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Datasheet for the decision of 26 March 2009

Case Number: T 1214/03 - 3.3.05

Application Number: 97936651.5

Publication Number: 0946450

IPC: C04B 22/06

Language of the proceedings: EN

Title of invention:
Hydraulic binder and cement compositions containing photocatalyst particles

Applicant:
ITALCEMENTI S.p.A.

Headword:
Hydraulic binder/ITALCEMENTI

Relevant legal provisions:
EPC Art. 54(1)(2), 56, 123

Relevant legal provisions (EPC 1973):
-

Keyword:
"Novelty (yes)"
"Inventive step (yes): effect noticeable even at low concentrations of catalyst"

Decisions cited:
-

Catchword:
-

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Case Number: T 1214/03 - 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 26 March 2009

Appellant: ITALCEMENTI S.p.A.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 6 May 2003 refusing European patent application No. 97936651.5 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: G. Raths
Members: E. Waeckerlin
C. Vallet

Summary of Facts and Submissions

I. This appeal lies from the decision of the examining division to refuse European patent application No. 97 936 651.5.

II. The impugned decision was based on the set of claims 1 to 17 filed with letter dated 4 March 2002. Claim 1 reads as follows:

"1. Cement composition, suitable to forming architectural concrete, containing in bulk photocatalyst particles able to oxidise polluting substances in the presence of light, air, and environmental humidity, said composition consisting of an hydraulic binder containing from 0.01 to 10 % by weight of the photocatalyst, water and coarse or fine aggregates."

III. In the decision, the examining division referred to the following documents:

D1: Patent abstracts of Japan, vol. 16, no. 098 (C-0918)

D2: GB 849 175 A

D3: EP 0 633 064 A

D4: EP 0 590 477 A

The examining division held that the closest prior art was represented by D2. The cement composition according

to claim 1 of the application was found to lack an inventive step having regard to the disclosure of D2.

IV. The appellant lodged an appeal against the decision by the examining division. Together with the grounds of appeal dated 11 September 2003 a set of amended claims 1 to 17 was submitted.

V. Summons to oral proceedings were issued on 11 September 2008. In response, the appellant filed extensive comments with letter dated 13 February 2009. Furthermore four sets of amended claims were submitted, representing the main request and the first, second and third auxiliary requests, respectively.

VI. Oral proceedings were held on 26 March 2009. After discussion of the claims according to the main request and the three auxiliary requests, the appellant handed over a set of claims 1 to 13 representing the final main request.

Claim 1 of the new main request submitted during the oral proceedings reads as follows:

"1. Hydraulic binder for a cement composition with water and fine and/or coarse aggregates to make architectural concrete, to preserve over time the original appearance of architectural concrete made therefrom and at the same time to decrease pollution in the environment in contact with said architectural concrete, said hydraulic binder containing particles of a photocatalyst able to oxidize polluting substances in the said environment in the presence of light, air and environmental humidity, said photocatalyst particles

being distributed in bulk throughout the mass of the hydraulic binder in amount from 0.01 to 1 % by weight of the hydraulic binder."

VII. The arguments presented by the appellant in support of the patentability of the claimed subject-matter may be summarised as follows:

D2 relates to compositions for coating objects which may be made of concrete, but not to binders for producing concrete as such. Since the mixtures according to D2 contain only a minor amount of cement, they are not suitable as hydraulic binders for concrete. Furthermore the titanium dioxide particles contained in the mixtures according to D2 act as a white pigment of the coating composition, not as a photocatalyst. There is no reference to photocatalytic action in D2.

As far as document D1 is concerned, there is no disclosure that the titanium dioxide particles contained in the mixtures have the structure of anatase, which is the photocatalytically active form of titanium dioxide, as opposed to the rutil structure. D1 does not mention photocatalytic or self-cleaning properties, nor does it specify the amount of titanium dioxide used.

Documents D3 and D4 are not relevant either, because they relate to coatings, i.e. to layers placed on the surface of substrates, and not to cementitious substrates containing photocatalytic particles in bulk.

In the building and construction industry there existed a prejudice against the invention, because the skilled persons considered that low amounts of photocatalytic particles would not be effective.

In view of the technical advantages of the invention, in particular the simplicity of manufacture of architectural concrete by means of the claimed hydraulic binder, as well as the colour stability of the concrete, the structural performance and high resistance against mechanical action and the effectiveness of protection, the invention involves an inventive step.

VIII. The appellant requested that the decision under appeal be set aside and that a European patent be granted on the basis of the main request filed during the oral proceedings.

