

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 March 2012 (22.03.2012)

(10) International Publication Number
WO 2012/035456 A1

PCT

(51) International Patent Classification:
C04B 12/04 (2006.01)

(21) International Application Number:
PCT/IB2011/053593

(22) International Filing Date:
12 August 2011 (12.08.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10176378.7 13 September 2010 (13.09.2010) EP

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: WHITE SCREED HAVING HIGH LIGHT REFLECTION, SPOT RESISTANCE AND EASY CLEANABILITY

(57) Abstract: The use of a binder system comprising Compounds containing aluminium oxide, Silicon oxide and titanium oxide for producing a screed, in particular a white screed having high light reflection, spot resistance and easy cleanability, characterized in that the sum of the oxides calculated as Al_2O_3 , SiO_2 and TiO_2 in the binder system is ≥ 41 % by weight, based on the water-free binder system, is proposed.



WO 2012/035456 A1

White screed having high light reflection, spot resistance and easy cleanability

The present invention relates to the use of a binder system comprising compounds containing aluminium oxide, silicon oxide and titanium oxide for producing a screed, in particular a white screed having high light reflection, spot resistance and easy cleanability.

Conventional cement-grey screeds absorb a relatively large amount of light. In industrial production areas, electric energy in the form of light can be saved by means of white floor systems due to higher reflectivities. However, conventional binders have the disadvantage that they soil easily and are difficult to clean, which continually reduces the savings potential during long-term use. Organic and in particular oily contamination leads to spots which are difficult to remove on the surfaces of such screeds.

Various binder systems are available for producing screeds. Portland cement is a known inorganic binder. It was mentioned for the first time in the British patent BP 5022 and has been continually developed further since then. Modern Portland cement contains about 70% by weight of $\text{CaO} + \text{MgO}$, about 20% by weight of SiO_2 and about 10% by weight of $\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$. Due to its high CaO content, it cures hydraulically. White cement is a particularly low-iron and therefore white type of Portland cement. Furthermore, aluminates or high-alumina cements are known. Cured cement has a pronounced roughness, tends to become soiled and is difficult to clean. The cement surface is, depending on the composition, sometimes also relatively lipophilic and releases organic or oily contamination only after intensive cleaning.

Certain slags from metallurgical processes can be used as latent hydraulic binders as additions to Portland cements. Activation by means of strong alkalis such as alkali metal hydroxides, alkali metal carbonates or water glasses is also possible. They can be employed as mortars or concretes by mixing with solids (e.g. silica sand having an appropriate particle size) and additives. For example, blast furnace slag is a typical latent hydraulic binder. The cured products generally have the properties of hydraulically cured systems.

Inorganic binder systems based on reaction compounds based on SiO_2 in combination with Al_2O_3 , which cure in aqueous alkaline medium, are likewise generally known. Such cured binder systems are also referred to as "geopolymers" and are described, for example, in EP 1236702 A1, EP 1081114 A1, WO 85/03699, WO 08/012438, US 4,349,386 and US 4,472,199. Compared to cements, geopolymers can be cheaper and more resistant and have a more favourable CO_2 emissions balance. As reactive oxide mixture, it is possible to use metakaolin, slags, fly ashes, activated clay or mixtures thereof. The alkaline medium for activating the binder usually comprises aqueous

solutions of alkali metal carbonates, alkali metal fluorides, alkali metal hydroxides and/or water glass. In general, a geopolymer surface is less rough and less porous than a cement surface and therefore displays a lesser tendency to become soiled. However, such a surface is, depending on the composition, sometimes relatively
5 lipophilic and releases organic or oily contamination only after intensive cleaning.

EP 1236702 A1 describes a building material mixture containing water glass for producing chemicals-resistant mortars based on a latent hydraulic binder, water glass and a metal salt from the group consisting of "metal hydroxide, metal oxide, carbon-
10 containing metal salt, sulphur-containing metal salt, nitrogen-containing metal salt, phosphorus-containing metal salt, halogen-containing metal salt" as control agent. As latent hydraulic constituent, it is also possible to use slag sand. As metal salt, alkali metal salts, in particular lithium salts, are mentioned and used.

15 EP 1081114 A1 describes a building material mixture for producing chemicals-resistant mortars, where the building material mixture comprises water glass powder and at least one water glass hardener. Furthermore, over 10% by weight of at least one latent hydraulic binder is contained and the building material mixture comprises at least one inorganic filler.

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To protect soiling-susceptible surfaces of building products from external influences, these can also be upgraded by means of hydrophobic or hydrophilic coatings.

