Cement additive, cement composition and chemically prestressed concrete produced therefrom

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SANTRAUKA

The invention relates to a cement additive comprising amorphous calcium aluminate and an expansive material prepared by subjecting a mixture of CaO raw material and CaSO4 raw material to heat treatment, where the content of CaSO4 in the expansive material formed is from 20 to 50 parts by weight in 100 parts by weight of the total amount of CaO and CaSO4.

IEŠKINIAI (5) išversta iš vokiečių

1. cement admixture comprising amorphous calcium aluminate and an ex pansives material that was formed by heat treatment comprises a mixture containing CaO raw material and $CaSO_4$ raw material, wherein the content of $CaSO_4$ in the expansive material formed from 10 to 50 parts by weight in is 100 parts by weight of the total amount of CaO and $CaSO_4$.

2. cement admixture according to claim 1, characterized in that it further contains a latent hydraulic material, a thickening agent and a water reducing agent.

3. cement admixture according to claim 1, characterized in that it further comprises dextrin having a cold water soluble content of 10 to 65 wt .-%.

4. A cement composition comprising cement and as defined in any one of claims 1, 2 or 3 cement admixture.

5. Chemically prestressed concrete, which was prepared by mixing, compacting a cement mixture containing cement as defined in claim 4 composition in a mold and then hardened.

APRAŠAS išversta iš vokiečių

The present invention relates to a cement admixture, a cement composition and produced therefrom, chemically prestressed Be ton. This is primarily useful in the fields of housing, for building and for construction purposes.

Cement provides for the construction of residential buildings or for the con struction of buildings is an indispensable material. It can be said that one can produce cost than cement large structures with any other material.

In the cured products produced from cement, however slight cracks form, which is a problem. Such a cracking may be caused by various factors.

One of these factors is the drying shrinkage and for the purpose of compensation of such drying shrinkage is proposed by a number of expansive cement materials (eg. For example, Japanese Unexamined Patent Publication no. 13 650/1978 and no. 31 170/1978).

As a second factor for the thermal cracking cracking may be mentioned due to the heat of hydration. As a method for reduction of thermal cracking has been the use of a low heat generating element Ze proposed, that is a cement, in which a small amount of Hy dratationswärme is generated. It also provides a method has been proposed in which an expansive cement material and a means for suppressing the Hy dratationswärme be used in combination (Japanese Examined Pa tentpublikation no. 262/1982).

The cement with low heat generation, a sol cher is mainly used in which a large amount of Pozzolanmaterials, as in example blast furnace slag or fly ash, Portland cement is incorporated. It is also known that this material is effective to prevent thermal cracking of a concrete mixture for construction purposes, z. B. a dam, and may be the reason that which occurs at the beginning of hydration Wärmebil tion reduced remarkably.

The cracks formed in a structure are usually a combina tion of thermal cracking and cracking due to drying shrinkage. Therefore, in order to prevent cracking at large, it is common practice to use egg nen cement, low heat generation and an expansive cementitious material in combination.

Expansive cement materials are divided generally into three types, and although a CaO-containing expansive cement material from calcium sulphoaluminate type or lime type, with the ability to form ettringite or $Ca(OH)_2$ as an expansive hydrate, an expansive cementitious material from metal powder type, for example, contains iron powder or aluminum powder, and an expansive cementitious material magnesia type. In Japan, all will neuter the expansive cement material from the CaO-containing type used, as it is relatively cheap.

As such CaO-containing expansive cement material is known an ex pansives cement material from f-CaO-C_3S type, which is obtained by heat treating a source of CaO and SiO-source and free lime (f-CaO) and Zementruineral 3CaO · SiO (C_3S) as the main components to sums (Japanese Unexamined Patent Publication no. 13 650/1978).

These expansive cement materials, however, there is the problem that when they are used as cement mixtures, which pozzolan materials are as blast furnace slag, fly ash and silica incorporated, the expansive properties are impaired remarkably. Consequently, this expansive cement materials must if they are to be used for such cement mixtures are used in large quantities, and they can be practically applied in economic terms hardly. Further, there is a problem in that the Langzeitbe resistance of the concrete may be impaired.

On the other hand, in recent years for the purpose of saving labor and in view of the difficulties in workplace safety of construction workers and in view of the continually increasing size of the Kon constructions concrete mixtures have been proposed in which orientation no Kompak is required or compacted with low vibration can be. In these, a large amount of a thickening agent and an agent for water reduction incorporated and a latent hydraulic material (pozzolan) such as fly ash or blast furnace slag is mixed with the cement (Japanese Unexamined Patent Publication Nos. 45 522/1991 and no. 237 049/1991).

These concrete mixture compositions, however, there was a problem per the fact that a substantial shrinkage occurred and the dimensional stability is poor.

Prestressed concrete is currently tonkonstruktionen widely used in the field of building and Be.

Made of prestressed concrete structures are characterized by the fact that the concrete does not crack under the intended load. The resistant ability of the structures is good, they have a low weight, the material is strong and can be repaired excellent. Prefabricated solid connection structures can be formed easily, and help to increase the safety factor in the strength of the components at.

As a method for introducing bias voltages, a mechanical method, an electrical method and a chemical method is known. A chemical method, ie a chemical biasing method, in ERAL nen in the case of concrete pipes or parts of buildings used with complicated shape and difficult stages of production. Various Zementbeimisch ments for such chemically prestressed concrete have been proposed (eg. As Japanese Unexamined Patent Publication Nos. 171/1976 7, no. 13650/1978 and no. 31170/1978).

