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**Datasheet for the decision
of 13 April 2012**

Case Number: T 0432/09 - 3.3.05

Application Number: 96941160.2

Publication Number: 808809

IPC: C04B 7/43, C04B 7/44

Language of the proceedings: EN

Title of invention:

Kiln exhaust gas processing method by chlorine bypass and apparatus therefor

Applicant:

TAIHEIYO CEMENT CORPORATION

Opponent:

Polysius AG

Headword:

Chlorine bypass/TAIHEIYO CEMENT CORP.

Relevant legal provisions:

EPC Art. 54, 56

Relevant legal provisions (EPC 1973):

-

Keyword:

"Novelty (yes)"

"Inventive step (yes) - improvement (yes) - crucial process step (not obvious) - crucial apparatus element (not obvious)"

Decisions cited:

-

Catchword:

-



Case Number: T 0432/09 - 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 13 April 2012

Respondent: TAIHEIYO CEMENT CORPORATION
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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
15 December 2008 concerning maintenance of
European patent No. 808809 in amended form.

Composition of the Board:

Chairman: G. Raths
Members: H. Engl
C. Vallet

Summary of Facts and Submissions

I. The appeal is against the decision of the opposition division posted on 15 December 2008 maintaining European patent EP-B-0 808 809 in amended form on the basis of the claims of the auxiliary request filed during oral proceedings.

II. The independent claims 1, 2 and 3 of said auxiliary request are worded as follows:

"1. A kiln exhaust gases processing method by a chlorine bypass system, comprising the steps of: extracting a portion of kiln exhaust gases from a kiln; cooling the extracted exhaust gases to a temperature equal to or lower than the melting temperature of a chlorine compound; separating the dust in the exhaust gases to rough powder and fine powder by a separator; and returning the separated rough powder to the kiln and supplying the fine powder to downstream of the separator, wherein the ratio of the extracted amount of the kiln exhaust gases is more than 0% to equal to or less than 5% and the separation point of the separator is 5 μm to 7 μm .

2. A kiln exhaust gases processing method by a chlorine bypass system, comprising the steps of: extracting a portion of kiln exhaust gases from a kiln; cooling the extracted exhaust gases to a temperature equal to or lower than the melting temperature of a chlorine compound; separating the dust in the exhaust gases to rough powder and fine powder by a separator; and

returning the separated rough powder to the kiln and supplying the fine powder to downstream of the separator, wherein the ratio of the extracted amount of the kiln exhaust gases is more than 0% to equal or less than 5%, the separation point of the separator is 5 μm to 7 μm , and all the fine powder is mixed with clinker or cement.

3. A kiln exhaust gases processing apparatus by a chlorine bypass system, comprising:
extracting means for extracting a portion of kiln exhaust gases from a kiln;
cooling means for cooling the extracted exhaust gases to 600°C to 700°C or less;
a separator for separating the dust in the exhaust gases to rough powder and fine powder; and
rough powder/fine powder transporting means for returning the separated rough powder to the kiln and supplying the fine powder to downstream of the separator, wherein said extracting means extracts the kiln exhaust gases at the ratio more than 0% to equal to or less than 5%, the separating point of said separator is 5 μm to 7 μm , and said rough powder/fine powder transporting means transports all the fine powder to a clinker tank or a finishing mill."

Dependent claims 4 to 7 concern further preferred embodiments of the apparatus of claim 3.

III. The opposition division relied *inter alia* on the following documents:

Dlb: H. Schlüter "Verfahren zur Reduzierung von Alkali- und Chlorkreisläufen in Rohmehlwärmetauscheröfen"

in "*Verfahrenstechnik der Herstellung von Zement*",
pages 172 to 174, published 1972

D2: DE 34 03 449 C2, published 1 August 1985

D3: H.-D. Maury and R. G. Pavenstedt "*Chlor-Bypass zur Erhöhung des Brennstoffeinsatzes aus Müll beim Klinkerbrennen*" in *Zement-Kalk Gips* Nr. 11/1998, pages 540 to 542, published 1988

D4: Taschenbuch "*Entstaubungstechnik Filtermedien*", third edition, Intensiv-Filter GmbH, Velbert, Germany, 1989, pages 156 to 157 and 211.