Reasons for the Decision

1. Allowability of the amendments under Article 123(2) EPC

1.1 Claim 1 is based on the combination of claims 1 and 10, as well as on various passages of the description of the application as originally filed, i.e. the application as published under the PCT. In particular it is based on page 4, lines 22 to 24 (water as a component of the cement composition); page 5, lines 4 to 6 (fine and/or coarse aggregates as components of concrete); page 5, lines 23 to 24 (architectural concrete); page 6, lines 20 to 24 (oxidation of polluting substances implying a decrease

of pollution in the environment); page 6, lines 10 to 13 (distribution throughout the mass of the hydraulic binder); page 14, line 14; page 18, line 5; page 20, table 4, column D; page 8, line 27 to page 9, line 2 (amount of photocatalyst particles, e.g. titanium dioxide, from 0.01 to 1 % by weight, based on the weight of the binder).

In the board's view the different parts of the description referred to above represent diverse elements of a joint and coherent disclosure. For this reason the individual features may be introduced in claim 1 without extending the subject-matter beyond the content of the application as filed under the PCT.

1.2 Dependent claim 2 is based on the combination of claims 2 and 3 as published under the PCT.

1.3 Dependent claims 3 to 13 are based on claims 4 to 9 and 11 to 15, respectively.

1.4 The board is satisfied that all amendments effected to the claims find their basis in the application as originally filed, i.e. as published under the PCT. Consequently the amended set of claims 1 to 13 is in conformity with Article 123(2) EPC.

2. Construction of claim 1

Claim 1 is to be construed as a product claim directed to a hydraulic binder comprising two mandatory components, namely
(i) the hydraulic binder as such, and in addition

(ii) photocatalyst particles capable of oxidizing polluting substances in the presence of light, air and environmental humidity, said particles being distributed in bulk throughout the mass of the hydraulic binder in an amount of from 0.01 to 1 % by weight, based on the weight of the hydraulic binder. According to the description the term *"hydraulic binder"* means a dry, solid, hydraulic cement material in powder form which provides plastic mixtures able to set and harden when mixed with water (see page 4, lines 4 to 7 and lines 11 to 16).

The remaining features of claim 1 all relate to the particular use of the hydraulic binder, namely the production of cement compositions which are used on their part for producing architectural concrete having the properties of preserving the original appearance of the architectural concrete over time and, at the same time, reducing environmental pollution.

In accordance with the established case law of the boards of appeal a claim for a product for a particular use is construed as meaning a product which is in fact suitable for the stated use. Thus, claim 1 has to be construed as including any hydraulic binders which are suitable for producing architectural concrete having the properties referred to above, other compositions comprising hydraulic binders being excluded from the scope of the claim.

3. Novelty - Article 54 EPC

3.1 Document D1 discloses a mixture of cement or a cement composition with titanium oxide for use as a raw material for the production of white panels. D1 does not specify the type of titanium oxide used. In particular there is no disclosure of specific types having photocatalytic activity. Moreover D1 is silent regarding the amount of titanium oxide in the mixture. Thus, having regard to these differences, the hydraulic binder according to claim 1 is distinguished from the subject-matter disclosed in D1.

3.2 Document D2 relates to a white coating composition consisting of white cement, finely divided titanium dioxide and what is called *"white additives"*. From the description of D2 it can be derived that the term *"white additives"* is used in the meaning of mixtures of white limestone sand, fine white hard rock sand, and coarse white hard rock sand (page 1, left hand column, lines 30 to 38). In other words D2 describes compositions containing cement, titanium oxide and aggregates in the form of fine and coarse white sand. The titanium oxide is preferably obtained from anatase (page 1, right hand column, lines 67 to 69). It is stated in D2 that an amount in the range of from 5 to 7.5 % by weight, based on the *"white additives"*, is expedient, the minimum being 3 % by weight (page 1, right hand column, lines 63 to 67; claims 1, 4). Therefore the composition disclosed in D2 can be regarded as a *"dry premix"*, i.e. a mixture of binder, titanium oxide particles and aggregates, but it does not constitute an hydraulic binder, since hydraulic binders are, by definition, free from aggregates (see,

in this respect, page 4, lines 4 to 11 and 19 to 21 of the application in suit). Therefore the hydraulic binder according to claim 1 is distinguished from D2 at least in that it does not contain aggregates.