With respect to an increasing demand for lightweight concrete structures, it has become increasingly necessary in recent times to apply chemical bias. So häufi ger cement mixtures are used, for example for the purpose of improving the work efficiency or reducing the costs which a pozzolan, such as high-furnace slag or fly ash incorporated is. Furthermore, chemical preload voltage is applied with respect to an increasing use under adverse environmental conditions, such as the application under ground.

Especially with a mixed cement was the problem that an adequate chemical bias can not be brought about simply by using a conventional cement admixture.

The inventors have found that it is possible to solve the above problems by using a certain specific cement admixture. The invention is based on these findings.

The present invention thus provides (1) a cement admixture comprising an amorphous calcium aluminate and an expansive material, wel has been de- formed by heat treatment of a mixture comprising CaO raw material and $CaSO_4$ raw material, wherein the content of $CaSO_4$ in the formed expansive material from 10 to 50 parts by weight per 100 parts by weight of the sum of CaO and $CaSO_4$ is, (2) a cement admixture which further contains a latent hydraulic material, a thickening agent and a water reducing agent in addition to the amorphous calcium aluminate and the expansive material , (3) a cement admixture which further contains Dex trin with a cold water soluble content of 10 to 65 wt .-% additional from that to which the amorphous calcium aluminate and the expansive material, (4) a cement composition comprising cement and such a cement comprises admixture and (5) a chemically prestressed concrete, which was Herge provides, by a cement mixture containing such a cement composition co, compacted in a mold, followed by curing.

The expansive material according to the invention to be used is Herge is by CaO raw material, and $CaSO_4$ raw material in a certain ratio vorbe mixed, followed by heat treatment. This gives mate rial in particular a mixed cement an effective expansive property.

The raw materials for the expansive material which is used according to the invention can be arbitrarily selected, depending on the purity and cost. They are not particularly limited. The CaO material can be, for example $CaCO_3$ material or Ca $(OH)_2$ material, such as limestone or hydrated lime; and the $CaSO_4$ raw material can be beispielswei se anhydrous gypsum, hemihydrate or gypsum dihydrate.

Impurities such as SiO, Fe_2O_3, CaF_2, MgO and TiO_2 present in the raw materials are not particularly limited as long as they do not adversely affect the purpose of the invention.

The raw material and the CaO-$CaSO_4$-raw material for the expansive material according Invention are preferably mixed such that $CaSO_4$ in the expansive material formed from 10 to 50 parts by weight constitutes, more preferably from 20 to 40 parts by weight, in 100 parts by weight of the sum of CaO and SO_4. If $CaSO_4$ is less than 10 parts by weight, it may occur at a such expansive material that arrived one day old mate rial an abrupt expansive property shows and established product in the hardened Ze, where such expansive material is used, crack , The achievable strength can also be low. If on the other hand, exceeding 50 parts by weight of $CaSO_4$, the expansive property is low and the extent of the induced bias is low.

In the present invention, the decomposition temperature of gypsum to form sulfuric acid varies significantly depending on the mixture ratios of the raw material mixtures Mi or the content of the contami certificates. The baking temperature for baking is not limited particularly be. In general, the baking temperature is preferably 1100 to 1600 ° C.

A method of mixing the raw materials is not particularly limited and conventional methods are used.

Further, the method is subject to the heat treatment of the raw materials kei NEN particularly limited, and it may be any method, such as Bac ken be with a rotary kiln or melting by an electric furnace, applied.

The fineness of the expansive material, the present invention will depend upon the particular purpose or application and is not particularly limited. Usually, however, it is preferable to provide a level ei Nes Blainewerts 1500-8000 cm² / g. If this value is to dress ner than 1,500 cm² / g, the reinforcing effect is reduced, and if the value of 8000 cm / g exceeds, sufficient expansive property is obtained.

In the case of cement admixture which the expansive material, amorphous calcium aluminate (hereinafter referred to as A-CA), a la tent hydraulic material, a thickening agent and a water reduction agent comprises varying the amount of the expansive material, depending on the spe cial use and is not particularly limited. However, it is generally preferred that in 100 parts by weight of the binder by means of which the expansive material, A-CA, the latent hydraulic material and the cement Mate comprises 3-12 parts by weight, more preferably 5-7 present parts by weight of an expansive material. If the amount is less than 3 parts by weight, the expansive property becomes insufficient. Other hand, if the amount exceeds 12 parts by weight, it is easy to abnormal expansion.

In the case of a cement admixture containing the expansive material, A-CA and the dextrin, the amount of the expansive material prior preferably 30-88 parts by weight, more preferably from 50 to 75 parts by weight in 100 parts by weight parts of the cement admixture. If the amount is less than 30 parts by weight, not the expansive property is insufficient, and if the amount exceeds 88 parts by weight, the effect of preventing the heat generating equipment by hydration is small.

The amorphous calcium aluminate, which is used in the invention is one which is obtained by melting a raw material mixture of CaO and Al_2O_3 raw material, quenching the melt to obtain a clinker, and pulverizing the clinker.

The melting temperature of the raw materials for the amorphous calcium aluminate varies depending on the impurities, and is not particularly limited. Generally, however, the temperature is preferably 1500-1700 ° C.

The CaO content of the amorphous calcium aluminate is preferably from 35 to 45 wt .-%, more preferably of 38 to 42 wt .-%. If the content is less than 35 wt .-%, the expansive property becomes insufficient and if the content exceeds 45 wt .-%, the fluidity of the cement composition becomes low, whereby the working efficiency is impaired.