IV. In the contested decision, the opposition division rejected the claims of the main request on the grounds that they contravened Article 123(2) and (3) EPC.

The subject-matter of the auxiliary request differed from D1a, which represented the closest prior art, in that a separator separated the dust in the exhaust gases to rough powder and fine powder by a separator, wherein the separating point of the separator was set at 5 μm to 7 μm and the separated rough powder was returned to the kiln. The technical problem to be solved was defined as providing a method for reducing the material losses in the bypass while achieving a good clinker quality and minimizing the coating formation when the fuel and the raw material fed to the kiln had a high chlorine content.

As none of the available prior-art documents suggested a separating point of 5 μm to 7 μm for the separator and as the opposed patent established that most of the

chlorine containing compounds in the bypass dust was indeed contained in the particles having a size of up to 5 μm to 7 μm , the claimed methods also involved an inventive step. Similar reasons applied to the apparatus claim.

V. The appeal of the opponent (appellant) was filed with letter dated 12 February 2009; the grounds for appeal were submitted with a letter dated 25 February 2009 and included the following new documents:

D7: DE-C-38 29 853

D8: VDI - Richtlinie VDI 3676 "*Massenkraftabscheider*"
(May 1980)

D9: W. Kreft, "*Vergleich verschiedener Bypass-Systeme in Klinkerbrennanlagen*", Zement-Kalk-Gips 1/1990, pages 20 to 25.

VI. The patentee (respondent) filed its observations with letter dated 20 August 2009. Enclosed was the document

D10: Chart (Figure 17.20) from "*Kagaku Kogaku Binran*", 5th edition, by Shadanhiojin KK. Kyokai, March 1988, Maruzen Co. Ltd.

VII. A further submission of the appellant was received with letter dated 11 January 2010.

VIII. Following a communication from the board, the respondent requested accelerated proceedings in accordance with the notice of the Vice-President Directorate General 3 of 17 March 2008.

IX. Oral proceedings took place on 13 April 2012. The respondent filed two new sets of claims as auxiliary requests 1 and 2.

X. The appellant essentially argued as follows:

The subject-matter of claim 1 lacked novelty over D7 in combination with the skilled person's general knowledge, as illustrated by D8.

D7 disclosed a cement clinker plant comprising a rotary kiln and a chlorine/alkali bypass. With reference to Figure 2 and column 4, lines 15 to 25, there was disclosed a variant A of operating a bypass comprising the steps of:

- extracting bypass gases from the kiln feeding area;
- cooling said bypass gases with air to about 600°C;
- removing particles in a high-efficiency cyclone;
- redirecting the clean gas to the heat exchanger/cyclone system; and
- recycling dust from the high-efficiency cyclone to the kiln (column 4, lines 7 to 9).

The bypass ratio was 5% (column 4, line 41).

It was common technical knowledge that the separation limit of a high-efficiency cyclone, such as the cyclone 12 used in D7, was about 5 µm. The appellant referred to D8 (page 11, left-hand column, paragraph 2), stating that the separation limit of efficient cyclones ("*Hochleistungs-Zyklonen*") was about 5 µm to 8 µm for

particles having a density of 2 g/cm^3 . D4 (Figure 8.2) also confirmed that the smallest size of particles which could be separated by a cyclone was about $5 \text{ }\mu\text{m}$.

Apparatus claim 3 lacked inventive step having regard to D7 or D3 in combination with D9. In particular, the claim feature relating to the means for supplying the fine powder to downstream of the separator was known from D9.

XI. The respondent essentially argued as follows:

D7, D8 and D9 were filed late and should not be considered in the appeal proceedings.

In any case, D7 did not mention the separating point of the cyclone and hence could not affect the novelty of claim 1.

The respondent also rejected the argument of the appellant that a separating point of between 5 and $8 \text{ }\mu\text{m}$ was general technical knowledge. Rather, according to the formula of Barth (appearing in D8, Table 2), the separated particle size of a cyclone was highly dependent on the size of the cyclone, the air flow velocity at the inlet and the density of the particles. The settling velocity disclosed in item 3.3.1 of D8 resulted in a calculated separating point of $1 \text{ }\mu\text{m}$, far from the claimed separating point. Therefore, even if the teaching of D8 was applied to D7, said document would not lead to the claimed subject-matter.