3.3 Document D3 describes a substrate coated with photocatalyst particles applied to the substrate by means of what is called a *"less degradative adhesive"*, i e an adhesive having a low rate of decomposition under photocatalytic conditions. According to D3 the term *"photocatalyst particles"* means any particles *"capable of exhibiting photocatalytic function upon irradiation with a radiation having a wavelength corresponding to not less than the band gap energy"*, preferably titanium oxide (page 4, lines 1 to 6). Among the suitable *"degradative adhesives"*, various types of Portland cement, white cement, aluminous cement and the like are mentioned (page 3, lines 37 to 48). The amount of photocatalyst particles is stated to lie in the range of 5 to 98 %, based on the total volume of the photocatalyst particles and the "less degradative adhesive" (page 3, lines 12 to 14). According to example 5, 0.2 g of pulverized titanium oxide are mixed with 0.8 g white cement, corresponding to an amount of titanium oxide of 25 % by weight, based on the weight of white cement, or 17 % by volume, based on the total amount of the titanium oxide and the white cement (page 8, lines 5 to 9). Similarly, example 6 refers to a mixture of titanium oxide and high alumina cement in the same proportion as in example 5 (page 8, lines 13 to 17).

The board notes that, although it is stated in D3 that the mixtures of cement and photocatalyst particles are

used as agents for coating substrates with a photocatalytically active layer, these mixtures are likewise suitable as hydraulic binders for the production of cement compositions and architectural concrete, having regard to their intrinsic properties. Nevertheless the hydraulic binder according to claim 1 of the present application is distinguished from the mixtures of D3 in respect of the lower amount of photocatalyst particles, which lies within the range from 0.01 to 1 % by weight, based on the weight of the hydraulic binder.

3.4 Document D4 relates to an architectural material comprising a base having a light-receiving surface and at least one transparent metal-oxide layer exhibiting phototcatalytic activity, for example titanium oxide (page 4, left hand column, lines 24 to 33; page 4, right hand column, lines 1 to 3; page 5, left hand column, lines 17 to 20; claims 1 and 7). However, D4 does not disclose any composition comprising photocatalyst particles and cement.

3.5 The board is satisfied that none of the documents D1 to D4 disclose a hydraulic binder having all the features contained in claim 1 of the main request. Therefore the claimed hydraulic binder is novel as required by Articles 52(1) and 54 EPC.

4. Inventive step - Article 56 EPC

4.1 As far as the starting point for the assessment of inventive step is concerned, the board notes that D2 does not address the issue of photocatalytical activity of the coating compositions described therein. For this

reason D2 is less relevant to the subject-matter of claim 1 than D3.

4.2 The board considers D3 to represent the closest prior art, because it deals *inter alia* with the photocatalytic activity of compositions comprising cement and photocatalyst particles, preferably titanium oxide, distributed in bulk throughout the mass. These compositions, when exposed to light, are effective for decomposing deleterious materials such as malodorous or oily substances deposited on the surface of substrates (page 5, lines 37 to 44).

4.3 According to D3 the minimum amount of photocatalyst particles is 5 %, based on the total volume of the photocatalyst particles and the adhesive, i.e. the cement (page 3, lines 12 to 14). In the case of a binary mixture of cement and photocatalyst particles this minimum amount corresponds to 5.26 % by weight, based on the weight of the cement alone. According to D3 lower levels have a negative impact on the photocalytic activity (page 4, lines 13 to 16).

4.4 In order to be suitable for producing concrete, hydraulic binders containing photocatalyst particles have to meet a number of essential requirements. In particular, a good photocatalytic activity is indispensable. Moreover, any adverse effects of the photocatalyst particles on the physico-mechanical properties of the hardened binder, as well as the products derived therefrom, particularly cement compositions and architectural concrete containing the binder, have to be avoided (page 6, lines 20 to 24).

Therefore, starting from D3 as the closest prior art, the technical problem to be solved can be seen in the provision of an hydraulic binder containing cement and photocatalyst particles, which meets the requirements of:
(i) having a good photocatalytic activity;
(ii)preserving the original appearance of architectural concrete made from the hydraulic binder; and
(iii) decreasing pollution in the environment in contact with the architectural concrete made from the hydraulic binder;
without impairing the physico-mechanical properties of the hardened hydraulic binder, cement composition, and architectural concrete made therefrom.

4.5 As the solution to this technical problem the present application suggests a hydraulic binder according to claim 1, characterised *inter alia* by an amount of photocatalyst particles in the range of 0.01 to 1 % by weight, based on the weight of the hydraulic binder.

4.6 The question arises, whether the technical problem is effectively solved by the proposed solution, or not. In this respect the examples contained in the description are instrumental.