The fineness of the amorphous calcium aluminate varies depending on the spe cial use. The fineness is generally preferred in egg NEM level by a Blaine value from 1500 to 6000 cm² / g. If the value is less than 1500 cm² / g, sufficient expansive property is preserver th and if the value of 6000 cm² / g by weight, the processing efficiency is low.

In the case of cement admixture comprising the expansive material and the amorphous calcium aluminate, the amount of the amorphous Cal ciumaluminats preferably from 10 to 50 parts by weight, more preferably from 15 to 35 parts by weight in the cement admixture. If it is less than 10 parts by weight, is easy to form cracks in the cement product produced therefrom, hardened. If the amount exceeds 50 parts by weight, the Expansivei ing properties are insufficient.

In the case of cement admixture comprising the expansive material, the amorphous calcium aluminate, the latent hydraulic material, the thickening agent and the water reducing agent, the amount of the amor phen calcium aluminate is preferably from 3 to 7 parts by weight in 100 parts by weight of binder which comprises expansive material, amorphous calcium aluminate, the latent hydraulic material, and cement. If the Men's ge less than 3 parts by weight, the timing of the expansion is delayed, and it can easily abnormal expansion occur. Other hand, if the amount exceeds 7 parts by weight, the fluidity is deteriorated, whereby the processing efficiency is adversely affected.

Is finer in the case of a cement admixture, comprising the expansive material, the amorphous calcium aluminate and the dextrin, the amount of the amorphous calcium aluminate is preferably from 10 to 50 parts by weight, more preferably from 20 to 40 parts by weight in 100 parts by weight parts of the Zementbeimi research. If the amount is less than 10 parts by weight, in the form out there prepared cured cement product easily cracks, and if the amount exceeds 50 parts by weight, the expansive property is insufficient.

The latent hydraulic material according to the invention is used, the cement to improve the fluidity, stability compared ge separation of the materials and to improve the density leibt einver. Specifically, it may, for example, a pozzolan such as silica dust, fly ash act or fine powder of blast furnace slag.

The fineness of the latent hydraulic material is not particularly limited, but is preferably at a level of a Blaine value of minde least 4000 cm² / g. If the fineness is less than 4000 cm / g, sufficient fluidity or resistance is obtained against separation of materials.

The amount of the latent hydraulic material is preferably from 10 to 70 parts by weight per 100 parts by weight of the total amount of cement and latent hydraulic material. If the amount is less than 10 parts by weight, the fluidity or resistance to separation of the materials in the cement composition becomes insufficient, and if the amount exceeds 70 weight parts, the fluidity is extremely small.

The thickener used in the invention serves to maintain fluidity upright or prevent a separation of the materials to ver. Special mention thickeners are made of water-soluble poly mers from eg., Methyl cellulose type, polyethylene glycol type, Ethylenoxidtyp, acrylic type, such as polyacrylamide, polyvinyl alcohol and. However, it may also be a commercial product, the mixture as an aqueous nichtauftrennbare Beimi is available, can be used.

The aqueous, non-separable admixture may for example be of methyl cellulose type, such as "Askaclean", trade name, manufactured by Shin-Etsu Chemical Industry Co., Ltd. or "Aqua Etter", trade name, manufactured by Takemoto Yushi KK or "Denkastabikon A" goods identifiers voltage produced by Denki Kagaku Kogyo KK, or the acrylic type, such as "Seabetter", trade name, manufactured by Sankyo Kasei Kogyo KK or "Aronseacrete W "trade name, manufactured by Toa Gosei Che mical Industries Co., Ltd.

These thickeners may be used in an amount as given by the respective manufacturers. However, in general the amount of such a thickening agent is preferably from 0.01 to 2 kg per m³ of concrete. It is advisable, depending on the intended use or application conditions, the amount of change in functional accordingly.

The water reducing agent used in the invention is not particularly limited. However, it is preferred to use a high-performance water-reducing agent, a high-performance AE water-reducing agent or to use a fluidizing agent. Wasserreduktionsmit tel can generally bonsäuretyp in a naphthalene, a melamine type, a polycarboxylic and aminosulfonic acid are divided.

As typical examples of naphthalene may be mentioned "Maity 2000 W11", trade name, manufactured by Kao Corporation, "Denka FT-500" or "Denka FT-80" are trade names, manufactured by Denki Kogyo KK Kagakn. "Mermento F-10", trade name, manufactured by Showa The ko KK or "Sicament 1000H", trade name, manufactured by Nippon KK Sica be mentioned as examples of the melamine type. "Darlex super 100PHX" or "Darlex super 200" are trade names, manufactured by the ka Grace KK or "Reobuild SP-8HS", trade name, manufactured by NMB KK can be mentioned as examples of the polycarboxylic acid, and "Paric FP-100U" Description of goods manufactured by Fujisawa Phannaceutical Co., Ltd. can be mentioned as an example of the Aminosulfonsäuretyps.

Furthermore, like water reducing agents are commercially available from other companies, such as Nippon Zeon KK, Kobe Zairyo KK, Nippon Paper Mills Co., Ltd., Takemoto Yushi KK, Fukui Chemical Industries Co., Ltd. and Dai-ichi Kogyo KK Seiyakn

These water reducing agents may in such an amount verwen be used provided they are given by the manufacturers respectively. However, in the case of the naphthalene type or melamine type, the amount is preferably from 1 to 4 parts by weight per 100 parts by weight of a binder, which comprises the cement expansive material and amorphous calcium aluminate.

Similarly, in the case of the polycarboxylic acid type or of the Aminosulfonsäuretyps the amount is preferably from 1 to 3 parts by weight. The amount of the water reducing agent is not particularly limited to these examples.