XII. Requests

The appellant requested that the contested decision be set aside and that the European patent be revoked.

The respondent requested that the appeal be dismissed and that the patent be maintained on the basis of the claims upheld by the opposition division (main request) or, in the alternative, on the basis of the claims of auxiliary requests 1 or 2, filed during oral proceedings.

Reasons for the Decision

1. Amendments (main request)

The amendments to the claims were not disputed and the board is satisfied that all claims meet the requirements of Articles 123(2) and (3) and 84 EPC.

2. Admissibility of late-filed documents

Document D7 is to be regarded as a response of the appellant to the contested decision. It is thus admitted, in particular as it is more relevant than D1a and was in fact considered by both parties as representing the closest prior art.

D8 is a technical standard and thus illustrates the common technical knowledge. It is therefore also to be admitted.

D9 was filed by the appellant with letter dated

11 January 2010. The board has duly examined the document as to its relevance and found it not to affect the decision to be taken. Therefore, D9 is not admitted.

3. Novelty (main request)

3.1 Document D7 is concerned with improvements in an SP (suspension pre-heater) cement kiln having a bypass system for reducing the build-up of unwanted components, in particular alkali, sulphur and chlorine.

Conventional bypass systems suffer from clogging in the feeding section of the rotary kiln and in the pre-heaters which is one problem D7 seeks to address.

Another object is to improve the heat balance of the process. See column 1, lines 5 to 13; lines 34 to 36; lines 46 to 50; column 2, lines 53 to 64; column 3, lines 2 to 12; column 4, lines 7 to 9; lines 15 to 26 and 41; and Figure 2).

In accordance with the embodiment designated as variant A (see column 4; Figure 2), D7 discloses a process wherein the bypass gases (in an amount of 5%) are extracted from the rotary kiln feeding zone 9 via bypass line 8, cooled by mixing with fresh air to about 600°C in a mixing chamber 19 to solidify the volatiles and fed into the high-performance cyclone ("*Hochleistungs-Zyklon*") 12 for separation of the solids. The cyclone off-gases are re-introduced into the suspension pre-heaters. Coarse dust is re-introduced into the kiln (see column 3, lines 9 to 12). The fine dust not separated in the cyclone 12 is removed from the process.

The board agrees with the parties that the only feature of the processes in accordance with claims 1 and 2 of the opposed patent which is not explicitly disclosed in D7 is the separation point of the bypass separator (cyclone). The separation point is also an essential feature of apparatus claim 3.

However, the appellant argued that a high-performance cyclone implicitly had a separation point (defined as the particle size at which the separation degree is 50%) of 5 to 8 μm , at a density of the particles of 2 g/cm^3 and a settling velocity of 1.5 to 4.5 $\times 10^{-3}$ m/s which was typical for the particles under consideration (see document D8, page 11, second paragraph). Attention was also drawn to D4 which discloses that the smallest particle size which can be separated in a cyclone was 5 μm . Therefore, in the appellant's view, the claimed separation point was implicitly disclosed in D7 so that claims 1 and 3 of the opposed patent were anticipated by D7.

The respondent rejected these arguments, arguing that the claimed separating point of 5 to 7 μm could not be derived from D7. In accordance with the claimed invention, the separating point was deliberately chosen on the basis of the finding that a sufficient chlorine reduction ratio could be obtained by a particle size of 5 to 7 μm ; reference was made to Figure 4 (curves D and E) and the description, paragraphs [0040] and [0041], of the patent in suit. No such finding was disclosed in D7. Moreover, even taking D8 into account, the separating point of a cyclone depended on a variety of parameters, in particular on the size of the cyclone and the density of the particles.

