trade name Mechatron®.

According to a preferred embodiment of the invention, the Portland cement powder is conveyed as a continuous stream, preferably using a screw conveyor, a belt conveyor or an air activated gravity conveyor. Further, the at least one added component is preferably continuously added to the continuous stream of Portland cement powder. By continuously feeding the at least one added component to the continuous stream of cement powder, an on-line blending process may be realized, which allows a continuous mode of operation.

In such a continuous process, the precise dosing of the at least one added component to the stream of cement powder is preferably achieved by controlling the feeding rate of the added component. In particular, the amount of the at least one continuously added component is controlled by feeding the at least one component to the stream of Portland cement powder at a feeding rate being controlled as a function of the mass flow of Portland cement powder. Preferably, the feeding rate is controlled exclusively as a function of the mass flow of Portland cement powder. This means, that the mass flow of Portland cement powder is the only parameter used in order to adapt the feeding rate of the at least one added component.

Preferably, the feeding rate is controlled as a function of the mass flow of Portland cement powder so as to obtain a predetermined mass ratio of Portland cement powder and added component(s) in the cement composition.

In order to achieve a precise dosing of the at least one added component, a feeding device is required that allows a precise adjustment of the feeding rate. In this connection, according to a preferred embodiment the at least one additive is fed to the Portland cement powder by means of a gravimetric feeder, such as a feeding unit distributed by Schenck Process GmbH, Darmstadt (Germany), under the trade name Mechatron®.

Cement compositions frequently contain more than one added component. The addition of more than one added component to the Portland cement powder conveyed from the storage container to the packing or loading station may be realized in various ways. One possibility is to produce a premix containing two or more added components in the required mass ratio and to add the premix to the flow of cement powder during the conveying step by means of a suitable installation, such as a feeder as described above. Preferably, however, the two or more added components are separately and independently added to the cement powder.

In this connection, according to a preferred embodiment of the invention, two or more added components are added to said Portland cement powder during said conveying step so as to obtain a cement composition, the added amount of said two or more added components each being separately controlled as a function of the mass flow of Portland

cement powder. In particular, the feeding rate of each added component is separately controlled as a function of the mass flow of Portland cement powder so as to each obtain a predetermined mass ratio of Portland cement powder and the respective added component in the cement composition.

Preferably, the at least one added component is a mineral component and/or a chemical additive or admixture. The mineral component may preferably be selected from the group consisting of ground granulated blast furnace slag, fly ash, natural pozzolans, ground limestone, silica fume, calcined clays and mixtures thereof. The chemical additive or admixture may preferably be selected from the group consisting of grinding aids, air entrainers, retarders, activators, expansion agents, coloring agents and water repellent additives.

According to a further aspect the invention refers to an installation for carrying out the inventive method. The installation comprises a container, in particular a silo, for storing Portland cement powder, conveying means for conveying the Portland cement powder to a packing station or a loading installation for loading a cement composition to a transport vehicle, a mass flow meter for measuring the mass flow of Portland cement powder being conveyed by means of said conveying means and a feeding device for feeding at least one added component to said Portland cement powder being conveyed by means of said conveying means, said feeding device being configured to control the amount of said at least one added component being fed as a function of the mass flow of Portland cement powder.

Preferably, said conveying means is designed to continuously convey the Portland cement powder, preferably as a screw conveyor, a belt conveyor or an air activated gravity conveyor. From this list of conveying means, an air activated gravity conveyor is preferred, such as the Airslide® conveying system marketed by FLSmidth. This conveying system is based on the idea to fluidize the material to be conveyed with air, in order to enable to use the forces of gravity to do most of the conveying work without any moving parts. In particular, driving low-pressure, low-velocity air through and between particles of the dry bulk material to be conveyed changes its behavior characteristics and makes it flow more like a liquid than a solid.

According to a preferred embodiment of the inventive installation, said feeding device is a gravimetric feeder configured to continuously feed said at least one added component to the flow of Portland cement powder.

In order to effectively control the blending ratio of the cement powder and the at least one added component, a preferred embodiment provides for a control unit, to which a measuring signal representative of the mass flow measured by the flow meter is fed and which is connected to the feeding device in order to control the feeding rate of the feeding device as a function of the mass flow of Portland cement powder so as to obtain a predetermined mass ratio of Portland cement powder and added component(s) in the cement composition.

The inventive installation preferably comprises two or more feeding devices, each feeding device being configured to

control the amount of the respective added component being fed as a function of the mass flow of Portland cement powder.

The invention will be explained in greater detail in the following with reference to a schematic illustration in the drawing of an embodiment of a device for carrying out the method according to the invention.

In Fig. 1 two silos 1 are shown, in which Portland cement powder is stored. In their bottom region the silos 1 have outlet openings for discharging cement powder into a first conveying means 2, in which the cement powder coming from the silos 1 is merged into a single stream of cement powder that is charged onto a second conveying means 3. The silos 1 may have stored cement powder having product characteristics differing from each other, such as different grinding fineness, different chemical composition or the like. By controlling the individual discharge rate of each silo 1, the product characteristics of the final product may be adjusted. Alternatively, cement powder coming from only one of the two silos 1 may be used.