In the present invention, as dextrin any dextrin be used, provided that only soluble in cold water content of 10 to 65 wt .-% is, for example, a dextrin, which is obtainable by to task a dilute acid to starch, followed by heat decomposition , a sol Chen, obtainable by enzymatic decomposition of starch or a sol ches, which is obtainable by condensation of glucose.

With "cold soluble content" of dextrin is understood here as the amount of dextrin, which dissolves in distilled water at a temperature of 21 ° C. Specifically, 10 g of dextrin are introduced into a 200 ml flask. Closing at 150 ml of distilled water are added at a temperature of 21 ° C and the mixture is kept one hour at a temperature of 21 ± 1 ° C, followed by filtration. The filtrate is distilled to dryness, then the ratio of the resulting dextrin is found to the un-age lights as cold soluble dextrin content.

In the present invention, the cold soluble content of Dex trin is from 10 to 65 wt .-%, preferably from 15 to 50 wt .-%, more before given to from 20 to 40 wt .-%.

The amount of dextrin is preferably from 2 to 20 wt .-%, more preferably from 5 to 10 wt .-% in 100 parts by weight of a cement admixture, comprising the expansive material, amorphous calcium aluminate and the dextrin. If the amount is less than 2 parts by weight, the effect of suppressing the heat of hydration respect Lich becomes small, and if the amount exceeds 20 parts by weight, the reinforcing property is low.

In the present invention, the cement admixture is one which comprises the expansive material and amorphous calcium aluminate, or one which comprises the expansive material, amorphous calcium aluminate, the latent hydraulic material, the thickening agent and the Wasserreduk tion medium. In particular, it is such a Zementbeimi research that can lend a cement blend of an effective expansive property ver. By the combined use of the expansive material and amorphous calcium aluminate can be prevented which takes the expansion starting, due to a consumption of free CaO in the composition by Zementzu pozzolan.

Furthermore, the degree of expansion and the timing of the Ex can pansion in cement admixture depending on the use of cement type to be set, namely by Nisse the mixture behaves sets of CaO raw material and $CaSO_4$ raw material, or by the mixing ratio of expansive material and amorphous Calciumalu sets aluminate.

Furthermore, it can be a such at the cement admixture of the present invention, which nat the expansive material, amorphous Calciumalumi and includes the dextrin. Such a cement admixture is able to give not only an effective expansive property, but also an excellent effect for reducing the heat of hydration, in particular in a mixed cement.

The fineness of the powder of the cement admixture according to the invention depends on the particular application and is not particularly limited. The fineness but generally preferably at a level of ei NEM Blaine 1500 to 8000 cm² / g. If the value is less than 1500 cm² / g, the reinforcing property is low and the flowability of the cement composition may be adversely affected. On the other hand, the value of 8000 cm / g exceeds not receive sufficient ex pansiveigenschaft.

In the case of the cement admixture comprising the expansive material and amorphous calcium aluminate, the amount of the cement admixture varied depending upon the particular intended use. The amount of the mixture is Zementbeimi but usually preferably from 3 to 15 parts by weight, more preferably from 5 to 10 parts by weight, per 100 parts by weight of cement. If the amount is less than 3 parts by weight, no sufficient self-expansive shaft can be obtained, and if the amount exceeds 15 parts by weight, it is easy to abnormal expansion.

In the case of cement admixture comprising the expansive material, amorphous calcium aluminate and the dextrin, the amount of the element Ze admixture preferably from 3 to 20 parts by weight, more preferably from 5 to 15 parts by weight in 100 parts by weight of total amount of cement and admixture Ze management. If the amount is less than 5 parts by weight, no can be obtained from reaching expansive property. If the amount exceeds 20 parts by weight, easily occurs abnormal expansion.

Further, if pre-stressed concrete is to be produced, varying the Men ge of the cement admixture according to the invention depending on the specific use items, but is usually preferably from 5 to 20 parts by weight, more preferably from 7 to 15 parts by weight in 100 wt. parts by the Ge total amount of cement and cement admixture. If the amount is less than 5 parts by weight, the amount of bias introduced is insufficient and an amount exceeding 20 parts by weight is, from an economic point does not make sense, since no additional effect can be expected.

The cement can be cements using different in this respect Portland as normal Portland cement, Portland cement with high early strength Portland cement with ultra high early strength and Portlandze ment with excessive heat (moderate heat portland cement), and various blended cements with a pozzolan, such as blast furnace slag or fly ash such Portland cements are mixed or cements with low heat generation, which use the blended cements as the base, and alumina cements. The features of the present invention become particularly evident when ge blended cements are used or cements with low heat generators supply, which represent mixed cements the base material.

The amount of water to be used in the invention may suitably in a corresponding manner hereby amended and is not particularly limited, depending on the types or quantities of the materials. It can be used in abundance, they usually verwen for mortar or concrete is used.

In the present invention, in addition to the research Zementbeimi, one or more members from the following group who incorporated in the a region in which the purpose of the present invention is not significantly impaired. This group consists of Härtungsmodifiziermitteln, to impact materials such as sand and gravel, AE agents, corrosion inhibitors, freeze protection products, polymer emulsions, clay minerals such as bentonite and Montmo rillonit, ion exchangers such as zeolite, hydrotalcite and Hydrocalumit, Anorga African sulfates such as aluminum sulfate and sodium sulfate, inorganic phosphates and boric acid.

The method of mixing or kneading of the cement admixture, or cement composition is not particularly Beschränkun Gene and there may be a conventional method can be used.