For the board, it is evident that within the teaching of D7 a number of different high-efficiency cyclones could also be envisaged having a size and e.g. a design for a gas inlet speed such that their separating point would not be in the claimed range. The patent in suit states that a separating point of 10 μm was conventional in an alkali bypass system, because an efficient and substantial removal of alkalis required the separation of particles of a size of up to 10 μm . The board considers that the bypass cyclone of D7 would typically be operated at such a high separating point because alkali removal was one of the main objects of D7 (see column 2, lines 53 to 62).

The fact that it is designated as a "high-efficiency" cyclone (more specifically: "*...ein speziell ausgebildeter Hochleistungs-Zyklon mit hohem Abscheidegrad und Trenngrad für Feinpartikel...*"; see column 3, lines 20 to 24) does not necessarily imply a low separating point of 5 to 7 μm . For the board, the above cited passage states only that the cyclone to be used in accordance with D7 should be highly efficient with respect to the separation of fine particles, a term not automatically implying particles of 5 to 7 μm size.

In summary, D7 lacks a direct and unambiguous disclosure of a separating point of the bypass separator of 5 to 7 μm . Therefore, novelty over D7 has to be accepted.

- 3.2 No other documents have been cited for novelty, nor is the board aware of any such prior art.

The claims of the main request therefore fulfil the requirement of Article 54 EPC.

4. Inventive step (main request)

4.1 The invention is concerned with processes and apparatus for reducing the build-up of chlorine in a cement clinker plant equipped with an SP (suspension pre-heater) or NSP (new suspension pre-heater), and in particular with the design of the alkali/chlorine bypass system. The patent aims at providing an economic and stable operation of kiln and pre-heater and a simple disposal of the fine particle dust (see paragraphs [0002] to [0005] and [0021]).

4.2 As already mentioned (point 3.1), document D7 is concerned with improvements in an SP cement kiln having a bypass system for reducing the build-up of unwanted substances, in particular alkali, sulphur and chlorine. Its aims are to reduce the risk of clogging in the feeding section of the rotary kiln and in the pre-heaters and to improve the heat balance of the process.

In view of these aims, which are similar to the ones of the opposed patent, and in view of the similarity in the apparatus details (in particular as regards the bypass construction), D7 is regarded as the closest prior art.

4.3 Starting from D7, the problem underlying the patent in suit is to provide an improved method for processing kiln exhaust gases and an improved apparatus for kiln

exhaust gases processing.

4.4 As a solution to these problems, the invention proposes a method according to claims 1 and 2, characterised in that the separation point of the bypass separator is 5 μm to 7 μm , and an apparatus according to claim 3, characterized in that it comprises rough powder/fine powder transporting means for returning the separated rough powder to the kiln and supplying the fine powder to downstream of the separator, and a bypass separator having a separating point of 5 μm to 7 μm .

4.5 It has to be investigated whether or not the problems defined above have been successfully solved.

4.5.1 As to the effects and benefits achieved by the claimed processes and apparatus, the board notes the following:

According to the description (paragraph [0027]), the invention is based on the finding that predominantly the chlorine compound impurities - although only present in an amount of one tenth of the alkali and sulphur compound impurities - cause a coating in the pre-heater and thus affect most severely the stable operation of the cement plant. Therefore, the invention pays close attention to the removal of the chlorine compounds. It was firstly found that the amount of bypass gas could be reduced to a value of 5% or lower while still achieving a sufficient reduction ratio of chlorine compounds of 90% (see paragraph [0029] and Figure 1). A lower bypass ratio reduces the heat losses. To be sure, D7 also discloses a bypass ratio of 5%. However, this claim feature is considered to contribute to the success of the claimed solution insofar as

chlorine compound reduction was found to be sufficient at the claimed bypass ratio.

Secondly and more importantly, it was found that chlorine compounds were mostly present on the fine dust particles of less than 5 to 7 μm size (see Figure 4, cumulative curve D), as compared to alkali compounds which are substantially present also on particles having a higher particle size of up to 100 μm (see Figure 4, curve E). Therefore, a sufficient reduction ratio of chlorine compounds could be obtained by removing dust particles of a size down to 5 to 7 μm , or in other words by setting the separating point of the separator to 5 to 7 μm . This has to be compared to a separating point of 10 μm conventionally used in alkali bypass systems (paragraph [0041]). By setting the separation point to the lower value of 5 to 7 μm , more rough powder was collected in the bypass separator and consequently more material could be recycled to the kiln, thereby minimising material losses while still ensuring stable operation, by separating the dust in the exhaust gases into rough powder and fine powder and by returning the separated rough powder to the kiln and supplying the fine powder to downstream of the separator. At the same time the amount of fine powder to be deposited was reduced. Recycling of the fine particles from the chlorine bypass to the kiln was found not to affect cement quality (expressed as 28 days compressive strength) as long as the added amount was lower than 0.1% (see Figure 5).