The second conveying means 3 is preferably designed as an air activated gravity conveyor and continuously conveys the cement powder to a loading section 5 of continuous vertical conveyor 4. The vertical conveyor 4 conveys the cement powder via a hopper 6 and an intermediate storage container 7 to a packing unit generally denoted by 8, in which the product is filled into bags. Excessive material is collected in collecting hoppers 9, which open out into a screw conveyor 10 that returns the material to the loading section 5 of the continuous vertical conveyor 4.

A conveying and packing installation as described above is commonly used at cement manufacturing plants around the world. According to the invention, such known installation is adapted to achieve an on-line blending of additives as follows.

A branching section 11 is installed in the conveying means 3, which allows branching off a stream of cement powder, which is conveyed via a conveyor 12 to a mass flow meter 13, which measures the mass flow of cement powder. The measurements continuously obtained from the mass flow meter 13 are used to control the feed rate of an added component that is added to the cement stream at a blending point 14 downstream of the mass flow meter 13. The added component is stored in bags 15 and charged into a hopper 16 of a screw conveyor 17. The screw conveyor 17 discharges the added component into a gravimetric feeder 18 that controls the feeding rate of the added component as a function of the mass flow measurement data received from the mass flow meter 13.

By adding the added component to the cement stream at blending point 14, a cement composition having a desired composition is obtained. The cement composition is charged onto a conveyor 19, which conveys the cement composition to a loading section 5 of the continuous vertical conveyor 4. The cement composition is then packed into bags as described above.

The installation illustrated in Fig. 1 may thus be used to either convey the cement powder contained in silos 1 to the packing station 8 or the cement composition obtained as

described above, depending on whether the branching section is active to divert the cement powder stream to the blending point 14.

Claims:

1. A method of producing a cement composition, which comprises Portland cement and at least one added component, comprising the steps of
 - storing Portland cement powder in a container, in particular a silo of a cement manufacturing plant,
 - conveying the Portland cement powder to a packing station or a loading installation for loading a cement composition to a transport vehicle,
 - measuring the mass flow of Portland cement powder during said conveying step,
 - adding the at least one added component to said Portland cement powder during said conveying step so as to obtain a cement composition, the added amount of said at least one added component being controlled as a function of the mass flow of Portland cement powder.
2. A method according to claim 1, wherein the Portland cement powder is conveyed as a continuous stream, preferably using a screw conveyor, a belt conveyor or an air activated gravity conveyor.
3. A method according to claim 2, wherein the at least one added component is continuously added to the continuous stream of Portland cement powder.
4. A method according to claim 3, wherein the amount of the at least one continuously added component is controlled by feeding the at least one component to the stream of Portland cement powder at a feeding rate being controlled as a function of the mass flow of Portland cement powder.

5. A method according to claim 4, wherein the feeding rate is controlled as a function of the mass flow of Portland cement powder so as to obtain a predetermined mass ratio of Portland cement powder and added component(s) in the cement composition.

6. A method according to any one of claims 1 to 5, wherein the at least one added component is fed to the Portland cement powder by means of a gravimetric feeder.

7. A method according to any one of claims 1 to 6, wherein two or more added components are added to said Portland cement powder during said conveying step so as to obtain a cement composition, the added amount of said two or more components each being separately controlled as a function of the mass flow of Portland cement powder.

8. A method according to claim 7, wherein the feeding rate of each added component is separately controlled as a function of the mass flow of Portland cement powder so as to each obtain a predetermined mass ratio of Portland cement powder and the respective added component in the cement composition.

9. A method according to any one of claims 1 to 8, wherein the at least one added component is a mineral component and/or a chemical additive or admixture, wherein the mineral component is preferably selected from the group consisting of ground granulated blast furnace slag, fly ash, natural pozzolans, ground limestone, silica fume, calcined clays, and mixtures thereof, and wherein the chemical additive or admixture is preferably selected from the group consisting of grinding aids, air entrainers,

retarders, activators, expansion agents, coloring agents, and water repellent additives.

10. An installation for carrying out the method according to any one of claims 1 to 9, comprising a container, in particular a silo, for storing Portland cement powder, conveying means for conveying the Portland cement powder to a packing station or a loading installation for loading a cement composition to a transport vehicle, a mass flow meter for measuring the mass flow of Portland cement powder being conveyed by means of said conveying means and a feeding device for feeding at least one added component to said Portland cement powder being conveyed by means of said conveying means, said feeding device being configured to control the amount of said at least one added component being fed as a function of the mass flow of Portland cement powder.