As a device for mixing the cement admixture with Ze ment, etc., you can use a conventional mixing apparatus example as an inclined drum mixer, a Omuni mixer, a mixer with a V-shape, a Henschel mixer or a Nauter mixer.

The respective materials can also be mixed at the time of application. You can also pre-mix some or all of them.

The curing process for a cured cement product which has been produced with the cement admixture according to the invention it is subject to no restrictions spe cial. One can use any conventional method, such as curing at normal temperature and normal pressure, with steam curing, curing with high temperature and high pressure or curing under pressure.

In the preparation of chemically prestressed concrete conducted using either of the cement admixture according to the invention making it is common practice to first dispose a tension insulating core in the mold. The clamping voltage insulating core is used to transmit a tensile stress in the concrete. Specifically, a PC steel material made of steel with a tensile strength ho can be forth zugbeanspruchbares or a material made of FRP, in which Fa fibers are fixed by an organic substance used. The procedures in matters of arrangement of Spannungsisolierkerns is not particularly limited, but preferably an arrangement in which direction is taken before, in which the tension is applied.

The method of applying a cement mixture, which was prepared by using Ver the cement admixture according to the invention is not particularly limited, and a conventional method can be applied.

In the following the invention will be with reference to examples in detail erläu tert. It should be noted, however, that the present invention by specific examples, is not limited.

Example 1

CaO and $CaSO_4$ raw material raw material are mixed so that the product assumes a molar ratio, as indicated in Table 1. At closing a heat treatment is carried out in an electric furnace at 1200 ° C for one hour, to obtain a clinker. In this way different clinker expansive materials are obtained under schiedlichem content $CaSO_4$. The weight ratios of CaO and $CaSO_4$ in the expansive material are determined evaluate the chemical analysis. $CaSO_4$ is calculated from the chemical analysis values of SO_3 CaO BE and is the value that is obtained by the total of CaO in the CaO content $CaSO_4$ subtracted.

This clinker was pulverized and adjusted to a Blaine value of 3,000 ± 200 cm / g, to obtain a cement admixture.

On the other hand, CaO and Al_2O_3 raw material raw material is melted at 1650 ° C by an electric furnace and then abge deters to obtain amorphous Calciumaluminatklinker which is subsequently pulverized to obtain amorphous calcium aluminate (A CA). To 100 parts by weight of expansive material prepared 50 parts by weight A-CAa are mixed to obtain a cement admixture. 100 parts by weight Ze ment are mixed with 7 parts by weight of the cement admixture, including the creation of a water / (cement + cement admixture) ratio = 60% (cement + cement admixture) / sand ratio of 1/2. This material is then cured in air at 20 ° C under a humidity of 80%. Raufhin since the expansion coefficient of the mortar is measured. The result se are summarized in Table 1.

Materials used

CaO raw material:
Limestone generated in the Oumimine, Herge provides Denki Kagaku Kogyo KK of Blaine value: 3840 cm² / g
$CaSO_4$ raw material:
Anhydrous gypsum as a by-product from the production of hydrofluoric acid, Blaine: 4210 cm² / g
Al_2O_2 raw material:
Commercially available bauxite
A CAa:
CaO content: 40%, Blaine: 3740 cm² / g
Cement α:
Normal Portland cement manufactured by Denki Kagaku Kogyo KK
Sand:
Standard sand produced in Toyoura Commercial Product δ:
"Expan", trade name, expan immersive material prepared by Onada Cement Co., Ltd., Blaine: 3100 cm² / g
Commercial Product ε:
"CSA # 20" trade name, ex pansives material produced by Denki Kagaku Kogyo KK, Blaine worth 2950 cm² / g
Water:
Tap water

Test methods

Expansion coefficient:
According to JIS A6202 (Method B)

Table 1

Example 2

The experiment is performed in the same manner as in Example 1 results in Runaway, with the exception that an expansive material is used with a $CaSO_4$ content of 30 parts by weight in 100 parts of the sum of CaO and $CaSO_4$ and the type and be geän amount of A-CA in Table 2 changed to obtain different cement admixtures. The the outcome of these are shown in Table 2.

Materials used

A CAb: CaO content: 35 wt .-%, Blaine: 3150 cm² / g
A CAc: CaO content: 45 wt .-%, Blaine: 3090 cm² / g

Table 2

Example 3

The experiment is performed in the same manner as in Example 1 Runaway leads, and with the exception that a cement admixture was prepared by using an expansive material with a $CaSO_4$ content of 30 parts by weight in 100 parts by weight of the sum of CaO $CaSO_4$ and the amount of the cement admixture per 100 parts by weight of cement, as shown in Table 3 is changed. The results are shown in Table 3.

Table 3

Example 4

The experiment is performed in the same manner as in Example 1 results in Runaway used with the exception that β cement as cement. The results are shown in Table 4.

Materials used

Cement β: β blast furnace slag cement is cement type B, produced by Ube Kosan KK

Table 4

Example 5

The experiment is performed in the same manner Runaway leads as in Example 2 is used except that only cement β and A-CAA. The results are shown in Table 5.

Table 5

Example 6

The experiment is performed in the same manner as in Example 3 Runaway leads, is used with the exception that β cement as cement. The He results are shown in Table 6.

Table 6

Example 7

The experiment is performed in the same manner as in Example 1 Runaway leads, with the exception that CaO and $CaSO_4$ raw material raw material to be baked at 1400 ° C by means of a rotary kiln to obtain a clinker of ex pansiven material. In this way, the expansive Mate rial and A-CA are produced.