For example, to remove paint defacing on exterior walls, antigraffiti systems which
25 reduce the adhesion of graffiti paints by hydrophobicization of the surface have been developed. Such coatings are described, inter alia, in WO 92/21729, WO 97/24407 and DE 19955047. Disadvantages of these systems are the often poor adhesion to the substrate, the low transparency, the high price and insufficient hardness.

30 US 2008/0250978 describes a hydrophobic, self-cleaning coating which is obtained by introducing hydrophobicized nanoparticles (e.g. microsilica or zinc oxide). The coating remains effective for a number of weeks at most.

A process for applying a coating to the surface of a product made of concrete or mortar
35 in order to improve the adhesion properties is disclosed in DE 3018826. An increase in the hydrophilicity is achieved by means of mixtures of polyvinyl alcohol and boric acid in aqueous solution, which gel due to the alkalinity of the substrate.

Further hydrophilic coatings and coating methods may be found in CN 101440168, EP
40 2080740 and US 4,052,347. Organic additives are used in all these coatings.

The use of titanium dioxide (e.g. rutile or anatase) in building products or coating compositions is also known. Titanium dioxide acts photocatalytically, i.e. it decomposes organic soiling by oxidation, on irradiation with UV (and if appropriately doped even on irradiation with visible light).

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For example, WO 08/079756 A1 describes a coating composition and a coated article, where the coating composition comprises photocatalytic particles (e.g. TiO_2) and an alkali metal silicate binder and also boric acid, borates or mixtures thereof. EP 2080740 A1 describes a hydrophilic coating comprising titanium dioxide and an ether/oleate-based organic compound.

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It has been an object of the inventors essentially to avoid at least some of the disadvantages of the prior art discussed above. In particular, a white screed having high light reflection, spot resistance and easy cleanability should be made available. In other words, the screed should at the same time preferably have a white colour with high light reflection, photocatalytic properties, low soiling and easy cleanability without recourse to surface upgrading having to be made.

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The abovementioned objects are achieved by the features of the independent claim. The dependent claims relate to preferred embodiments.

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The invention provides for the use of a binder system comprising compounds containing aluminium oxide, silicon oxide and titanium oxide for producing a screed, in particular a white screed having high light reflection, spot resistance and easy cleanability, characterized in that the sum of the oxides calculated as Al_2O_3 , SiO_2 and TiO_2 in the binder system is $\geq 41\%$ by weight, based on the water-free binder system.

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For the purposes of the present invention, "compounds containing aluminium oxide, silicon oxide and titanium oxide" are compounds and mixtures of compounds which comprise aluminium, silicon, titanium and oxygen. In quantitative analyses, it is generally customary to report the aluminium, silicon, and titanium contents as Al_2O_3 , SiO_2 and TiO_2 without aluminium, silicon and titanium actually having to be present as oxides. According to the invention, for example, silicates, aluminates, titanates, aluminosilicates, mixed oxides (e.g. $\text{Al}_2\text{Si}_2\text{O}_7$), cements, SiO_2 , Al_2O_3 and TiO_2 together with sources of any other elements should also be considered to be comprised. Titanium oxides are particularly preferably used in the form of titanium dioxide (rutile or anatase).

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The "binder system" comprises, according to the invention, compounds containing aluminium oxide, silicon oxide and titanium oxide. Preferred constituents of the binder system are discussed below. The oxide contents according to the invention are calculated in percent by weight (% by weight) on the basis of the "water-free binder

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system", i.e. according to the invention, water is not considered to be and calculated as a constituent of the binder system.

As soon as the binder system comes into contact with water, settling and curing of the binder system occurs. The water is either kept in reserve separately from the binder and added when required (one-component formulation) or is stored together with an alkaline activator and added if required (two-component formulation). This gives (if appropriate together with the inert fillers and/or further additives discussed below) the screed according to the invention.

The easy cleanability of the screed is promoted by good wettability with water, i.e. high hydrophilicity. This can be defined by means of the contact angle of an oil drop placed on the surface of the screed. If the screed is porous, the oil drop would be at least partly absorbed by the surface, so that a dynamic contact angle determination is necessary. This can be carried out by means of an underwater measurement method. Here, the term "hydrophilic" means a contact angle of $\geq 90^\circ$. In the case of contact angles of $\geq 135^\circ$, the effect can also be described as "superhydrophilicity". Particular preference is given to screeds in the case of which the oil drop becomes detached again after a short time in contact with water. In this case, the contact angle is considered to be 180° .