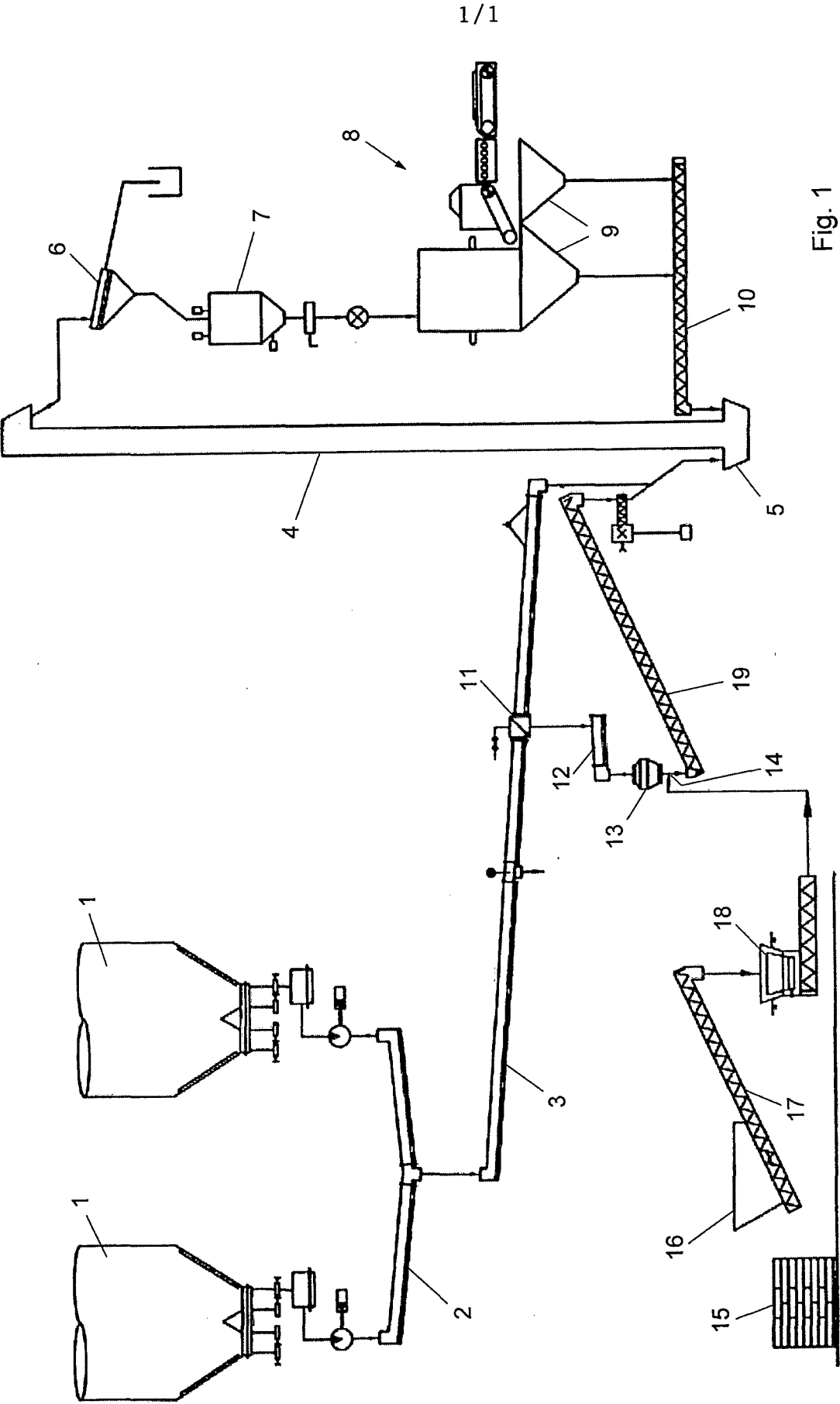
11. An installation according to claim 10, wherein said conveying means is designed to continuously convey the Portland cement powder, preferably as a screw conveyor, a belt conveyor or an air activated gravity conveyor.

12. An installation according to claim 10 or 11, wherein said feeding device is a gravimetric feeder configured to continuously feed said at least one added component to the flow of Portland cement powder.

13. An installation according to claim 10, 11 or 12, comprising a control unit, to which a measuring signal representative of the mass flow measured by the flow meter is fed and which is connected to the feeding device in order to control the feeding rate of the feeding device as

a function of the mass flow of Portland cement powder so as to obtain a predetermined mass ratio of Portland cement powder and added component(s) in the cement composition.

14. An installation according to any one of claims 10 to 13, comprising two or more feeding devices, each feeding device being configured to control the amount of the respective added component being fed as a function of the mass flow of Portland cement powder.



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER

INV. B01F15/04 B01F3/18 B28C7/04 B28C9/02 C04B40/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01F B28C C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 3 182096 B2 (SANKI TSUUUN KK) 3 July 2001 (2001-07-03) abstract; figures	1,2,6-9
X	----- EP 1 508 417 A1 (SCHLUMBERGER SERVICES PETROL [FR]; SCHLUMBERGER TECHNOLOGY BV [NL]; SC) 23 February 2005 (2005-02-23) paragraph [0035] - paragraph [0064]; figures paragraph [0006] - paragraph [0021]	1-8,10, 12-14
X	----- AT 11 796 U1 (HOLCIM TECHNOLOGY LTD [CH]) 15 May 2011 (2011-05-15) the whole document ----- -/--	1-5,7,8

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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