Using cement α and 30 parts by weight of a latent-hy draulic material in 100 parts by weight of the total amount of cement and latent hydraulic material and 7 parts by weight of the expansive material and 5 parts by weight of A-CAA 100 parts by weight of the binder containing the cement, the expansive material, A-CA and the latent hydraulic material, a concrete is produced. It is the functional unit of the binding means in the concrete 460 kg / m³, and unit amounts of the other Materia lien amount to 158.1 kg / m³ of water, 889 kg / m³ fine aggregates 741 kg / m³ coarse aggregate, 20 g / m³ thickener , 6.9 kg / m³ of Wasserre duktionsmittels and 23 g / m³ an AE agent.

In this concrete, the expansion coefficient and the flow value are the mass and the VF-value as indices for the fluidity measured. The results are also shown in Table 7.

Materials used

Expansive a material:
$CaSO_4$ content in the expansive material: 10 wt .-%
Expansive material b:
$CaSO_4$ content in the expansive material: 30 wt .-%
Expansive material c:
$CaSO_4$ content in the expansive material: 50 wt .-%
Expansive material d:
$CaSO_4$ content in the expansive material: 60 wt .-%
Expansive material e:
$CaSO_4$ content in the expansive Material: 100 wt .-%
Latent hydraulic material A:
Fly ash produced by Tohuku Hatsuden Kogyo KK

Thickener:
Methylcellulose, manufactured by Shin-Etsu Chemical Industries Co., Ltd.

Water reducing agent:
"Darlex super PHX 100", trade identifiers statement made by Denka Grace KK, main component: polycarboxylic acid type

AE agents:
"AEA S" trade name, manufactured by Denka Grace KK, main component: Sulfonsäurekohlenwasserstoff type
Fine aggregates:
Produced in Himekawa, Niigata-ken, specific gravity: 2.63
Coarse aggregate:
Produced in Himekawa, Niigata-ken, specifi cal weight: 2.67, G_{max} = 25 mm

Test methods

Expansion coefficient: According to JIS A6202 (Method B)
Flow value of the mass: The spread of the concrete is measured at two points in the vertical direction as outlined in the "Test of Aqueous Inseparable Concrete, slump flow test" in Appendix 1 of Aqueous Insepa rable Concrete Manual, published by the Foundation Engan Kaihatsu Gi jutsu Center and Gyoko Gyoson Kensetsu Gÿutsu Kenkyusho.

VF value: Using a VF Consistometer propose of Civil Engineering Association, the cement composition is formed from a perfora tion at the lower portion of a cylinder without vibration can flow out and the lowering of the upper surface of the cement composition in the zy-cylindrical container at the time when stops the flow is measured. The measured value is taken as the VF value.

Filling property: The filling property of concrete is evaluated without vibration. In a transparent acrylic container with a horizontal cross-section of 50 × 50 cm and a height of 40 cm, a total of 56 Beweh is approximately rods with 16 mm diameter arranged, in 8 rows tal in hori direction and 7 rows in the vertical direction parallel to each other in the horizontal direction with a distance of 50 mm in both the horizontal and vertical directions, in such a way that a space in which no bar is arranged on, is provided at one side of the container. In this space the concrete is filled and the filling properties in the area with Stabanord voltage is evaluated by the time required for complete filling. The assessment is made by symbols x, ○ and. The symbol x indicates that it takes at least 15 seconds ○ 10 seconds or less and 7 seconds or less, until the filling is complete.

Example 8

The experiment is performed in the same manner as in Example 7 Runaway leads, with the exception that the amount of the expansive material B in 100 parts by weight of a binder of cement, the latent hydraulic material Ma, the expansive material and A-CA was changed as shown in Table 8. The results are also shown in Table 8.

Example 9

The experiment is performed in the same manner as in Example Runaway leads 7, with the exception that the expansive material B is used and the type and amount of element in CA-A 100 parts by weight of the binder, the Ze, the latent hydraulic material, the expansive material and A-CA was changed as shown in Table 9. The results are also shown in Table 9.

Example 10

The experiment is performed in the same manner as in Example Runaway leads 7, with the exception that the expansive material and the type B is used and the amount of the latent hydraulic material in 100 parts by weight of the total amount of cement and latent hydraulic material, is changed according to Table 10. The results are shown in Table 10.

Materials used

Latent hydraulic material B: blast furnace slag, Blaine:
4200 cm^2 / g

Example 11

Using CaO and $CaSO_4$ raw material raw material, as used in Example 1, different materials with different expansive Materia be $CaSO_4$ content, as given in Table 11 produced in the same manner as in Example 7.

A cement admixture comprising 69 parts by weight of such ex pansiven material, 25 parts by weight A CAD and 6 parts by weight of dextrin is added to an α cement, in in an amount of 10 parts by weight 100 parts by weight of the total amount of cement and the α Zementbeimi research. This gives a mortar with a water / (cement + Zementbei mix) ratio of 50% and a (cement + cement admixture) / sand ratio of 1/2, the temperature at the end of the kneading is 20 ± 0.3 ° C. The temperature at the center of the mortar and the coefficient Ausdehnungskoef be measured. The results are shown in Table 11.

Materials used

A CAd: calcium carbonate and alumina quality '1' who mixed the order, a starting material with a molar ratio of CaO: Al_2O_3 = 10: 8 to obtain. This is melted at 1650 ° C and shrinks abge to obtain a clinker. This is then pulverized cm^2g to a Blaine of 3410.