A relatively high content of said oxides in the binder system can be advantageous since this increases the hydrophilicity of the fully cured screed and thus the easy cleanability. It is also advantageous in terms of the photocatalytic effect if the titanium dioxide particles having a photocatalytic action are surrounded very well by water. The sum of oxides calculated as Al_2O_3 , SiO_2 and TiO_2 in the binder system is preferably $\geq 50\%$ by weight, particularly preferably $\geq 60\%$ by weight, based on the water-free binder system.

A certain minimum content of SiO_2 is advantageous in order to achieve a high hydrophilicity. The content of oxides calculated as SiO_2 in the binder system should preferably be $\geq 15\%$ by weight, particularly preferably $\geq 25\%$ by weight and in particular $\geq 35\%$ by weight, based on the water-free binder system.

The content of CaO should be far below the contents usual for cement-based systems. Pure Portland cement comprises about 60% by weight of CaO . Firstly, it would then no longer be possible arithmetically to achieve the content of Al_2O_3 , SiO_2 and TiO_2 of $\geq 41\%$ by weight called for at the outset, and secondly a high CaO content does not appear to be particularly advantageous according to the invention. The content of oxides calculated as CaO in the binder system is preferably $\leq 35\%$ by weight, more preferably $\leq 30\%$ by weight, particularly preferably from 8 to 28% by weight and in particular from 12 to 25% by weight, based on the water-free binder system.

It has been found that the oxide composition of the binder system is primarily responsible for the easy cleanability according to the invention. This oxide composition is advantageously achieved by the binder system comprising hydraulic, latent hydraulic
5 and/or pozzolanic binders and also alkali metal silicate and titanium dioxide. Here, at least part of the titanium dioxide can also be replaced by zirconium dioxide.

The hydraulic binder is, for example, selected from among Portland cements including white cements, aluminat cements and mixtures thereof, with the content of Portland
10 cements and/or aluminat cements in the binder system preferably being $\leq 30\%$ by weight, particularly preferably $\leq 20\%$ by weight and in particular $\leq 10\%$ by weight, based on the water-free binder system. Screeds produced from pure Portland cements or aluminat cements (high-alumina cements) have a hydrophilicity which is too low.

15 As indicated above, Portland cement contains about 70% by weight of $\text{CaO} + \text{MgO}$, about 20% by weight of SiO_2 and about 10% by weight of $\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$. Aluminat cement or high-alumina cement contains from about 20 to 40% by weight of CaO , up to about 5% by weight of SiO_2 , from about 40 to 80% by weight of Al_2O_3 and up to about 20% by weight of Fe_2O_3 . These types of cement are well known in the prior art.

20 The latent hydraulic binder is, for example, selected from among slags, in particular blast furnace slag, slag sand, slag sand flour, electrothermic phosphorus slag, stainless steel slag and mixtures thereof. These slags can be either industrial slags, i.e. waste products from industrial processes, or synthetically produced slags. The latter is
25 advantageous since industrial slags are not always available in a constant amount and quality.

For the purposes of the present invention, a latent hydraulic binder is preferably a
30 binder in which the molar ratio of $(\text{CaO} + \text{MgO})\text{:SiO}_2$ is in the range from 0.8 to 2.5 and particularly preferably in the range from 1.0 to 2.0.

Blast furnace slag is a waste product from the blast furnace process. Slag sand is granulated blast furnace slag and slag sand flour is finally pulverized slag sand. Slag sand flour varies in terms of its milling fineness and particle size distribution depending
35 on the origin and work-up form, with the milling fineness having an influence on the reactivity. The Blaine value is employed as characteristic parameter for the milling fineness and is typically in the range from 200 to 1000 $\text{m}^2 \text{kg}^{-1}$, preferably from 300 to 500 $\text{m}^2 \text{kg}^{-1}$. The more finely the slag sand flour is milled, the higher the reactivity. Blast furnace slag generally contains from 30 to 45% by weight of CaO , from about 4 to 17%
40 by weight of MgO , from about 30 to 45% by weight of SiO_2 and from about 5 to 15% by weight of Al_2O_3 , typically about 40% by weight of CaO , about 10% by weight of MgO , about 35% by weight of SiO_2 and about 12% by weight of Al_2O_3 .