4.6.1 Example 1 illustrates the bleaching effect of light on test samples of cement mortar obtained from the hydraulic binder according to claim 1 (page 13, line 17 to page 16, line 15). The *"white values"* of samples containing various amounts of titanium oxide, namely 0 %, 0.1 %, 0.5 %, 1 %, 5 % and 10 % by weight, respectively, were determined. It was found that the *"white value"* of the titanium free sample was 194.9

after 60 hours of exposure to light. The values of the samples containing 0.1 %, 0.5 % and 1 % by weight, respectively, were 201.0, 203.6 and 204.5 (page 18, table 1, TiO_2 free specimen and samples 3, 4 and 5). This shows a significant improvement of the *"white value"* over the value obtained for the titanium free sample, even if the level of titanium oxide is as low as 1 % by weight or less. Thus, the test results are in conformity with the statement made in the description, according to which *"even extremely low percentages of photocatalysts may produce a very high effect of colour conservation with time"* (page 9, lines 3 to 4).

4.6.2 As far as the impact of the content of titanium oxide particles on the physico-mechanical properties of hardened mortar is concerned, test samples containing an amount of titanium oxide of 0 %, 0.1 %, 1 % and 5 % by weight, respectively, were investigated in example 3. It was found that the compressive strength of the titanium free sample was 58.1 MPa. The corresponding values for the samples containing 0.1 % and 1 % by weight of titanium oxide were 58.2 MPa and 57.4 MPa, respectively. In the case of the sample containing 5 % of titanium oxide a decrease of the compressive strength to 56.7 MPa was observed (page 20, table 3, samples 1 to 4).

It results from the experimental data that the addition of small amounts of up to 1 % by weight of titanium oxide particles does not have a significant adverse effect on the compressive strength of the hardened mortar. In this context the board notes that the compressive strength is generally recognised as one of

the most important performance indicators of cement materials.

4.6.3 In view of the experimental data referred to above, and in the absence of any evidence to the contrary, the board concludes that the technical problem is, in fact, solved by the hydraulic binder according to claim 1.

4.7 It remains to be investigated, whether the proposed solution was obvious to the skilled person, having regard to the state of the art.

4.7.1 The technical teaching of D3 does not provide an incentive to reduce the amount of catalyst particles below the minimum of 5 % by volume, based on the total amount of photocatalyst particles and cement, as indicated in D3 to the range of 0.01 to 1 % by weight, based on the weight of the binder. On the contrary D3 teaches away from the suggested solution, since it advises against reducing the amount of photocatalyst particles below the level of 5 % by volume, based on the total amount of photocatalyst particles and cement. As is explained in D3, such low amounts tend to result in an undesirably reduced photocatalytic activity (page 4, lines 14 to 16).

4.7.2 Regarding the physico-mechanical properties of the mixtures of cement and photocatalyst particles disclosed in D3, or those imparted on cement compositions and architectural concrete obtained thereof, no teaching is provided by the document. D3 is completely silent on the matter. In view of the specific application described in D3, which is the coating of substrates including ceramics, glass,

plastics and paper sheets (page 4, lines 40 to 43; page 5, lines 19 to 22), the skilled person will conclude that in any case, the requirements regarding physico-mechanical properties like the compression strength of coating materials are lower than those of architectural concrete. Therefore D3 provides neither explicitly nor implicitly any guidance as far as the physico-mechanical properties are concerned.

4.7.3 Similarly, document D2, taken alone or in combination with D3, contains no pointer to the suggested solution. There is no clear reference in D2 to any photocatalytic action of the coating composition described in the document, although it is stated that coated blocks of concrete possess self-cleaning properties when exposed to rain water. The self-cleaning effect is explained by the tendency of titanium oxide particles to form with rain water a suspension, which is capable of wetting and covering dirt particles (page 1, right hand column, line 80 to page 2, left hand column, line 5). Nowhere in D2 it is stated, however, that the presence of light is required in order to oxidize polluting substances and, by this, to obtain a brightening effect.

4.7.4 In D2 the issue of the physico-mechanical properties is not addressed. Since the products are used as coating compositions, the same considerations as in the case of the products according to D3 apply. No guidance is given by D2 in this respect.

4.7.5 Therefore the board concludes that the skilled person was not induced by the prior art to provide a hydraulic binder as defined in claim 1, in order to solve the technical problem posed.

4.8 For the reasons set out above the subject-matter of claim 1 and, consequently, of claims 2 to 13 depending thereon, involves an inventive step as required by Articles 52(1) and 56 EPC.

5. In view of the substantive amendments effected to the claims, the description has to be adapted accordingly.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent on the basis of the main request filed at the oral proceedings, the figures 1 to 7 as originally filed, and a description to be adapted.

The Registrar: The Chairman:

C. Vodz G. Raths