Dextrin:
"MF30", trade name, Herge up by Nichiden Kagaku KK, soluble in cold water content: 30 wt .-%

Sand:
River sand produced in Himekawa, Niigataken, now 5 or less

Measurement Method

The temperature at the center of the mortar: Approximately 3.5 liters of mortar are charged into a cylindrical container made of foamed styrol a height of 30 cm, has an inner diameter of 13 cm and a thickness of 10 cm. The curing takes place in a constant temperature room at 20 ° C. The temperature is automatically measured at the center of the mortar with egg nem thermocouple.

Example 12

The experiment is performed in the same manner as in Example 11 Runaway leads, with the exception that the amount of the cement admixture, wherein said expansive material with a $CaSO_4$ content of 30 wt .-% in 100 parts by weight of the total amount of CaO and $CaSO_4$ was used according to Tabel le 12 is changed where the quantity mentioned relates to the amount in 100 parts by weight of the total amount of cement and cement admixture. The results are also shown in Table 12.

Example 13

The experiment is performed in the same manner as in Example Runaway leads 11, is used with the exception that β cement as cement. The He results are shown in Table 13.

Example 14

The experiment is performed in the same manner as in Example 13 Runaway leads, with the exception that an expansive material is used with a $CaSO_4$ content of 30 wt .-%, the amount of dextrin and the total amount of the expansive material and A-CA be kept constant and the amount of A-CA in 100 parts by weight of the cement admixture containing the expansive material, A-CA and dextrin, as shown in Table 14 is modified. The results are He also shown in Table 14.

Example 15

The experiment is performed in the same manner as in Example 13 Runaway leads, with the exception that an expansive material is used with a $CaSO_4$ content of 30 wt .-%, the amount of the cement admixture, and that the expansive material, A-CA containing dextrin is kept constant and the type of dextrin and the amount of dextrin in 100 parts by weight of the cement admixture be amended in accordance with Table 15. When the amount of dextrin is changed, the amounts of the expansive material and A-CA are increased or reduced to the same extent. The results are also shown in Table 15.

Materials used

Dextrin 2: Cold water soluble content: 10 wt .-%
Dextrin 3: Cold water soluble content: 45 wt .-%
Dextrin 4: Cold water soluble content: 65 wt .-%

Example 16

A cement admixture comprising 69 parts by weight of an expansive material with a $CaSO_4$ content of 30 wt .-%, 25 parts by weight of A-CA and 6 parts by weight of dextrin are mixed with cement, in an amount of 10 parts by weight in 100 parts by weight of the total amount of cement and cement admixture. The same aggregates are verwen det as used in Example 7, at 352 parts by weight of the big ben aggregates and 255 parts by weight of fine aggregates, which incorporated in 100 parts by weight of the total amount of cement and cement admixture be. A concrete obtained with a water / (cement + Zementbei mix) ratio of 49% and a temperature after completion of the kneading of 20 ° C. This concrete is poured into a mold of 50 × 50 × 50 cm, made of iron, with four sides are insulated with foamed styrene with egg ner thickness of 10 cm and two sides for the release of heat are open. The curing takes place in a constant temperature room at 20 ° C. The temperature is automatically measured at the center of the concrete with egg nem thermocouple. Furthermore, the expansion coefficient is mea sen. The results are shown in Table 16.

Example 17

Using the same raw material of CaO and $CaSO_4$-Rohma material, as used in Example 1, various expansive materials with different $CaSO_4$ content are prepared in the same manner as in Example 1.

To 100 parts by weight of such an expansive material 35 parts by weight A CAD are added to obtain a cement admixture.

Using cement β a concrete with a water / (cement + cement admixture) ratio of 40% and a content of the fine to aggregates is produced by 39%, using 1 part by weight of a water reducing agent per 100 parts by weight of the total amount of cement and cement admixture. The unit amount of cement 1054 is 385 kg / m³ and unit amounts of cement admixture, the same fei nen aggregates as used in Example 7, gross to impact materials and water 64.5 kg / m³, 654 kg / m³, kg / m³ and 172 kg / m³.

Using a PC steel rod as a main reinforcement and a PC steel wire as a reinforcing spiral Zugisolationskern is arranged with a ratio of 0.4% steel in a mold. The prepared concrete is poured and formed with centrifugal force to a concrete pipe with a diameter of 20 cm, a length of 25 cm and a wall thickness of 40 ± 1 mm. The whole 24 hours in a room for curing are laser-sen. Then the concrete pipe is stripped and subjected to steam curing at 65 ° C for 10 hours. After the steam curing, the tube is subjected to an outside Wassersprühhärtung.

The voltage is measured with a voltmeter that was previously associated with the spiral reinforcement and the amount of preload tion, which was introduced in the measuring direction of the concrete is determined at a material which has 28 days old. The results are shown in Table 17.

Materials used

Water reducing agent:
"Denka FT-500G", manufactured by Denki Kagaku Kogyo KK

Coarse aggregate:
River gravel produced in Himekawa, Niigata-ken specific gravity: 2.67, $G_{max:}$ 15 mm

Table 17

Example 18

The experiment is performed in the same manner as in Example 17 Runaway leads, with the exception that an expansive material is used with a $CaSO_4$ content of 30 parts by weight in 100 parts by weight of the total amount of CaO and $CaSO_4$ and the type of A CA is changed. The results are shown in Table 18.