Electrothermic phosphorus slag is a waste product of the electrothermic production of phosphorus. It is less reactive than blast furnace slag and contains from about 45 to 50% by weight of CaO, from about 0.5 to 3% by weight of MgO, from about 38 to 43%
5 by weight of SiO₂, from about 2 to 5% by weight of Al₂O₃ and from about 0.2 to 3% by weight of Fe₂O₃ and also fluoride and phosphate. Stainless steel slag is a waste product from various steel production processes and has a highly variable composition (see Caijun Shi, Pavel V. Krivenko, Della Roy, Alkali-Activated Cements and Concretes, Taylor & Francis, London & New York, 2006, pp. 42-51).

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The pozzolanic binder is, for example, selected from among amorphous silica, preferably precipitated silica, pyrogenic silica and microsilica, glass flour, fly ash, preferably brown coal fly ash and hard coal fly ash, metakaolin, natural pozzolanas such as tuff, trass and volcanic ash, natural and synthetic zeolites and mixtures
15 thereof. An overview of pozzolanic binders which are suitable for the purposes of the invention may be found, for example, in Caijun Shi, Pavel V. Krivenko, Della Roy, Alkali-Activated Cements and Concretes, Taylor & Francis, London & New York, 2006, pp. 51-63. The pozzolanic activity can be tested in accordance with DIN EN 196 part 5.

20 Amorphous silica is more reactive, the smaller the particle diameters. Amorphous silica is preferably an X-ray-amorphous silica, i.e. a silica which displays no crystallinity in the powder diffraction pattern. For the purposes of the present invention, glass flour should likewise be considered to be amorphous silica.

25 The amorphous silica advantageously has a content of at least 80% by weight, preferably at least 90% by weight of SiO₂. Precipitated silica is obtained industrially by precipitation processes starting out from water glass. Depending on the method of production, precipitated silica is also referred to as silica gel. Pyrogenic silica is produced by reaction of chlorosilanes such as silicon tetrachloride in an H₂/O₂ flame.
30 Pyrogenic silica is an amorphous SiO₂ powder having a particle diameter of from 5 to 50 nm and a specific surface area of from 50 to 600 m² g⁻¹.

Microsilica is a by-product of the production of silicon, ferrosilicon or zirconium and likewise consists largely of amorphous SiO₂ powder. The particles have diameters in
35 the range from 0.1 µm to 1.0 µm. The specific surface area is in the range from 15 to 30 m² g⁻¹.

On the other hand, commercial silica sand is crystalline and has comparatively large particles and a comparatively low specific surface area. According to the invention, it
40 serves as inert aggregate.

Fly ashes are formed, inter alia, in the combustion of coal in power stations. Fly ash of class C contains, according to WO 08/012438, about 10% by weight of CaO, while fly ashes of class F contain less than 8% by weight, preferably less than 4% by weight and typically about 2% by weight of CaO. The CaO content of fly ash of class C can in individual cases be up to 25% by weight.

Metakaolin is formed in the dehydrogenation of kaolin. While kaolin gives off physically bound water at from 100 to 200°C, dehydroxylation with breakdown of the lattice structure and formation of metakaolin ($\text{Al}_2\text{Si}_2\text{O}_7$) takes place at from 500 to 800°C. Pure metakaolin accordingly contains about 54% by weight of SiO_2 and about 46% by weight of Al_2O_3 .

The alkali metal silicate is advantageously selected from among compounds having the empirical formula $m \text{SiO}_2 \cdot n \text{M}_2\text{O}$, where M is Li, Na, K or NH_4 or a mixture thereof, preferably Na or K.

The molar ratio of m:n is advantageously from 0.5 to 4.0, preferably from 0.7 to 3.8, particularly preferably from 0.9 to 3.7 and in particular from 1.6 to 3.2.

The alkali metal silicate is preferably a water glass, advantageously a water glass powder and in particular a sodium or potassium water glass. However, lithium or ammonium water glasses and mixtures of the water glasses mentioned can also be used.

The ratio of m:n (also referred to as modulus) indicated above should preferably not be exceeded since otherwise complete reaction of the components can no longer be expected. Lower moduli such as about 0.2 can also be employed. Water glasses having higher moduli should be brought to moduli in the range according to the invention by means of a suitable aqueous alkali metal hydroxide before use.

Potassium water glasses are commercially available predominantly as aqueous solutions since they are strongly hygroscopic, while sodium water glasses in the advantageous modulus range are also commercially available as solids. The solids contents of the aqueous water glass solutions are generally from 20% by weight to 60% by weight, preferably from 30 to 50% by weight. Particular preference is given to potassium water glasses since they have less tendency to effloresce than sodium water glasses.