4.5.2 These effects were not disputed by the appellant. They appear plausible to the board.

Therefore, the board is satisfied that the above-mentioned improvements (in terms of stable operation, lower heat and material losses and less dust to be deposited) have been achieved and that the technical problem defined above has been solved by the processes of claims 1 and 2.

The same arguments apply - *mutatis mutandis* - to apparatus claim 3 which recites the same essential features and is thus specifically adapted for carrying out the processes of claims 1 and 2. Therefore, the board is satisfied that the apparatus according to claim 3 achieves the same improvements as the methods of claims 1 and 2.

- 4.6 It remains to be decided whether or not the claimed solution was obvious in view of the prior art.

Process claims 1 and 2

An alkali/chlorine bypass amount of 5% is conventional in view of D7. This feature cannot, thus, contribute to the presence of inventive activity.

However, the crucial step is the separating point of 5 to 7 μm of the bypass separator which is not suggested by the prior art. To be sure, it may be obvious that the amount of waste dust could be reduced by lowering the separation point of the separator, compared to what was conventional in an alkali bypass. However, there is no teaching that a sufficient reduction ratio of chlorine could still be obtained by removing particles of a size of only up to 5 to 7 μm ("fine powder") from the system, compared to a

separating point of 10 μm conventionally used in alkali bypass systems, and recycling the rest (the "rough powder") to the kiln. Nor does the prior art disclose that all of the coarser dust could be returned to the kiln without affecting the cement quality and that only the finer dust - containing most of the chlorine compounds - should be removed from the plant and deposited. See embodiment 1, directed to a kiln exhaust gases processing apparatus (paragraph [0049]).

D1b is concerned with a process of reducing alkali and chlorine compound build-up in a raw meal suspension pre-heater kiln. D1b proposes a bypass ratio of 7% for efficient alkali removal and dust recycling (see page 174, left-hand column, second paragraph). Although it is stated that an efficient cyclone will substantially remove alkalis from the system (which are predominantly attached to the fine particles) (see page 173, left-hand column, second paragraph), there is no teaching as to the specific removal of chlorine compounds and certainly no suggestion of a separating point of the cyclone in the range claimed in the patent in suit.

D3 discloses a bypass system for an SP kiln wherein the dust separated in the bypass cyclone is not returned to the kiln, but used for mortar products (see Figure 1). Therefore, D3 cannot suggest the advantageous reduction in material loss achieved by the patent in suit.

Lastly, the fact that cyclones capable of separating particles having a particle size as small as 5 μm were known in the art (for instance D4; D9, page 11, left hand column) does not in the board's view automatically

direct the skilled person to the concept of usefully and advantageously employing such a cyclone as a separator in a method for treating exhaust gases of a kiln.

Apparatus claim 3

The above finding of non-obviousness applies equally to apparatus claim 3. The claimed apparatus comprises the crucial feature relating to the separator having a separation point of 5 to 7 μm , as well as features relating to the separation of the dust into fine and rough powder and to the transportation of the rough powder to the kiln and of the fine powder to downstream of the separator. In view of the reasons given for the method claims, the claimed apparatus is a specific adaptation of the apparatus of D7 for carrying out the methods of claims 1 and 2 and is not derivable in an obvious manner from the state of the art.

- 4.7 Dependent apparatus claims 4 to 7 concern preferred embodiments of the apparatus of claim 3 and are likewise patentable.
- 4.8 The board concludes that the claims of the main request meet the requirements of Article 56 EPC.
- 4.9 In view of the above, there is no need to deal with the auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

C. Vodz

G. Rath