Materials used

A CAe:
Molar ratio of CaO: Al_2O_3 = 10: 11, Blaine 3010 cm² / g CaO content: 33%
A CAF:
Molar ratio of CaO: Al_2O_3 = 10: 10, Blaine 3150 cm² / g CaO content: 35%
A CAg:
Molar ratio of CaO: Al_2O_3 = 10: 7, Blaine 3090 cm² / g CaO content: 44%
A CAh:
Molar ratio of CaO: Al_2O_3 = 10: 6, Blaine 2980 cm² / g CaO content: 48%

Table 18

Example 19

Using cement β and a cement admixture, which was prepared by mixing 35 parts by weight A CAD to 100 parts by weight of an expansive material with a $CaSO_4$ content of 30 parts by weight in 100 parts by weight of total amount of CaO and $CaSO_4$, a concrete with a water / (cement + cement admixture) ratio of 40% and a content of the fine aggregate is made of 39%. In this case 1 part by weight of a water reducing agent per 100 parts by weight of cement is used and cement admixture. Here, a unit amount of cement is 374 kg / m³ and unit amounts of cement admixture, the same fine and coarse aggregates, as used in Example 17 and water amount to 66 kg / m³ 685 kg / m³ 1098 kg / m³ and 167 kg / m³.

Using the concrete made a box-shaped channel having an outer dimension of 2340 × 2340 × 1500 mm, a thickness of 170 mm and a Hüftbereichsdimension of 150 mm is formed.

Steel reinforcements are made in double-rod assembly where the steel ratio is at 1.6% in the main reinforcing bar side and 0.25% on the distribution side bar. 3 hours after the introduction of the concrete, a steam curing is conducted at a temperature rise rate of 16 ° C / h and the mold is held at the maximum temperature of 65 ° C for 3 hours. After the steam curing, the mold is allowed to cool naturally Wei se. 24 hours later, the molded product is removed from the mold and allowed to stand at room temperature. When a material is due 14 days old, the voltage is measured with a voltmeter. The results are shown in Table 19.

Table 19

Example 20

Using cement β and an expansive material with a $CaSO_4$ content of 30 parts by weight to 100 parts by weight of Gesamtmen ge of CaO and $CaSO_4$ a mortar with a mortar flow value of 200 ± 20 mm with W / C = 34 % were prepared. Here, the cement admixture in which 30 parts by weight of A CAD are mixed with 100 parts by weight of ex pansiven material in an amount of 8 parts by weight per 100 parts by weight of the total amount of cement and cement admixture used. The (cement + cement admixture) / sand ratio is 1: 1.8.

By Zentrifugierformen with 25G at the maximum rotation a steel pipe of 10 cm in diameter × 30 cm lined in a thickness of 0.5 cm with the prepared mortar.

The steel pipe obtained, lined with mortar is 4 hours ste hengelassen and then heated at a temperature increase of 16 ° C / h. Subsequently, a steam curing is carried out while maintaining the tube for 3 hours at a maximum temperature of 50 ° C.

The product is then allowed to cool naturally, taken at 24 hours from the mold and allow to stand outside close. The condition regarding cracks and peeling is observed in a material that is a year old. The results are shown in Table 20.

Table 20

Example 21

The experiment is performed in the same manner as in Example 17 Runaway leads with the exception that an expansive material with a $CaSO_4$ content of 30 parts by weight in 100 parts by weight of the total amount of CaO and $CaSO_4$ is used, and that a cement admixture is used, which was prepared. by mixing 35 parts by weight A CAD To 100 parts by weight of an expansive material The amount of cement admixture per 100 parts by weight of the total amount of cement and cement admixture is changed according to Table 21. The results are also shown in Table 21.

Table 21

From the above examples it is clear that the invention Ze element admixture has an excellent property and forth expansive projecting shows effects in terms of reducing the heat of hydration in a mixed cement. One can therefore obtain a concrete, which has excellent dimensional stability and no compaction requires.

Further, a surface pre-stressed concrete mixing is created with the cement admixture according to the invention, in which a high degree of preload voltage has been introduced.

PATENTŲ ŠALTINIAI

Cituojamas patentas	Oficialaus pateikimo data	Paskelbimo data	Pareiškėjas	Pavadinimas
DE2023695B2 *	14 gegužės 1970	25 rugpjūčio 1977		Verfahren zur herstellung von quellzement fuer die erzeugung von spannbeton durch vermischen von portlandzement mit einer quellkomponente
DE3711549A1 *	6 balandžio 1987	15 spalio 1987	Ube Industries	Lightweight calcium silicate moulding and prodn. using expansion agent - forming ettringite on reaction with water, giving strong prod. similar to wood
DE4410850A1 *	29 kovo 1994	5 spalio 1995	Pro Mineral Ges	Bindemittel für hydraulisch abbindende Fließstriche oder Industrieböden

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US8618195	31 sausio 2008	31 gruodžio 2013	Italcementi S.P.A.	Solid mixture and coating based on a sulfo-aluminous or sulfo-ferroaluminous clinker and cementitious-based pipes thus coated
US20100330318 *	31 sausio 2008	30 gruodžio 2010	Italcementi S.P.A.	Solid mixture and coating based on a sulfo-aluminous or sulfo-ferroaluminous clinker and cementitious-based pipes thus coated
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KLASIFIKACIJOS

Tarptautinė klasifikacija	C04B7/32, C04B28/06
Suderintoji klasifikacija	C04B28/065, C04B7/323
Europos klasifikacija	C04B28/06B, C04B7/32B

TEISINIAI ĮVYKIAI

Data	Kodas	Įvykis	Aprašas
14 rugsėjo 1995	8110	Request for examination paragraph 44	
18 lapkr. 1999	D2	Grant after examination	
18 gegužės 2000	8364	No opposition during term of opposition	
27 rugsėjo 2014	R071	Expiry of right	