Water glasses can be produced industrially by melting silica sand with the corresponding alkali metal carbonates. However, they can also be obtained without difficulty from mixtures of reactive silicas with the appropriate aqueous alkali metal hydroxides or alkali metal carbonates. It is therefore possible according to the invention

to replace at least part of the alkali metal silicate by a mixture of a reactive silica and the corresponding alkali metal hydroxide or alkali metal carbonate.

5 The amount of water required for setting is generally from 15 to 60% by weight, preferably from about 25 to 50% by weight. These amounts are in addition to the total weight of the water-free binder system, which is calculated as 100% by weight.

10 The hydraulic, latent hydraulic and/or pozzolanic binder and also the alkali metal silicate and the titanium dioxide can be present together as one component in the binder system of the invention. This one-component formulation is mixed with water when required.

15 However, the hydraulic, latent hydraulic and/or pozzolanic binder and also the titanium dioxide can also be present as a first component in the binder system of the invention. In this case, the alkali metal silicate is present together with at least the amount of water required for setting as a second component which is used when required for mixing with the first component.

20 Inert fillers and/or further additives can be additionally present in the binder according to the invention. These optional components, can, as an alternative, also be added only during preparation of the screed.

25 Possible inert fillers are generally known sands and/or flours, for example those based on quartz, limestone, barite or clay, in particular silica sand. Lightweight fillers such as perlites, kieselguhr (diatomaceous earth), expanded mica (vermiculite) and foam sand can also be used. To improve the light reflection, solid glass spheres, hollow glass spheres and/or crushed glass can also be used.

30 Possible additives are, for example plasticizers (e.g. polycarboxylate ethers), antifoams, water retention agents, fluidizers, pigments, fibres, dispersion powders, wetting agents, retarders, accelerators, complexing agents, aqueous dispersions and rheology modifiers known per se.

35 The advantages achieved according to the invention are firstly the high chemical resistance of the screed, and secondly that the screed is hydrophilic, spot-resistant and photocatalytic. It is possible to produce screeds having an excellent mechanical strength. The high reflectivity resulting from the white colour is particularly advantageous here. Another advantage is that this high reflectivity is retained over the duration of use since a screed having these properties is barely soiled and is particularly easy to clean. Said effects are present in the overall screed composition and not only on the surface. This means that the effects are retained even after mechanical wear.

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The present invention is illustrated by the following example.

Example 1

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A screed is produced from the following constituents:

	Slag sand flour:	150 g
	Microsilica, white:	100 g
	Opalescent glass flour:	50 g
10	Silica sand (typical screed particle size):	700 g
	Potassium water glass (modulus: 1.0; solids content: 40% by weight):	160 g
	Shrinkage reducer:	20 g
	Titanium dioxide (anatase)	20 g

15 The calculated oxide composition is:

	Al ₂ O ₃ :	5% by weight
	SiO ₂ :	55% by weight
	TiO ₂ :	6% by weight
	CaO:	18% by weight
20	K ₂ O:	11% by weight
	Na ₂ O:	2% by weight.

The solids are homogeneously mixed with one another and stirred with the aqueous potassium water glass solution. The screed composition obtained in this way can be
25 laid on concrete in a bonded or floating manner. A white screed having a shrinkage after 28 days of < 1 mm/m, a compressive strength after 28 days of > 60 MPa and a tensile strength in bending after 28 days of > 4 MPa is obtained.

To test the screed, a conventional ink which can be removed by means of mains water
30 is applied. In addition, an oil-based spot former in accordance with DIN EN 14411 or used oil is applied. Both can likewise be completely removed by means of water. In addition, photocatalytic action of the screed surface can be confirmed by means of silver nitrate solution. For this purpose, a 1% strength silver nitrate solution is applied to the surface of the screed and irradiated with a UV lamp. After a short time, the
35 otherwise clear silver nitrate solution becomes black as a result of photocatalysis (silver ions are reduced to silver, while OH ions are oxidized).

Claims

1. Use of a binder system comprising compounds containing aluminium oxide, silicon oxide and titanium oxide for producing a screed, in particular a white screed having high light reflection, spot resistance and easy cleanability, characterized in that the sum of the oxides calculated as Al_2O_3 , SiO_2 and TiO_2 in the binder system is $\geq 41\%$ by weight, based on the water-free binder system.
2. Use according to Claim 1, characterized in that the sum of oxides calculated as Al_2O_3 , SiO_2 and TiO_2 in the binder system is $\geq 50\%$ by weight, preferably $\geq 60\%$ by weight, based on the water-free binder system.
3. Use according to Claim 1 or 2, characterized in that the content of the oxides calculated as SiO_2 in the binder system is $\geq 15\%$ by weight, preferably $\geq 25\%$ by weight and in particular $\geq 35\%$ by weight, based on the water-free binder system.
4. Use according to any of Claims 1 to 3, characterized in that the content of the oxides calculated as CaO in the binder system is $\leq 35\%$ by weight, preferably $\leq 30\%$ by weight, particularly preferably from 8 to 28% by weight and in particular from 12 to 25% by weight, based on the water-free binder system.
5. Use according to any of Claims 1 to 4, characterized in that the binder system comprising hydraulic, latent hydraulic and/or pozzolanic binders and also alkali metal silicate and titanium dioxide.
6. Use according to Claim 5, characterized in that the hydraulic binder is selected from among Portland cements, aluminate cements and mixtures thereof and the content of Portland cements and/or aluminate cements in the binder system is $\leq 30\%$ by weight, preferably $\leq 20\%$ by weight and in particular $\leq 10\%$ by weight, based on the water-free binder system.
7. Use according to Claim 5, characterized in that the latent hydraulic binder is selected from among industrial and synthetic slags, in particular blast furnace slag, slag sand, slag sand flour, electrothermic phosphorus slag, stainless steel slag and mixtures thereof.
8. Use according to Claim 5, characterized in that the pozzolanic binder is selected from among amorphous silica, preferably precipitated silica, pyrogenic silica and microsilica, glass flour, fly ash, preferably brown coal fly ash and hard coal fly ash, metakaolin, natural pozzolanas such as tuff, trass and volcanic ash, natural and synthetic zeolites and mixtures thereof.

9. Use according to Claim 5, characterized in that the alkali metal silicate is selected from among compounds having the empirical formula $m \text{SiO}_2 \cdot n \text{M}_2\text{O}$, where M is Li, Na, K or NH_4 or a mixture thereof, preferably Na or K.
- 5 10. Use according to Claim 9, characterized in that the molar ratio of m:n is from 0.5 to 4.0, preferably from 0.7 to 3.8, particularly preferably from 0.9 to 3.7 and in particular from 1.6 to 3.2.
- 10 11. Use according to Claim 5, characterized in that the titanium dioxide is selected from among rutile and anatase and mixtures thereof.
12. Use according to any of Claims 1 to 11, characterized in that from 15 to 60% by weight, preferably from 25 to 50% by weight, of water is necessary for setting.
- 15 13. Use according to Claim 12, characterized in that the hydraulic, latent hydraulic and/or pozzolanic binders and also the alkali metal silicate and the titanium dioxide are present together as one component.
- 20 14. Use according to Claim 12, characterized in that the hydraulic, latent hydraulic and/or pozzolanic binder and the titanium dioxide are present as a first component and the alkali metal silicate together with at least the amount of water necessary for setting are present as a second component.
- 25 15. Use according to any of Claims 1 to 14, characterized in that inert fillers and/or further additives are additionally present in the binder system.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2011/053593

A. CLASSIFICATION OF SUBJECT MATTER

C04B 12/04 (2006.01) i

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)

IPC: C04B 12/-; C04B 28/-; C04B 41/-; C04B 18/-

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)

WPI; EPODOC; CNKI; CNPAT: binder, screed, TiO₂, SiO₂, Al₂O₃, resistance, reflection

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US5824147 A (REDLAND TECHNOLOGIES LIMITED) 20 Oct. 1998 (20.10.1998) Column 2 lines 18-26, 34-37, 48, 51, Column 3 lines 1-10	1-15
A	CN1369239 A (ZHANG, Yanming et al.) 18 Sep. 2002 (18.09.2002) Claim 1	1-15
A	CN1465647 A (DALIAN INST. CHEM. PHYSICS CAS.) 07 Jan. 2004 (07.01.2004) Claim 1	1-15
A	CN1098028 A (INST. TIANJIN PETROCHEMICAL CO.) 01 Feb. 1995 (01.02.1995) Claim 1	1-15
A	CN101139513 A (SHENZHEN JINKE SPECIAL MATERIAL CO. LTD.) 12 Mar. 2008 (12.03.2008) Claim 1	1-15

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search 28 Nov. 2011 (28.11.2011)	Date of mailing of the international search report 05 Jan. 2012 (05.01.2012)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer ZHANG Jia Telephone No. (86-10)82245385

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2011/053593

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